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Measuring end-user delight: Is success in project design and delivery enough?

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Measuring end-user delight: is success in project design and delivery enough?

Muath Abu Arqoub

Submitted in total fulfilment of the requirements of the degree of

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Supervisors:

Professor Craig Langston, Associate Professor Greg Skulmoski and
Assistant Professor Amir Ghanbaripour

ABSTRACT

This dissertation focuses on end-user delight. It can only truly be measured once a project has been finished, handed over (or transferred) to those it was designed for, and experienced for a minimum review period. The latter is considered as one year, but it is reasonable to argue that it is a continuum over the life cycle of the project's influence. The term 'project' is used here, but it should be interpreted in the widest sense including products, change initiatives, events, assets and artefacts. End-user delight is synonymous with satisfaction and, based on meanings for this word, encompasses emotions such as gratification, fulfilment, approval, pleasure, happiness, contentment, agreement, liking, taste, joy, enjoyment, and pride. Project success is intimately connected with end-user delight. It is absurd to think of success being achieved when most end-users are dissatisfied.

It is not that we do not know how to measure post-implementation satisfaction (delight) – we obviously need to survey end-user opinion – it is just that we do not know how to integrate it with the wider perspective of successful pre-implementation (design) and implementation (deliver) processes. Perhaps even more importantly, we do not know whether this can be done generically across all project types or if every project is unique.

Project success when evaluated after a project enters its operational phase is highly important because it determines whether project outcomes are being accepted, adopted and/or purchased, rather than rejected and ignored. It includes end-user reaction, behaviour and usage and can relate to basic criteria like quality and price or broader engagement according to financial, social, ethical and environmental consequences. In simple terms, it comes down to whether the outcome provided what they had expected (needs) and/or hoped for (wants).

The aim in this study is to develop a model for measuring end-user delight in an appropriate and practical format, and then empirically test this model for reliability and validity through statistical analysis of collected data.

Most past studies address the evaluation of project management success in qualitative terms. This research, however, utilizes both quantitative and qualitative methods of assessment. The outcomes provide ordinal metrics of end-user delight that combine numerical (quantitative) and categorial (qualitative) data for the purpose of comparing and ranking the performance of different projects.

Therefore, the research design is one of literature review, conceptualization of a new model based on an assessment of past attributes, field testing via surveying end-users for each case study, statistical validity and reliability testing, and discussion of how this approach can be used in practice and integrated with other aspects of success pertaining to earlier project phases. The collected data were tested for reliability, confirmatory factor analysis, correlation analysis, and item response theory analysis and results were tabulated, diagrammed, and interpreted.

Seven case studies were analyzed for projects of different scale (small and large) and type (product creation, service provision, system development and post occupancy evaluation) to assess end-user satisfaction. In all cases, the scale adopted in this research provides a score (using a scale of -100 to +100) for end-user delight suitable for comparing and ranking project performance.

Case studies are presented using graphical means for ease of understanding. It is found that the end-user satisfaction (EUS) model is appropriate and provides confidence for use in practice. Generic archetypes of satisfaction are discussed. EUS is related back to a corresponding initial design decision support system (DSS) and four virtuous loops are proposed. Finally, EUS can be integrated into a broader measure of project success, known as *i3d3*, illustrated using examples of megaprojects in three different countries.

It is concluded that success in project design and delivery is not enough. Measuring end-user delight for projects, regardless of their type, size, location or date, is necessary before any determination of overall project success can be made. EUS stands equally alongside DSS and traditional assessment of project delivery success (PDS) focused on cost, time, scope and risk to judge whether designers achieve their ultimate purpose of satisfying societal needs and wants.

DECLARATIONS

This thesis is submitted to Bond University in total fulfilment of the requirements of the degree of Doctor of Philosophy (PhD).

The contents of this document represent my own original work towards this research degree and contain no material that has previously been submitted for a degree or diploma at this University or any other institution, except where due acknowledgement is made.

Muath Abu Arqoub

The research associated with this thesis received ethics approval from the Bond University Human Research Ethics Committee (BUHREC): Ethics Protocol Number: MA03051.

This thesis makes careful note of all sections which have been previously published, along with relevant copyright information.

The following papers arising from this thesis incorporating my authorship have been peer-reviewed and published during the period of candidature:

1. Langston, C., Ghanbaripour, A.N. & Abu Arqoub, M. (2018). **Measuring project success: conceptualizing a new approach applicable to all project types**, AUBEA 2018 Conference, Singapore, September.
2. Abu Arqoub, M., Langston, C. & Skulmoski, G. (2018) **Measuring end-user delight: is success in project design and delivery enough?**, ICEC-PAQS 2018 Conference, Sydney, November.
3. CCCR. (2019). **The application of the *i3d3* model for measuring project success.** Centre for Comparative Construction Research, Bond University, Australia. https://bond.edu.au/cccr

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A PhD study is a very long-routed journey but may become still longer if one is walking alone on this path. Luckily, I was not a single pedestrian to walk on this challenging journey and facing various hurdles, but my supervisors, teachers, family, friends, and fellow researchers always joined with me to ease and shorten this challenging and rewarding journey.

The idea of research and the whole plan of study might remain incomplete if continuous guidelines of my principal supervisor, Professor (Dr) Craig Langston, were not available to me. He was so kind to guide, direct, and support me whenever I was stuck up with any difficulty, problem, issue, or blind corner. Under his leadership, I have destined to complete this manuscript and now approached the final boundaries of study accomplishment. Thus, my words will remain incomplete and inappropriate despite my best efforts to thank him. Although his role was the major one, the contribution, advice, and support of my supervisory team members, Dr Greg Skulmoski and Dr Amir Ghanbaripour, were not lesser indeed because they constantly guided me whenever I needed help, in addition to their knowledge, skills, and experience that was direly needed to solve so many research problems. Their kindness and academic help will be my asset in my whole life.

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My message to new researchers is not to worry during hard and difficult times; just utilize your capabilities and potential as well as the guidance of your supervisors to solve problems and complete your assignments.

Muath Abu Arqoub

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CHAPTER 1: INTRODUCTION

1.1 Purpose of this chapter

The purpose of this chapter is to set out the motivation for the study, to identify a worthy problem to be addressed, to define the aim, objectives and research questions that are to be pursued, to outline the adopted research design, and finally to preview the structure of the work that follows.

This dissertation focuses on end-user delight. It can only truly be measured once a project has been finished, handed over (or transferred) to those it was designed for, and experienced for a minimum review period. The latter is considered as one year, but it is reasonable to argue that it is a continuum over the life cycle of the project's influence. The term 'project' is used here, but it should be interpreted in the widest sense including products, change initiatives, events, assets and artefacts. End-user delight is synonymous with satisfaction and, based on meanings for this word, encompasses emotions such as gratification, fulfilment, approval, pleasure, happiness, contentment, agreement, liking, taste, joy, enjoyment, and pride. Project success is intimately connected with end-user delight. It is absurd to think of success being achieved when most end-users are dissatisfied.

1.2 Motivation for the study

Achieving success is a unanimous wish but defining and explaining success is not an agreed-upon phenomenon because the meaning of success is not the same for each person, stakeholder group and organization, nor is it constant over time and across particular industry sectors (Beale & Freeman, 1991; Freeman & Beale, 1992; Songer & Molenaar, 1997; Jugdev & Müller, 2005; Bannerman, 2008; Ika, 2009; Mukerjee & Devi, 2017). The varying perceptions of success might be due to differences of opinion, the inherent complexity in the descriptors, non-uniform parameters and criteria used in defining the work, the nature and stage of the project, type of industry and business, and many other external factors (Shenhar et al., 2001; Davis, 2014; Albert et al., 2017; Ajmal & Al-Yafei, 2019). Therefore, answers are not always the same to questions like what success is, how to measure it, and what criteria can be used for its evaluation (Frese & Sauter, 2003). Despite the best efforts of researchers, scientists and experts, these differences have not been resolved, and therefore, an agreed definition cannot be provided.

1.2.1 The concept of project success based on performance success criteria

A forty-year review of published work by Jugdev and Müller (2005) concluded that both the definition and scope of project success are highly dynamic due to consistently changing contributions and dissenting views of researchers and others. In the past, project success was just completing the project within cost and time expectations, and then achieving quality standards was added as a further factor (de Wit, 1988; Pinto & Slevin, 1988; Freeman & Beale, 1992). Satisfaction of client and other stakeholders was also considered important because the previous three project success factors were seen by some as too narrow (Atkinson, 1999). Subsequently, HSE (health, safety and environment) attributes were added to the definition of project success (Belassi & Tukel, 1996; Songer & Molenaar, 1997; Baccarini, 1999; Lim & Mohamed, 1999). Thus, the process of including more success factors was started as each new study adds one or more factors to an ever-increasing list (Bannerman, 2008; Bryde, 2008; Cavarec, 2012; Bragantini & Caccamese, 2015; Almsalam, 2016). Standish Group (2009) listed 10 success factors and Fortune and White (2006) listed 20 topmost factors.

The differences in perceptions of project success continue continues unabated. For example, Radujković et al. (2010) identified top-ten project success factors each for investors, managers, and contractors separately. Karlson (2015) enlisted 16 factors, while Marr (2013) enumerated 75 factors for better performance and success of managers and projects. More recently, Al

Hammadi (2018) also proposed 10 factors of success. Variations in understanding of project success were suggested to relate to the nature of the project, stage of implementation, geographical and climatic conditions, and rules and regulations. The major difference in the perceptions is claimed because of stakeholder themselves (clients, project managers, contractors, suppliers and vendors, and customers/end-user) who are having dissimilar ideas, thoughts, authorities, and interests (Shenhar et al. 1997; Lim & Mohamed, 1999; Shenhar et al. 2001; Dimitrios, 2009; Davis, 2014; Davis, 2016; Damoah & Akwei, 2017; Tam et al., 2020) since their benchmarks for defining project success are quite different. The interests of stakeholders vary too: for instance, project owner's interest will be in time, cost, and generation of good revenue, which is only possible by the good quality of the project product (Sanvido et al., 1992; Atkinson, 1999; Sadeh et al., 2000) while contractors and sub-contractors might be looking to minimize cost.

The success of the project management is different to project feasibility or end-user satisfaction – the former more likely to be focused on delivery performance (Müller & Turner, 2007). Whereas the prioritized success for government departments will be abiding by HSE standards and other social criteria both during project implementation and post-delivery. Customer and end-user interests will differ from other stakeholders such as local community representatives, action groups, insurers, financiers and the like.

1.2.2 The relationship of real success to end-user satisfaction and delight

Lim and Mohamed (1999) segregated project success into micro (measured by traditional criteria of time, cost, quality, performance and safety) and macro (evaluation after the project delivery through utility, operation, and the level of satisfaction) viewpoints. Thus, the first part related to the performance and management of a project while the second related to the satisfaction of end-users. A multilevel framework (process success, project management success, product success, business success, and strategic success) was suggested by Bannerman (2008), which also revealed that the success of a project is not restricted to success during execution. Project management success is relevant to the performance of the management teams, product success describes the success of major deliverables, business success has relevance to net benefits of the project to the organization, and strategic success is associated with the benefits of external stakeholders (investors, competitors, industry analysts or regulators). Nevertheless, evaluation of project success is typically and prematurely evaluated after delivery of the project and stopped thereafter. Success criteria have been developed for

measuring success from start to finish of the project but not afterward (Jugdev & Müller, 2005; Adinyira et al., 2012; Serrador & Pinto, 2015; Serrador & Turner, 2015; PMI, 2017) because the projects enter operation after delivery and are then a business function.

Although projects usually end at the point of delivery, their final success can only be ascertained through examining whether the project brought satisfaction and delight to customers and end-users for which the project was ultimately designed. Torbica and Stroh (2001) claimed that if end-users are satisfied, only then the project should be considered successful. If users, clients and customers indeed impact the success of a project, then projects must meet their requirements too (Davis, 2016; Davis, 2018). Only then can the outcomes of projects can be fully evaluated (Jugdev & Müller, 2005; Hyvari, 2006; Bower & Walker, 2007; Lang, 2007; Dimitrios, 2009; Ika, 2009; Egeland, 2011; Zarina et al., 2014).

Projects should have goals in their procurement that can be achieved during the initiate phase, delivered amid the implement phase, and generate delight to end-users through what might be called the influence phase (operational use). End-user delight can be judged in terms of design intentions based on perceived end-user needs (essential requirements) and wants (wish list). Financial, social, ethical, and environmental aspects are highly important for project success evaluation and cover most if not all issues. The ultimate success of the project lies, at least in part, through meeting the expectations of end-users from delivering a quality product (Hanaysha et al., 2016; Haverila & Fehr, 2016; Fuentes et al., 2019; Haass & Guzman, 2019; Ershadi et al., 2020).

1.3 Problem statement

Technological developments and use of digital techniques have changed project and business management fields as they have in other disciplines. Project success can be judged using a large list of possible criteria (Hough & Morris, 1987; Baccarini, 1999; Greer, 1999; Lim & Mohamed, 1999; Shenhar & Dvir, 2007; Standish Group, 2009; Kerzner, 2011; Cavarec, 2012; McLeod et al., 2012; Alzahrani & Emsley, 2013; Davis, 2014; Davis, 2017; Damoah & Akwei, 2017). Phases of a project's life cycle (including pre-implementation, implementation, and post-implementation activity) and the concept of benefits realization have been used more recently to characterize success (Aaltonen, 2011; Albert et al., 2017; Ajmal & Al-Yafei, 2019). In particular, Davis (2017) discussed different stakeholder groups judging success at different

life cycle phases. The last decade was the period when customers and end-users' perceptions of project success were highly emphasized by both researchers and the marketing departments of organizations because consumers were seen as the authoritative participants who will be accepting or rejecting the products or services that a project delivers (van der Westhuizen & Fitzgerald, 2005; Turner & Zolin, 2012; Suprapto et al., 2015). Post-implementation success and the concept of consumer satisfaction are not being accentuated enough (Choi & Chu, 2001; Müller & Jugdev, 2012; Williams et al., 2015). Therefore, measuring real satisfaction of end-users (or preferably their delight) has become a priority issue, leading to a need to research how this can best be achieved. So far, this area of research is limited.

There is a significant deficiency regarding the importance of end-users and their roles for earning consistent revenues during the operational phase of a project so that the investment can be justified (Ivanka et al., 2009; Henoekl, 2015; He et al., 2019). The level of satisfaction is a highly important attribute for success and manifests itself in different ways (Liu & Walker, 1998; Torbica & Stroh, 2001). Hence, there is an urgent need for development of a model to determine end-user satisfaction after project delivery. This includes whose responsibility it is to collect data, how it is processed, what criteria might apply and when it should be done.

It is not that we do not know how to measure post-implementation satisfaction (delight) – we obviously need to survey end-user opinion – it is just that we do not know how to integrate it with the wider perspective of successful pre-implementation (design) and implementation (deliver) processes. Perhaps even more importantly, we do not know whether this can be done generically across all project types or if every project is unique. Therefore, this dissertation will explore these problems through an empirical case study approach, informed by previous research into project success factors and criteria, that can be tested for validity and reliability.

1.4 Aim, objectives and research questions

Project success when evaluated after a project enters its operational phase is highly important because it determines whether project outcomes are being accepted, adopted and/or purchased, rather than rejected and ignored. It includes end-user reaction, behaviour and usage and can relate to basic criteria like quality and price or broader engagement according to financial, social, ethical and environmental consequences. In simple terms, it comes down to whether the outcome provided what they had expected (needs) and/or hoped for (wants).

The aim in this study is to develop a model for measuring end-user delight in an appropriate and practical format, and then empirically test this model for reliability and validity through statistical analysis of collected data.

The quantification of opinion into a numeric score via a questionnaire is a common method for measuring user satisfaction (Pinto & Prescott, 1988; Henoekl, 2015). Vaezi (2013) identified two approaches for assessing the satisfaction of end-users: (i) a process approach of assessing decisions that lead to satisfaction, and (ii) looking at satisfaction as an overall experience of consumption using specific metrics. The second approach has been adopted in this dissertation so that it does not overlap with earlier measurement of project design and delivery and a scale has been developed and tested for validity and reliability. Boateng et al. (2018) claimed that scale development and validation are critical mechanisms for assessing satisfaction of consumers in health, social and behavioural sciences.

1.4.1 Research objectives

To achieve the above aim, six research objectives need to be accomplished:

1. Undertake a thorough review of the literature for measuring project success, including critical success factors and success criteria, with a particular emphasis on those that apply to post-implementation satisfaction.
2. Determine the attributes that best measure satisfaction across a range of project types (such as delivery of an asset, service, product, system, event, etc.) informed by previous theories and models used in health, social and behavioural sciences.
3. Conceptualize a generic attribute-based approach for measuring end-user delight in a consistent and transparent manner that consolidates the various attributes into a small number of critical success factors reflecting financial, social, ethical and environmental consequences.
4. Collect satisfaction data using a bespoke survey instrument for a series of case studies and empirically test and validate the new approach.
5. Recommend how the measurement of end-user delight can be incorporated practically into a wider model of project success and then applied to assess and rank performance for projects displaying different characteristics.
6. Identify any limitations inherent in the procedure for measuring end-user delight that require further research.

1.4.2 Research questions

There are five research questions (RQ1-5) that are to be answered as part of this study:

1. What set of generic or specific attributes enable end-user delight to be quantified as a performance metric for project success?
2. How can end-user delight be structured and utilized as feedback to better inform future design processes?
3. For projects where end-user opinion matters, are there patterns of end-user delight that provide insight into how effective designers were in addressing their needs and wants?
4. What method can assess the validity and reliability of the proposed model for end-user delight?
5. Can the new model measure end-user delight for projects regardless of their type, size, location or date?

Most past studies address the evaluation of project management success in qualitative terms. This research, however, utilizes both quantitative and qualitative methods of assessment. The outcomes provide ordinal metrics of end-user delight that combine numerical (quantitative) and categorial (qualitative) data for the purpose of comparing and ranking the performance of different projects.

1.5 Research design

Current project management practices do not always lead to favourable outcomes (Alias et al., 2014). It was found by Hardy-Vallee (2012) that 100% successful completion of projects was done by only 2.5% of companies, after reviewing 10,640 projects from 200 companies in 30 countries and across a wide range of industries. The average percentage of failed projects was found to be 14% (PMI, 2017b). Project failure or partial success could be due to many factors but ignoring customer and/or end-user input during the design and delivery of projects plays a significant role in determining outcomes. The rapidly growing and complicated global business environment has intensified competition among organizations and hence customer satisfaction has attracted greater importance (Neely, 2005). Positive feedback provides evidence of successfully implemented projects and reduces the likelihood of customer or end-user rejection and dissatisfaction.

For satisfaction, customers compare the performance of a product or service to their perceptions, both being within the tolerance zone, whereas delight is considered an extreme level of satisfaction when expectations exceed the tolerance zone (Parasuraman et al., 1985; Barnes et al., 2016). Torres (2014) used a psychological basis in defining the difference between customer satisfaction and customer delight and found that delight is more effective while satisfaction is more attitudinal. Compared with satisfaction, delight indicated a higher impact on post-consumption behaviours such as loyalty (Barnes et al., 2016). His framework proposed that customer-driven service quality is affected by ideal expectations, performance, detailed criteria and value perceptions Torres (2014). The testing of the service-experience model of Rivera et al. (2019) indicated the importance of frontline employees of the hospitality service industry and found it to be the topmost factor in providing happiness and delight to customers. An organization's staff is the most important component influencing customer happiness while other factors are service quality, service availability and customer service interaction. Delight is an integral part of the satisfaction of the end-user, therefore, should necessarily be considered during the review of project performance. Hence, measuring delight is highly important for assessing the success of a project.

Although all researchers do their best to conduct their piece of research as accurately as possible, they may be constrained by time, finance, resources, and local specifications that also limit the use, adaptability and scope of an investigation. Merriam and Tisdell (2016) pointed out some restrictions of studies in terms of structural or methodological constraints that are beyond the researcher's control.

In this study, access to case studies proved problematic, and the coverage of different project types was less than anticipated. Nevertheless, seven different case studies were surveyed using a bespoke attribute-based questionnaire. They fulfilled two purposes. First, they demonstrated the practical nature of the process and its suitability to online data collection procedures. Second, the collected information was undertaken and statistically analyzed in two separate iterations to provide an opportunity to adjust the survey attributes as needed.

Therefore, the research design is one of literature review, conceptualization of a new model based on an assessment of past attributes, field testing via surveying end-users for each case study, statistical validity and reliability testing, and discussion of how this approach can be used in practice and integrated with other aspects of success pertaining to earlier project phases.

1.6 Structure of the thesis

Six chapters form the body of this dissertation. Each is briefly described so that the structure of the work is more easily appreciated at the outset.

Chapter 1 introduces the research and describes its scope, including the motivation for the study, problem statement, aim, objectives and research questions, research design and structure of the work that follows. It is clear from this chapter that the research addresses a gap in existing knowledge, conceptualizes a novel approach to measuring end-user delight, applies statistical analysis to validate the model, and presents recommendations for project managers on how to integrate end-user delight into the assessment of project success. The unique nature of this work lies in devising a questionnaire instrument that can be applied to any type of project and how the results obtained from its use can revolutionize the measurement of project success during the first part of a project's operational life.

Chapter 2 covers the critical review of underpinning literature having direct relevance to the subject of measuring end-user delight. Some background is provided on projects and their management, before focusing on past attempts to measure their success. Much confusion is evident and great opportunity exists to form a better and more transparent approach to performance assessment. Theoretical aspects concerning end-user satisfaction attributes are reviewed, grouped and coded for later analysis. The role and importance of end-users, definitions of consumer satisfaction, its measurement and antecedents of user satisfaction are also presented. A gap in existing knowledge is identified and forms the basis for the work that follows.

Chapter 3 introduces a new conceptual framework for measuring end-user delight. It compiles past attributes into a four-level hierarchical structure. A four-quadrant model is constructed to measure the level of satisfaction based on needs and wants. The research method adopted for collection of primary data is also described. A unique questionnaire is developed to measure the opinion and relevance for each attribute, which is then sent to project end-users for each of seven case studies intended to reflect different project types and scales. A brief description of each case study is provided. These case studies were undertaken in two stages. The first stage (four pilot case studies) comprised 342 respondents and the second stage (three megaproject case studies) comprised 345 respondents. Case studies were sourced from Australia (4), United Arab Emirates (1), Peoples Republic of China (1) and Bangladesh (1).

Chapter 4 analyses the performance of the model and tests its validity and reliability. These results are presented using graphical for ease of understanding. It is found that the model is appropriate as a means of assessing end-user delight and hence provides confidence for its use on other projects in the future. This part of the dissertation provides the evidence that the conceptualized model for measuring end-user delight is robust.

Chapter 5 discusses the findings and relates it to future implementation in practice. Generic archetypes of satisfaction are presented and critiqued. The relevance of attributes used to measure end-user satisfaction are checked from the data collected in the field. Integration of end-user delight with project design and delivery outcomes is explored in detail. Satisfaction is related to corresponding design considerations and four virtuous loops are proposed to support continuous improvement and designer feedback.

Chapter 6 reflects on the contribution of this research to the field of project management and its significance. A series of recommendations for implementation are made. Limitations and future research are discussed. The research outcomes are summarized and tied back to the aim, objectives and research questions stated in Chapter 1.

Finally, references and five appendices are provided as support.

1.7 Summary

This chapter provided an overview of the research undertaken and its logical. It set up the parameters that guide the work and argued the case made later that a significant contribution to knowledge has been achieved.

The next chapter will look at the theoretical underpinnings for this research with particular emphasis on previous findings related to the measurement of project success and end-user satisfaction.

CHAPTER 2: CRITICAL LITERATURE REVIEW

2.1 Purpose of this chapter

The purpose of this chapter is to critically review the underpinning literature related to end-user satisfaction (delight) of delivered projects. This requires an understanding of project management process as well as what constitutes project success. Projects can apply to any industry, so it is important to determine whether a generic solution for measuring end-user responses exists or can be created. The review looks at interdisciplinary satisfaction criteria with a view to develop a generic assessment framework. A systematic and integrative literature review was performed to sort through the extensive quantity of past research (refer to: **Appendix 1**).

Success and satisfaction are linked. It is not possible to claim a successful project if the people for whom the project was designed are dissatisfied with the outcome. Expecting satisfied end-users is possible when their views are canvassed during the design process. Therefore, design and delight must share a common framework for evaluation. Only then can feedback help to

inform future design and lead to continuous improvement in the process. This alignment is fundamental and is founded on understanding end-user needs and wants.

2.2 Background

2.2.1 What is a project?

Change aimed at improvement in current conditions is built into human nature. Therefore, all individuals, business organizations and government authorities consistently must put in their best efforts to uplift the status and living conditions of communities by providing better infrastructure and services across a wide range of industry sectors. Simultaneously, business opportunities emerge for creating products and providing services to meet the needs and wants of people as their prosperity rises. To accomplish such jobs, assignments and targets, planned activities are required in the form of projects.

According to Wysocki (2009), a unique, complex and connected set of activities directed towards a common goal is called a project. The facets of a project are time-binding, budget, and scope as well as the goal or purpose-directed activities that must be completed under agreed specifications. Hence, duration, cost, and detailed specifications are integral constituents of a project (Sadeh et al., 2000; Westerveld, 2003). The planned activities of a project have neither been undertaken before nor are likely to be repeated exactly in the same scenario. A project is a unique and temporary endeavour for achieving planned objectives definable as deliverables, outcomes or benefits (APM, 2019).

The *PMBOK® Guide* defines a project as a "temporary endeavour with a beginning and an end, and it must be used to create a unique product, service or result" (PMI, 2017a, p. 4). Hence, projects are those activities that must have a defined purpose and cannot continue for an indefinite period. The activities which are related to performing daily or periodic assignments cannot be considered projects. For instance, teaching students by a college teacher or treating a patient by a physician or dealing with complaints of the public by a government official or production of mobile phones in a factory do not fulfill characteristics of projects and cannot be called projects. Of course, the construction of a college building, establishing a hospital or an office, or setting up a mobile manufacturing factory are the projects for starting the above routine activities.

A project is temporary that is closed after creating facilities to manufacture products or service provisions or getting desired objectives and results (PMI, 2017a).

2.2.2 Project management

Project management is related to managing projects efficiently and effectively to achieve assigned targets; therefore, it is regarded as highly important for the execution of plans. The Project Management Institute (PMI) defines project management as "the application of knowledge, skills, tools, and techniques to a broad range of activities to meet the requirements of a particular project" (PMI, 2017a, p.10). APM (2019) has elaborated further, calling project management as the achievement of specific project objectives through the application of processes, methods, skills, knowledge and experience matching accepted criteria measurable by agreed parameters. Project management must bring out some final deliverables within a specific time and budget. An important factor distinguishing 'project management' from 'management' is a final deliverable during a fixed timespan compared to a permanently ongoing process. Project management requires professional needs, a variety of skills, including management and technical skills, and good business awareness. Project management is not a routine process and especially demands strong project control with appropriate interwoven flexibilities for meeting on-ground facts and requirements. An efficient project manager is always keeping project success in mind because it is the final destination to reach (Ofori, 2013).

The major components of project management are: (1) giving the reasons why a project is necessary; (2) forming a business case to justify the investment; (3) identifying project requirements, specifying the quality of the deliverables, and estimating resources and timescales; (4) securing corporate agreement and funding; (5) developing and implementing a management plan for the project; and (6) leading and motivating the project delivery team. Some more activities included in project management are managing the risks, issues, and changes on the project; monitoring progress against targets and taking strong actions if lagging; managing the project budget; maintaining communications with stakeholders and the project organization and closing the project in a controlled fashion when appropriate after achieving objectives.

Some authors have suggested that the profession of management must be overhauled because, despite the introduction of modern aids, software, and automation, complete or partial project failures or delays and cost and schedule overruns occur many times, while frequent changes to

the project document also become necessary (Bryde, 2003; Cicmil et al., 2006; Winter et al., 2006; Lee, 2007; Stare, 2010; Padalkar & Gopinath, 2016). Thus, that there is a need for further research to develop valid and useful theories of project management which are practically useful. The resultant improvements may largely help to upgrade project management in various sectors and industries.

Westland (2018) reported that the field of project management effectively began in the second decade of the twentieth century after a book *The Principles of Scientific Management* was published by Frederic Taylor in 1911 and scheduling tools were introduced by Henry Gantt in 1917. However, from the 1950s onward, formal and legal procedures, like the registration of the American Association of Cost Engineers (now AACE International) in 1956, were completed to designate and identify the profession of project management in the USA. Similarly, the International Project Management Association (IPMA) was founded in 1965 in Switzerland. PMI was established in 1969. PRINCE (Projects in Controlled Environments) was established in 1989 by the UK government as a standard for all information systems projects. Later, many software and techniques were formulated (theory of constraints, earned value, critical chain project management, complex project management, and the Agile Manifesto) for use in practice. Project management has emerged over the years as a blend of science and art requiring very advanced skills, experience and familiarity with current management practices (Attarzadeh & Ow, 2008; Ershadi et al., 2020).

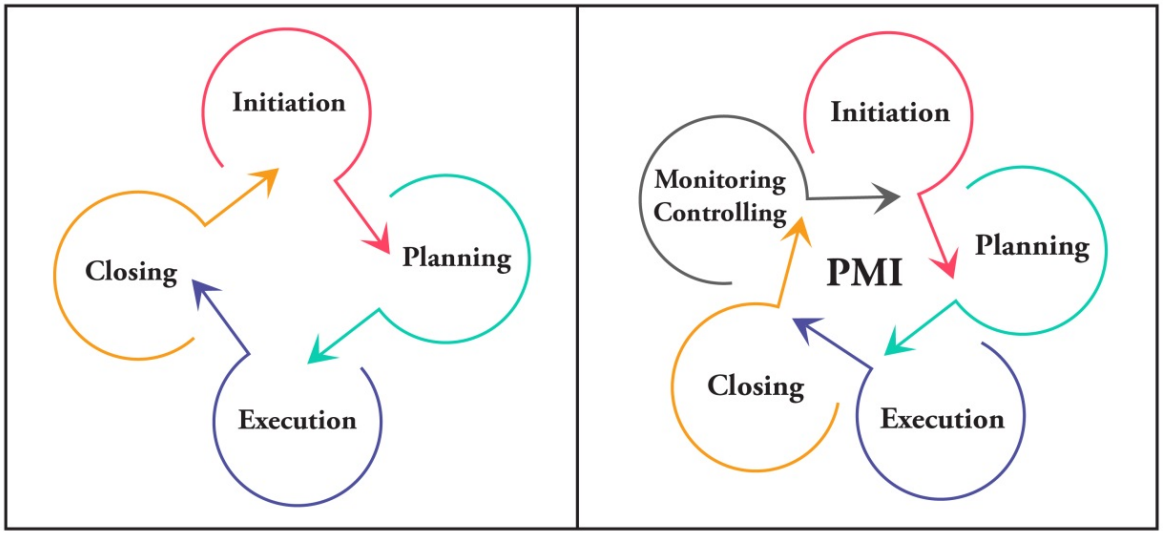
2.2.3 Project life cycle and its phases

All projects pass through various stopovers, called stages or phases of project execution, whereby each phase is comprised of a set of activities, processes and targets to achieve. From start to completion, a project is divided into a few segments of similar mechanisms, following each other in a logical sequence because a subsequent phase cannot be started before a former one has concluded. In practice, some of the phases may overlap or occur simultaneously. Thus, projects have a life cycle to reach their destination, but this process does not really come to a sudden end, even after the handover to the client, because new needs of people and business may appear, and some subsequent deficiencies could be identified that need to be fixed or form the foundations to plan and execute a fresh initiative.

There are four critical stages in a project's life cycle according to Westland (2007): initiation, planning, execution, and closure (Figure 2.1, left-hand side). Whereas PMI has suggested five

stages: initiation, planning, execution, monitoring and controlling, and closure (Figure 2.1, right-hand side). More detail of the key phases is presented and discussed in the following subsections.

Figure 2.1. Comparison of four and five phases of the project lifecycle



Adapted from Roseke (2016) and Invensis Inc. (2020)

2.2.3.1 Initiation phase

The first step in the project management life cycle is the initiation phase because it encompasses identifying the needs for a new project based upon a community or business problem or opportunity demanding a solution. Resultantly, an idea for the project is conceived, a project is defined, and a project team is appointed to plan the project. A business case is created including a detailed description of the problem or opportunity and preferred solutions, business objectives, assumptions and constraints, a list of the alternative solutions, an analysis of the business benefits, costs, risks, and issues, and main project deliverables. A summary of the plan for implementation including a schedule and financial analysis is prepared. Then, the project sponsor approves the business case or development plan, and the expected funding is allocated. The success of the presumed project depends to some extent on its clarity and accuracy at the outset (Westland, 2007; Galbus, 2016; Roseke, 2016).

Initiation is the starting point of a project and a key decision-making phase. The project's nature and scope are determined, and project objectives and goals are identified. The criteria for accomplishing those goals are specified. The boundaries and dimensions of the project are identified and appointment of the project team, deemed responsible for project implementation, is conducted. According to Newton (2015), project milestones should also be fixed during this

phase. The deliverables, constraints, and risks should be assessed. The project justification, identification of project stakeholders, especially investors, and specification of roles and responsibilities of project team members are also potential characteristics of this phase (PMO, 2020). Brown (2019) has suggested five sequential steps during the initiation phase: feasibility study, project scope identification, listing of deliverables, assessing various stakeholders, and preparation of a business case.

2.2.3.2 Planning phase

The foundation stones of a successful project are laid down during the planning phase, which is regarded as the key to the design process. A project management plan is developed and approved that will be a roadmap for later stages by everybody who has a direct or indirect concern or interest in the formulation of the project (Cleland & Ireland, 2008). Under project planning, all organizational knowledge, information and data, as well as the expertise of professionals, are utilized for estimating the expected expenditures on project resources, expected cost and schedule (Westland, 2007; Cattani et al., 2011).

The project goals are enlisted that, according to Esposito (2015), should be SMART (specific, measurable, attainable, realistic and timely), and CLEAR (collaborative, limited, emotional, appreciable and refinable). The project scope is also finalized during the planning stage, which encompasses goals, expected results, deliverables, acceptance criteria, responsibilities, tasks, boundaries, and deadlines (Rad & Anantatmula, 2005; Sebastian, 2007). Fixing quality standards, describing available resources with the organization, decisions on a realistic schedule, and performance baselines/measures are the mechanisms performed under planning. Milestones help greatly to keep the project on track. The roles and responsibilities are clearly described for all individuals, teams members and stakeholders for involving, engaging and holding accountable everyone in the project (Westland, 2007; Williams, 2008; Newton, 2015).

The major outcome of the planning phase is a project management plan (PMP) which includes many sub-plans: resource plan, financial plan, quality plan, risk plan, acceptance plan (including standards and criteria), communications plan, procurement plan, resource plan, contract plan, and so on. Thus, the PMP is the master document that establishes how the project will be implemented and managed. The essential components of a PMP are the scope statement, list of critical success factors, deliverables, work breakdown structure, schedule, budget, quality benchmarks, stakeholder list, and risk register (Nepomuceno et al., 1999; Carmichael, 2000; Dinsmore & Davies, 2005; Kwak, 2005; Turner & Müller, 2005; Lock, 2007; Westland, 2007;

Williams, 2008; Wysocki, 2009; Gordon & Curlee, 2011; Dionne, 2013; Roseke, 2016). Having said that, the list of critical success factors is not very common in practice.

2.2.3.3 Execution phase

Project execution is the third phase of project management during which most of the technical work is completed according to the project plan by contractors and sub-contractors, suppliers and vendors under the oversight of the project team and alongside other stakeholders like senior management, government departments, environmentalists, NGOs (protecting rights and benefits of labour, human beings and community), law regulators and, less frequently, representatives of community, customer and end-user groups. The role of project management is highly important for implementing the goals of a project through to completion for all project milestones and targets in time and within the allocated cost, dealing with probable risks, and accepting approved changes as required.

Monitoring is going on simultaneously to assess the performance of the project and teams working in it (Turner & Müller, 2005; Houston & Bove, 2007; Müller & Turner, 2007; Andersen et al., 2009; Burke, 2013). The arrangement of all project resources (budget, material, machinery and human resources) is indispensable for project execution. The project manager is, in fact, responsible to deliver all project activities, processes, mechanisms, assignments, milestones, set objectives, and finally all goals and targets (Mir & Pinnington, 2014). The project manager must communicate and coordinate with all stakeholders for keeping the project work running with minimum complaints and must identify and obey HSE laws and regulations. Thus, the execution phase, including monitoring and controlling of progress, is the phase in which all plans are implemented for achieving the project objectives successfully (Westland, 2007; Kendrick, 2015; Pathak, 2020).

2.2.3.4 Closure phase

The closure phase is the concluding component after the project is delivered as a finished product or service (Dvir, 2005). Simultaneously, the relevant documents are issued and all agreements with stakeholders are ended and reconciled. The results of the accomplished project are communicated to the project sponsor. When project documents are ready, securities are released, and final payments are made to the parties who participated in the project execution.

A review and evaluation may be conducted by hiring an independent third party to determine the project's success through a comparison between the deliverable against the defined

objectives and assessing the results and releases in the final evaluation report (Stevens, 2002; Phillips, 2003; Westland, 2007; Aziz, 2015; Harvard Business Review Staff, 2016). Brown (2019) elaborates that the closure phase may comprise analysing the project team's performance, overall delivery performance, closure documents preparation, accounting for time and budget, and conducting reviews and evaluations. This is the point at which an assessment of end-user delight could be undertaken. It rarely is.

2.2.4 Project stakeholders

In general, stakeholders in a project may be individuals or groups having any interest in the project being planned or implemented. Freeman (1984, p. 46) defined stakeholders of a project as "any group or individual who can affect or is affected by the achievement of the organization's objectives". For management, identification of relevant stakeholders and their expectations is highly essential and must be carefully watched during the implementation of a project to ensure minimum or no complaints (Davis, 2014). Any conflicts, complaints, discrepancies and claims must be resolved by the project managers on behalf of the project sponsor according to the plan of the project (Lam et al., 2010; PMI, 2017a). A strategy should be developed, and suitable tactics adopted to manage stakeholders, which will help to avoid opposition, contradiction, restraining, and damage to the project (Berman et al., 1999).

Stakeholders can be broadly interpreted. They include the group, referred to herein as 'end-users', that comprise clients and their employees, potential customers, local community and others for whom the project is largely intended to help.

2.2.5 Deliverables

Projects are typically initiated and planned by sponsors such as governments and their entities, business enterprises, community organizations and individuals. The targets of government projects are welfare, benefits, and uplift of people and local communities as well as the construction of public infrastructure, while private businesses conduct projects for earning profits on their investments through sales and revenue. Every project is intended to generate some goods or establish some utility for people, and these can be called products and services respectively. Angel (2019) elaborates on the deliverables of projects as goods, services, platforms, applications or systems that are created, supported and maintained for solving problems, providing benefits and meeting the needs of customers and end-users. Deliverables are the tangible outcomes that are required. However, it is important to distinguish between

outcomes that are produced as part of the project's execution and those that arise after the project is completed. The latter is referred to as benefits realization.

2.2.6 Ongoing project performance assessment

On-going project performance assessment is different from project evaluation conducted after the closing of the project. It is also called monitoring project progress which has been identified as a separate phase in the life cycle by PMI (2017a). The completion of activities and milestones specified for the given period presents an update of the progress that is communicated by the project manager to the project sponsor and relevant stakeholders. Any deficiencies and problem areas are also shared with higher authorities to take resolving actions. For all these activities, project managers use performance metrics. They can also use these metrics to foresee and avoid risks, identify and solve potential problems, and assess the quality of work (Müller & Turner, 2007). Project monitoring mostly addresses objectives, resources, costs, actions, scope, quality and safety (Savolainen et al., 2012; PMI, 2017a). There are numerous performance metrics and automated systems for monitoring assessment in various projects (Escrig-Tena & Bou-Llusar, 2005; Müller & Turner, 2007).

These metrics can be called key performance indicators (KPIs). However, there is no universal agreement on the use of KPIs or what they should measure (Ahmad, 2011; Osorio et al., 2014). KPIs may be best considered as success criteria that can be used to measure whether performance objectives, or critical success factors, have been achieved. The following section concentrates on the nature of project success in practice as it has evolved from simple beginnings to complex applications.

2.3 Project success

2.3.1 A review of project success and success factors

Project success, critical success factors, and success criteria are gaining importance due to the need to evaluate and compare project performance. Success is the expectation attached to each project as the ultimate destination. The meanings of success vary broadly to different people, at different times and phases of a project, by type of project, across various industries and sectors and under different scenarios (Jugdev & Müller, 2005; Ika, 2009; Mukerjee & Devi, 2017).

During the 1950s, the concept of project success was introduced but was restricted to the completion of projects within schedule and cost allocations. Barnes (1988) shared the idea of the *Iron Triangle* (also called the *Triple Constraint*), comprising time, cost and output (or scope) as vertices of the triangle. Popular opinion has incorrectly interpreted scope as quality. Barnes' viewpoint was endorsed and accepted by many authors of his time (de Wit, 1988; Pinto & Slevin, 1988; Freeman & Beale, 1992), but later criticized as well by others for not including key factors of project success like the satisfaction of various stakeholders and HSE requirements (Belassi & Tukel, 1996). The consistent addition of new factors started towards the end of the twentieth century and has continued until today. Many of these additional factors are specific to the type of project being evaluated, such as engineering, construction or information technology (IT) projects (Atkinson, 1999; Baccarini, 1999; Greer, 1999; Lim & Mohamed, 1999; van der Westhuizen & Fitzgerald, 2005; Shenhar & Dvir, 2007; Aaltonen, 2011; Kerzner, 2011; Cavarec, 2012; McLeod et al., 2012; Turner & Zolin, 2012; Alzahrani & Emsley, 2013; Davis, 2014; Suprapto et al., 2015; Albert et al., 2017; Damoah & Akwei, 2017; Ajmal & Al-Yafei, 2019; Gao et al., 2020; Zhang et al., 2020).

Many theories, models and frameworks for evaluation of project success have also been observed in the literature: for example, Shenhar et al. (1997), Atkinson (1999), Lim and Mohamed (1999), Sadeh et al. (2000), van der Westhuizen and Fitzgerald (2005), Bannerman (2008), Stare (2010), and Williams et al. (2015). The idea of different perceptions of project success by various stakeholders has been emphasized (Davis, 2017) while the evaluation of success after delivering the project, medium-term and long-term sustainability, and satisfaction and delight of end-users has also been advocated (Vaezi, 2013; Williams et al., 2015; Schiebler, 2019; Wu & Wu, 2019; Ingle & Mahesh, 2020; Iriarte & Bayona, 2020).

2.3.2 Perceptions of stakeholders on project success

Jugdev and Müller (2005) found that published literature over the last 40 years showed the definition and scope of project success remained highly dynamic and have been changing consistently. Earlier, project success was related to the implementation phase only, but later, it has been associated with the entire life cycle of a project and the sustainability/adaptability of the product/service being offered to customers and end-users after handing over projects to operational business units. Therefore, differentiation in the understanding of the terms: project success, project management success and product success appeared progressively in the

literature (de Wit, 1988; Munns & Bjeirmi, 1996; Baccarini, 1999; Cooke-Davies, 2007; Toor & Ogunlana, 2008; Ika, 2009; Creasy & Anantatmula, 2013).

The uniformity in the definition of project success is missing mainly due to the interests of different stakeholder groups involved at different phases of the project life cycle (Aaltonen, 2011; Alzahrani & Emsley, 2013; Davis, 2014; Albert et al., 2017; Ajmal & Al-Yafei, 2019). The number and variety of stakeholders involved in a project differ according to the nature and objectives of the project as well as roles they play during various project phases, (Hough & Morris, 1987; Lim & Mohamed, 1999; Shenhar & Dvir, 2007; Kerzner, 2011; McLeod et al., 2012; Turner & Zolin, 2012; Suprapto et al., 2015).

The multitude of project success factors has led to the identification of critical success factors (CSFs) as those that play a major role in final project success. Project success criteria, on the other hand, are the measures used to assess project success. There has been no common list of CSFs that can be used, thus a complex combination of different factors affecting project success have arisen (Khang & Moe, 2008; Serrador & Turner, 2015; Williams, 2016). Some have attempted to identify categories of CSFs, such as project-related factors, procedure-related factors, project management action-related factors, human-related factors, and external environment-related factors.

More recent work, however, has used financial, social, ethical and environmental consequences to help identify CSFs at various phases of the project life cycle regardless of the project type (CCCR, 2019). For example, during project initiation the CSFs were listed as feasible, useable, achievable and sustainable. Similarly, during project implementation the CSFs were listed as within budget, on schedule, as specified and no surprises. This work includes a post-implementation phase, called project influence, and cites corresponding CSFs as desirable, adaptable, practicable and serviceable.

Variable CSFs have been enlisted by authors in different industries and fields, at various times, and in specific projects. For example, Standish Group International (Standish Group, 2009) compiled a revised list of top ten success factors for IT projects, comprising user involvement, executive support, clear business objectives, emotional maturity, optimization, agile process, project management expertise, skilled resources, execution, and tools and infrastructure. After consultation of 63 published papers, Fortune and White (2006) prepared a list of the 10 topmost CSFs and calculating a percentage for each factor. Their top ten list contributing to 60.3% of

overall success and comprised (in descending order): support from senior management (9.8%), clear realistic objectives (7.8%), the detailed plan kept up to date (7.3%), good communication/feedback (6.8%), user/client involvement (6.0%), skilled, suitably qualified, and enough staff/teams (5.0%), effective change management (4.8%), competent project manager (4.8%), strong business case/sound basis for the project (4.0%), and sufficient/well-allocated resources (4.0%). Radujković et al. (2010) also tabulated their top-ten project success factors that are of specific interest to the stakeholders/participants of various types of projects (see Table 2.1).

Table 2.1. Top-ten KPIs related to project stakeholder/participants

Rank	Investors	Contractors	Consultants
1	Client satisfaction	Quality	Changes in the owner's project support
2	Cost	Cost	Number of investor interferences
3	Communication (organizational)	Identification of client's interest	Cost
4	Time/schedule increase	Time/schedule	Employees' satisfaction
5	Time/schedule predictability	Cooperation with subcontractors	Profitability
6	Defects	Motivation	The satisfaction of the project team
7	Avoidance of unprofitable processes	Productivity	Cost predictability
8	Quality	Innovation and learning	Changes in project objectives
9	Rework	Time/schedule increase	Motivation
10	Legal problems with land	Client satisfaction	Cost increase

Source: Radujković et al. (2010)

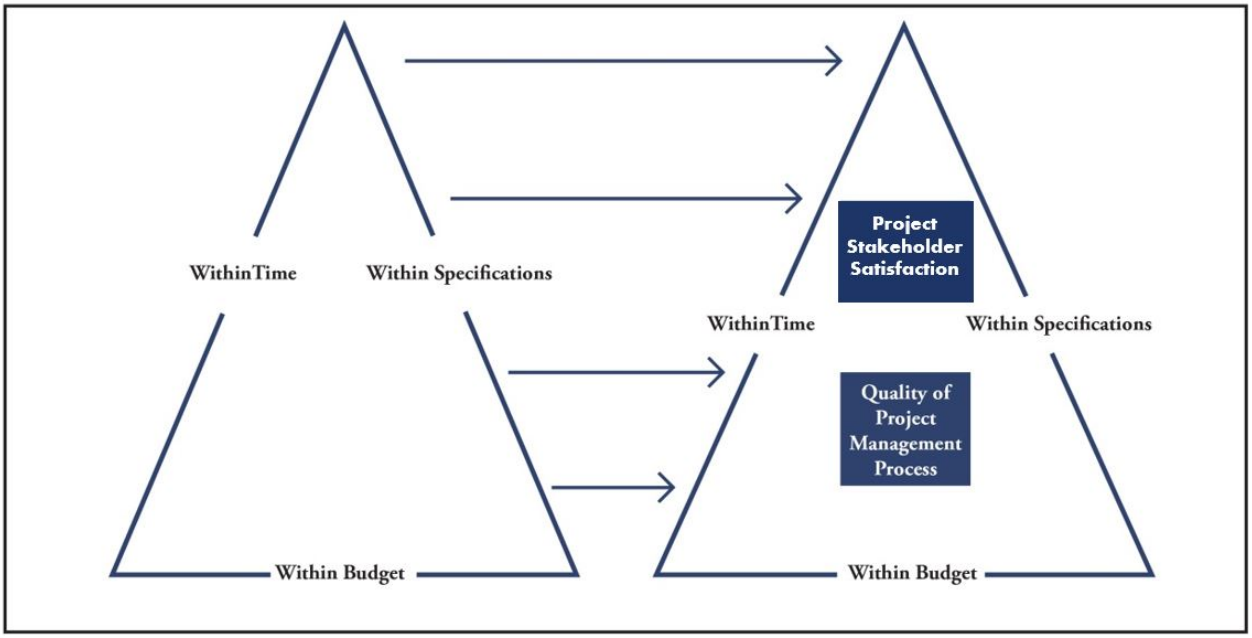
2.3.3 The temporal nature of project phases on project success

The old definition of project success, or more precisely project management success, was the completion of the project within agreed cost and time constraints and achieving performance targets (Greer, 1999). However, this concept has been considered insufficient to measure the project success since the satisfaction of stakeholders was seemingly ignored (Baccarini, 1999; Schwalbe, 2004; Cavarec, 2012; Damoah & Akwei, 2017), despite the clear evidence in practice that the project managers frequently articulate satisfaction in terms of delivery within

budget, on schedule and as specified. Stakeholder indeed have wider interests, but this just signifies the difference between project success and project management success.

Badi and Pryke (2015) have emphasized the very strong cooperation of all the participating stakeholders in making a project successful. Hence, van der Westhuizen and Fitzgerald (2005) modified the traditional triangle demonstrating success (left-hand side of Figure 2.2) by adding the stakeholder's satisfaction and the quality of the project management parameters (right-hand side of Figure 2.2).

Figure 2.2. Extension of the traditional view of project success



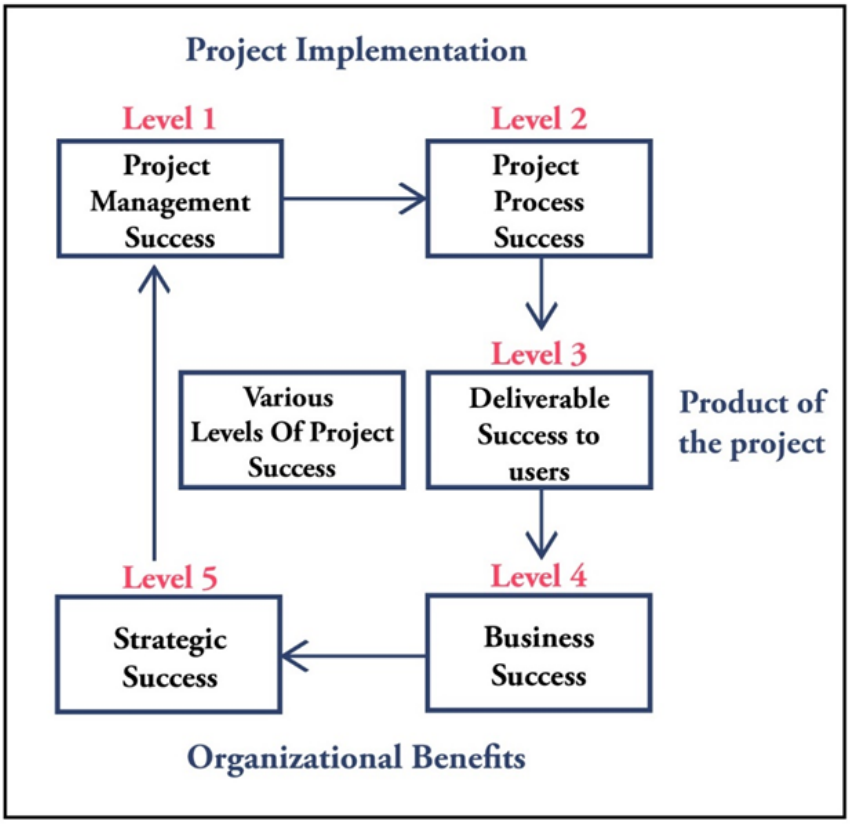
Adapted from van der Westhuizen & Fitzgerald (2005)

Project management success is mostly assessed at the end of the implementation phase employing traditional outcome measurements (Jugdev & Müller, 2005; Musawir et al., 2017) like cost, time, quality, and performance, and sometimes satisfaction of stakeholders (Turner & Zolin, 2012; Mir & Pinnington, 2014). Some researchers differentiated between project efficiency and project success. Project efficiency includes parameters like within budget, on schedule and as specified, while project success includes parameters like business-oriented results, sustainability and customer satisfaction (Cooke-Davies, 2002; Shenhar & Dvir, 2007; Müller & Jugdev, 2012; Serrador & Turner, 2015).

Bannerman (2008) attempted to make sense of this dichotomy (see Figure 2.3). Project efficiency is one measure out of five drivers: project efficiency; team satisfaction; impact on the customer; business success; and preparing for the future. Therefore, taking a more holistic

look at the success of an accomplished project is necessitated (Shenhar & Dvir, 2007; Mir & Pinnington, 2014). Despite this advance, the perception of end-users of the project is different from managers and stakeholders involved during the project's procurement. This aspect appears largely ignored.

Figure 2.3. Various levels of project success



Adapted from Bannerman (2008)

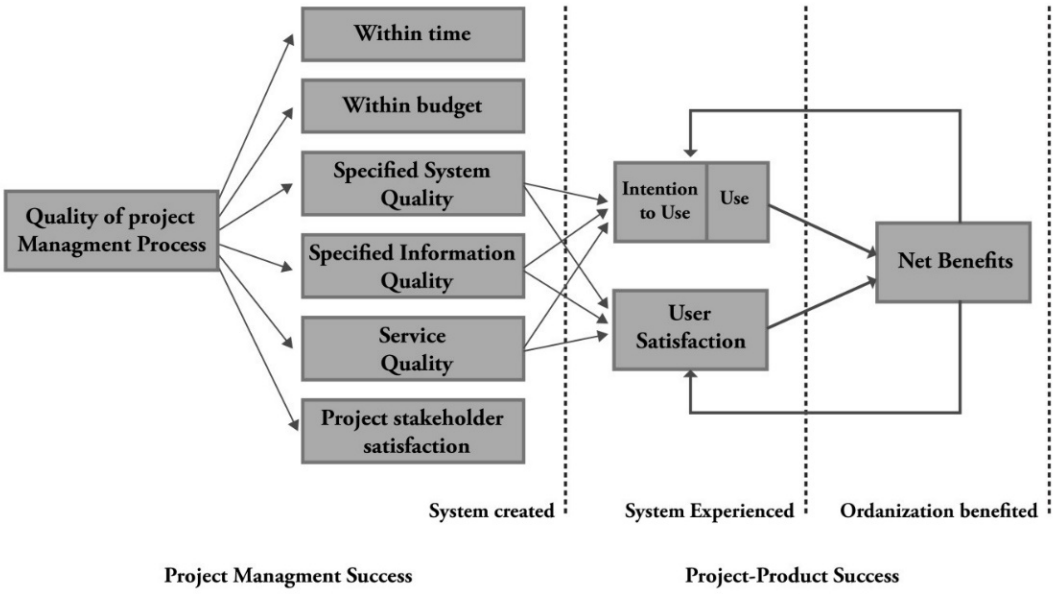
2.3.4 Customer and end-user perceptions of project success

The end-user is often called a client, customer or recipient of a project, and is also included as a stakeholder category (Westerveld, 2003). Projects are planned and executed for the benefit and development of people and communities in the public sector while for the generation of revenue and earning profits by selling of project's product or providing services to customers and end-users in the private sector. However, these outcomes appear after the projects have been delivered to the project sponsor and the operational phase has commenced (Dvir, 2005; Serrador & Pinto, 2015; Serrador & Turner, 2015; PMI, 2017a).

The perception of end-users is linked to the acceptance of the project, product or service, which is different from project management success targeted by management teams (Baccarini, 1999;

Shokri-Ghasabeh & Kavousi-Chabok, 2009). For example, Baccarini (1999) clarified that over budget or schedule is a failure of project management and efficiency, but if the outcome of that project is accepted by users, then the project still can be declared successful. Therefore, the modified triangle (right-hand side of Figure 2.2) of van der Westhuizen and Fitzgerald (2005) is not a realistic assessment of success under end-user perception because of ignoring so many parameters which can only be measured after the delivery of the project, such as system quality, information quality, information use, user satisfaction, individual impact, and organizational impact (Atkinson, 1999; Fortune & White, 2006). Similarly, Kerzner (2011) demanded that the completed project must meet customers' acceptance as well. Due to this criticism, van der Westhuizen and Fitzgerald (2005) suggested another advanced model (Figure 2.4), which was elaborating on how to deliver a product successfully including various phases relating to the behaviour of customers and end-users. Thus, a holistic view of project success and its implications may be useful for practitioners.

Figure 2.4. An advanced project success model



Adapted from van der Westhuizen & Fitzgerald (2005)

From the perception of end-users, satisfaction is a highly important parameter of project success, the significance of which is appealing to project managers in terms of ensuring expected benefits are realized. The quality of the project's product and longer sustainability are other parameters that can guarantee to accept and adopt the project's outcomes by end-users (Serra & Kunc, 2015; Aarseth et al., 2017). The previous review of the literature suggests that the planners should create a vision to involve end-users during project implementation and post-

delivery phases, which can create trust, attitude and motivation for acceptance of the project's contribution (Christenson & Walker, 2008; Pasian, 2015). The results of the study by Williams et al. (2015) indicated that the drivers of customer satisfaction and relationship quality changed significantly when the project was delivered on time or late. For example, in case of late delivery, another product could be marketed by a competitive organization, or the choices and demands of customers, and end-users might change their opinions during the time passing in delayed delivery. Hence, project management efficiency and timely delivery are also greatly related to the acceptance and satisfaction of the end-users.

2.3.5 Success factors used in the evaluation of project success

As there is no universal definition of success, the major agreement is also missing regarding the evaluation of success factors employed in this process. Questions like these have never been adopted uniformly:

1. when can the evaluation be undertaken?
2. who will do the evaluation?
3. who will be evaluated?
4. what will be the yardsticks employed in the evaluation?
5. how many times must the evaluation be accomplished?
6. can all stakeholders be satisfied with a single evaluation?

Accomplishing goals of time, budget and scope is not a comprehensive measure of project success (Frank et al., 2011; Serrador & Turner, 2015). Controversies does exist in the literature regarding the process of the project evaluation (de Wit, 1988; Baccarini, 1999; Jugdev & Müller, 2005; McLeod et al., 2012; Millhollan & Kaarst-Brown, 2016; Albert et al., 2017), but the details of disagreements cannot be resolved. Just to give one example, Haass and Guzman (2019), reviewing project management literature until 2019, pointed out the limitations of past evaluations mainly addressed the objective aspects of performance and overlooked the subjective, which also must reflect the temporal, dynamic, complex and users impacts on current projects and vice versa. They reviewed 138 articles from the literature using thematic analysis to identify five groups based on the degree of subjectivity: efficiency, effectiveness, business success, impact, and sustainability. The meta-framework they proposed may help practitioners in the selection of appropriate approaches, criteria and factors for their models that

can be used for the evaluation of project performance. Success should be the key outcome in the evaluation of projects (Cavarec, 2012).

Millhollan and Kaarst-Brown (2016) synthesized the project management literature and highlighted the potential conflict in goals for the measurement of success from three perspectives: project outcomes, project management processes, and the project manager's influence due to different perspective of success as defined by various stakeholders at various points in time. Aarseth et al. (2017) completed a systematic literature review covering all papers published in five leading journals in the fields of project management and sustainable production before 2016. They found that the sustainability of project outcomes is important and can be achieved through various strategies involving all stakeholders.

The success evaluation may target the performance of project management teams, suppliers and vendors, contractors and sub-contractors, meeting requirements of HSE and other regulations, the achievement of objectives, matching time and cost allocations, quality and scope of the project, and satisfaction of all the stakeholders including customers and end-users. The temporal variations in success assessment include evaluation of project execution at different phases, on project accomplishment, post-delivery, long-term project success, and operational sustainability (Jugdev & Müller, 2005; Turner & Zolin, 2012). Projects may look successful at commissioning but might prove faulty or weak afterward and could not attract community acceptance in the long run (Turner, 1999; Shenhar et al., 2001; Eduardo Yamasaki Sato & de Freitas Chagas Jr, 2014).

Pollack et al. (2018) performed the most extensive analysis to date to review 109,804 papers published from 1970 to 2015 (45 years) related to project management research that included time, cost and quality. Their analysis indicated that these single factors appeared in 19,855, 18,136, and 12,098 papers respectively, whereas combinations of time and cost, time and quality, cost and quality, and time, cost and quality were mentioned in 5,810, 3,210, 3,348, and 1,458 papers respectively, thus covering 63,920 (58%) published articles in total. The remainder of 45,884 papers represented 42% and highlighted other aspects of project management. Their work provides a ringing endorsement of Barnes' Iron Triangle.

Besides gaining importance, the measurement of post-delivery project success is rarely manifested during practice in most of completed projects (Eskerod et al., 2015; Haverila, & Fehr, 2016). The study by Fuentes et al. (2019) indicated that projects are proving consistently

weak to provide valuable outcomes on a medium-term and long-term basis. The major cause has been poor design (Locatelli et al., 2017) and lack of appropriate vision (Christenson & Walker, 2004), while sustainability-related targets require collaboration and joint efforts from the major stakeholders of a project (Yuan, 2017). Therefore, stakeholder satisfaction along with so many other success factors play a major role in making a project successful when measured across pre-implementation, implementation and post-implementation phases.

2.3.6 Importance and involvement of users in project success evaluation

End-users of projects have been declared very important to CSFs and feature at number one on the top 10 list prepared by Standish Group (Standish Group, 2009) and at number five in the study of Fortune and White (2006). Al Hammadi (2018), in his PhD at the Grenoble Ecole De Management in France, revealed his top five CSFs as cost, time, quality, satisfaction of end-user and HSE. A study by Tam et al. (2020) revealed that the capability of teams and end-user involvement are the two major factors for the success of IT projects. The thematic analysis by different authors revealed that five success dimensions are common between client and end-users: communication, time, satisfaction, using finished product/acceptance, and cost/budget. However, between some groups, there were no common success dimensions, like executives, sponsors, and owners – indicating no agreement in project success dimensions between various stakeholders (Davis, 2016). The end-users of a business significantly impact the outcomes of a project, and therefore must be involved during all phases of the life cycle of a project (Eichhorn, & Tukel, 2018).

The quality of the product or service delivered by a project describes its characteristics matching approved standards concerning the needs and wants of end-users and motivating them for their acceptance and satisfaction. The satisfaction of end-user needs and wants is directly associated with their perception of success (Baccarini, 1999; Dvir et al., 2003; Joslin & Müller, 2015; Kocherla, 2012).

End-users might be considered the final adjudicator for the execution of a successful project that can also prove fruitful for the project sponsors and investors because they perform a pivotal role in the determination of success or failure of completed and delivered project. According to Lim and Mohamed (1999), even if a project is delivered on time, according to the desired specifications, and within budget, but project outcomes/products/services are not appreciated by end-users, that project would be considered a failure. During the planning and project

designing phase, good communication with end-users and taking their comments on board will help to fully align project objectives with their likely end-user satisfaction.

Of course, the involvement of end-users should not stop with the planning phase, but they must be involved in the subsequent phases of project implementation for pointing out any errors which can be addressed simultaneously, rather than facing them after completion of a project. The adaptation of this mechanism can prove very useful in converting objectives into performance measures by project managers. The acceptance of end-users can occur by continuous consultation with them throughout the life cycle to increase the likelihood of success. Their involvement in the final stages of handover is extremely important for making getting end-users onboard, because if the deliverables are not acceptable there is every chance the project will be considered as a failure (Berman et al., 1999; Torbica & Stroh, 2001; Cooke-Davies, 2002; Dimitrios, 2009; Xue et al., 2010; Cattani et al., 2011; Akinnuwesi et al., 2013).

2.3.7 Models and theories related to the evaluation of project success

The success of a project to meet the perceptions of any stakeholder can also be measured through certain success models. Some salient models are presented below.

2.3.7.1 Nicholas (1989)

Nicholas (1989) developed a model comprising major causes of project success that were identified from a survey and are related to management, management systems, and communication. He emphasized the role of management (top management, project manager, and management teams), users, communication, and the systems implementing projects in making a project successful. Various CSFs were enumerated and placed under each major group. Proper planning, control and implementation processes could play a vital role in destining a project to success, according to the highlights of his research.

2.3.7.2 Belassi and Tukel (1996)

Belassi and Tukel (1996) proposed their model of project success, classifying the factors of project success into four major groups. They claimed that their model addresses the gaps found in the literature at that time. The four groups they identified comprised factors relating to the:

1. Project itself
2. Project management team (manager and team members)

3. Organization
4. External environment

They mentioned that the CSFs of all groups are interconnected, and a single factor can impact factors of the other groups significantly. They claimed that this type of categorization will be proved helpful in finding the root causes of defects and deficiencies, or overall failures, and making the project successful because of allowing project managers to assess and track their tasks efficiently. However, the inclusion of many intangible and qualitative factors in the model makes it hard to measure.

2.3.7.3 Shenhar et al. (1997)

In the model proposed by Shenhar et al. (1997), the success of projects comprise four dimensions. The first dimension is the project efficiency, which covers execution and implementation with all its activities, procedures, and management until the completion of the project. The second dimension is the impact of the project on customers. The third dimension is the direct business success of a project, as assessed after delivering the project to the client or the customer. It involves the assessment of success when a significant percentage of sales have been attained, usually in between the first and second year. The final dimension is preparing for the future, and in this component another project evaluation is undertaken between the third and fifth year after the completion of the project for measuring long-term performance and assessing deficiencies and new needs. Later, Shenhar et al. (2001) strengthened their concepts further, however, the deficiency in this work was that it emphasized the time more than other parameters of the product that were also highly important.

2.3.7.4 Atkinson (1999)

Atkinson (1999) divided the successful implementation of projects into two stages in his model. The first stage was called the delivery stage comprising of all project implementation processes and activities required to complete the project which must always be accomplished in an appropriate manner as spelled out in the project documents. The post-delivery stage was the second stage of his model which has two further phases: assessing the system and assessing the benefits. In the first phase of the post-delivery stage, it is determined whether the system is working correctly, whereas during the second phase of the post-delivery stage the benefits of the project are assessed. However, this model can be criticized because of prioritizing the

clients' interest and not evaluating the benefits and economic value of the finished product for the end-users.

2.3.7.5 Lim and Mohamed (1999)

Lim and Mohamed (1999) developed a model to describe the successful execution of a project. These researchers recommended examining the projects from a different perspective: macro, and micro viewpoints. The model takes into consideration the views of stakeholders like contractors, developers, individual owners, and even public views about the project. The macro viewpoint evaluates whether completion was within the required time and if it was done satisfactorily and if the utility and operations were met. While the micro viewpoint assesses whether the completion of the project was on time, within the cost estimates, meeting quality and safety standards and whether good performance was attained. The model protected the interests of clients and customers. However, important parameters like HSE and stakeholder satisfaction were not included in this model.

2.3.7.6 Sadeh et al. (2000)

The concept of project success is divided into four levels in the model proposed by Sadeh et al. (2000). Attaining the goal of the project's design forms the first stage, which is based on the contractual agreement signed by the client and contractor(s). The second level considers the expectations of the customer and their benefits from the product while the third segment undertakes the expected value for the organization after developing and marketing the project outcome. How the developed outcomes gain value from the technological infrastructure is examined in the fourth component of this model. A roadmap has been presented amalgamating the four dimensions to assess the success of any project, but the model is limited due to the interest of stakeholders other than the client being ignored, as well as giving no importance to HSE and other regulations.

2.3.7.7 Cooke-Davies (2002)

The model of Cooke-Davies (2002) emphasized making a distinction between project success and project performance because in some cases, the projects implemented according to plans (on time and within budget) have been assessed as failures due to non-producing benefits to the customer, or could not achieve the intended outcomes, or did not earn the expected revenue. According to him, examples of projects can be presented which faced issues, delays and

overruns, but in the long run, were declared as successful because of benefits brought during post-delivery stages.

2.3.7.8 Stare (2010)

Stare (2010) developed the 'comprehensive change model' because of its scope for predicting and preventing changes. The negative effects of changes on a project were also researched. He claimed the success of his model was identifying and detecting changes in a timely fashion and responding immediately to them. Thus, the negative effects on project implementation could be avoided. However, this model cannot be used for evaluating the success of a project as it emphasized only a single factor for controlling change.

2.3.7.9 Davis (2018)

Davis (2018) proposed a new model for the evaluation of project success and urged that all the critical attributes associated with various perceptions of stakeholders of project success must be involved in project assessment. Her study indicated that most of the project failures are the result of different interpretations of the criteria and factors of success by multiple stakeholder groups. Therefore, unique projects must have agreed parameters that can be monitored and controlled to control the chances of failure. The testing of the model supported sharing perceptions of project success by multiple stakeholders, better decision-making, and motivation of employees.

2.3.8 Concluding remarks

Project success evaluations were overwhelmingly conducted during and immediately after completion of projects, whereas post-delivery and long-term sustainability were seldom assessed, although direly needed. The review presented in Section 2.3.7 has indicated that there is a significant deficiency regarding the importance of end-users and customers and their roles in evaluating the operational phase of a project. Hence, the need emerges to address this identified deficiency because the level of satisfaction is an vital attribute of success, and a project could only be successful if end-users are generally satisfied with the final products/services arising from it.

2.4 Satisfaction of customers and consumers

2.4.1 Definitions of satisfaction

Customers and consumers are the ultimate recipients (end-users) of completed projects for whom projects were particularly planned and executed to address specified objectives and attain some fixed targets. If they are satisfied, they will be motivating and urging others to purchase and use products/services, thus contributing to the generation of more revenue and making the project successful during the post-delivery phase (Xueming & Bhattacharya, 2006; Vaezi, 2013; Torres, 2014; Schiebler, 2019). Project success should include the satisfaction of end-users because the products, services, systems or assets achieved from the project are not the final goals of projects unless these are accepted and adopted. End-users will be delighted only if they are satisfied from consumption of outcomes. Such satisfaction can relate to financial, social, ethical and environmental consequences that a project might induce.

Like the other definitions in the field of project management, the method for measuring consumer satisfaction is not unanimous and researchers and authors have defined satisfaction in their ways and words. Everyone understands the concept of satisfaction, but most people cannot define it because giving words to feelings can be difficult (Oliver, 1997). Giese and Cote (2000) have reported that past research was majorly focusing on testing and proposing models related to consumer satisfaction (Mano & Oliver 1993; Oliver, 1993; Spreng et al., 1996), giving little attention to defining the concept. Non-consensus in defining consumer satisfaction has limited the scope of research on this subject because researchers cannot select validation measures under different scenarios (Yi, 1990; Peterson & Wilson 1992; Gardial et al., 1994).

The definition of satisfaction by the Oxford Dictionary (online version) is “fulfilment of one's wishes, expectations, or needs, or the pleasure derived from this”. Thus, consumers’ satisfaction is associated with personal needs and wants. Westbrook (1987, p. 260) defined satisfaction as a “global evaluative judgment about product usage/consumption”. Thus, he was emphasizing judgment by consumers and not taking fulfilling needs and wants into consideration. Fornell (1992) defined satisfaction as overall evaluation after purchase, whereas Fornell et al. (1996) modified this definition by concluding that satisfaction is an overall consumption experience of and evaluation is based over time in the context of purchase price.

Kotler (1997) considers satisfaction as a person's feeling of pleasure or disappointment resulting from comparing the perceived performance of an outcome compared to expectations. Oliver (1999, p. 34) defined consumer satisfaction as pleasurable fulfilment: "that is, the consumer senses that consumption fulfils some need, desire, goal, or so forth and that this fulfilment is pleasurable". Giese and Cote (2000) argued that despite many differences in the definition of satisfaction, some common elements are also there: consumer satisfaction is an emotional or cognitive response, focused on expectations and consumption experience of consumers, and the response is occurring at a particular time.

Nevertheless, satisfaction can only be manifested through some indicators which are mostly abstract parameters and cannot be quantitatively measured. The absence of complaints of the product also favours its acceptance and satisfaction (Slevin & Pinto, 1986; Pinto & Slevin, 1988; Wateridge, 1998; Pinto & Prescott, 1990; Belassi & Tukel, 1996; Müller & Turner, 2007; Turner & Zolin, 2012; Wu et al., 2017). Successful and sustainable products or services arising from a project must give some satisfaction to the end-users if it is to remain alive in the customers' market for a long time. Otherwise, it will be replaced by a better product or service.

2.4.2 Theories of satisfaction

Consumer satisfaction is an important outcome after utilization of a product or service from a project by end-users, which on one hand is dependent upon quality, price and superiority over comparable options. On the other hand, satisfaction is a highly important parameter from a sales and marketing point of view. Researchers had been doing work to understand the concept of satisfaction from various scenarios, aspects and behaviours and have put forth different theories to elaborate on this concept as well as its determinants. The important ones are presented below.

2.4.2.1 Dissonance theory

The basis of this theory (Festinger, 1957) is that people may adjust to new facts or remain strict to old beliefs or even both whenever some new ideas, facts or materials are presented to them. It depends upon whether the new things bring comfort or discomfort to their mind. If a new product or service does not match the expected performance or service quality, psychological tension is created in the minds of consumers, which is called dissonance, and they try to reduce it. The author of this theory further elaborated that dissonance will only occur because of disconfirmation due to the bigger gap between the performance of the product and desires and expectations attached to that new product which is irreversible. Although some studies provided

support for the dissonance theory (Olshavsky & Miller 1972; Olson & Dover 1979; Spreng & Olshavsky, 1993), still it is difficult to assume that all conditions could be favourable to meet in such a typical experiment where inconsequential expectations are possible to create through product or service information (Yi, 1990).

2.4.2.2 Contrast theory

The results of a laboratory experiment by Cardozo (1965) indicated that customers' satisfaction is associated with two factors; the effort and struggle put in to acquire the product, and the expectations they had of the product before its use. To be more specific, the study suggested that the satisfaction of the product may be higher if the effort to obtain the product was high. This finding contrasts with the usual understanding of marketing efficiency in which the product is made easily and conveniently available for effortless access to consumers.

The other aspect of this theory is direct, suggesting that that satisfaction will be lower if the product meets lesser expectations than were foreseen. However, later literature (Peterson & Wilson, 1992; Parker & Mathews, 2001) did not agree with this theory and regarded it as a weak interpretation because it was found that consumers use a holistic perspective when they are going to purchase and consume a product resulting in their satisfaction. Moreover, some studies found many factors of satisfaction and concluded that it is a combined response of several determinants (Yi, 1990; Spreng et al., 1996; Oliver, 1997).

2.4.2.3 Assimilation-contrast theory

Anderson (1973) proposed this theory, pointing out the presence of zones of acceptance and rejection in perceptions of consumers. A small difference between expectation and performance will cause acceptance of the product but the larger difference may stimulate the rejection behaviour of consumers because the performance of the product will fall in the rejection zone. Thus, a bigger gap between high consumer expectations and actual product performance experienced by the consumers will indicate a less favourable evaluation of a product. However, this theory was criticized due to mixed results; a few favourites, and mostly contrasting (Oliver, 1980b; Yüksel & Yüksel, 2008).

2.4.2.4 Expectation-disconfirmation theory

Expectation-disconfirmation theory propounds that the consumers have already created a standard of expectation about any product or service in their mind and they can only be satisfied

if consumption of a product performs according to or nearer that standard, indicating their satisfaction and acceptance. However, if the performance is lower, they will remain dissatisfied. Thus, according to this theory, consumer satisfaction is just a comparison of the performance of the product as adjudged by the consumers against the pre-assessed standard of the product/service under consideration (Olson & Dover, 1979). Therefore, in the expectation-disconfirmation paradigm, satisfaction is a function of expectation and disconfirmation, whereas expectations standards form the basis of comparison.

The results of some of the studies (Weaver & Brickman, 1974; Oliver, 1977; Oliver, 1979; Swan & Trawick, 1981) supported assumptions of this theory. A supporting argument can also be taken from the adaptation level theory of Helson (1964) that suggested individuals interpret stimuli with a comparison of an adapted standard (benchmark). The theory, however, is also criticized because it assumes only predictive expectations that might be created under the influence of advertisements, reports, and motivation by friends, relatives, companions, or other situational conditions. The standard adopted in the mind of consumers might not be true (LaTour & Peat, 1980; Oliver, 1980b). However, Lankton and McKnight (2012) still found some use in this theory.

2.4.2.5 Comparison level theory

This theory is a modified version of expectation-disconfirmation (LaTour & Peat, 1980). Thibaut and Kelley (1959) pointed out that the foundations of purchases by consumers and subsequent satisfaction can be found under the difference between the actual outcome and a standard comparison level. Any outcomes exceeding a comparison level will be producing a positive discrepancy and will be satisfying the consumers using the product/service. In contrast, outcomes falling below the standard comparison level will be resulting in a negative discrepancy and thus causing dissatisfaction. The comparison level is set up by various factors like consumers' previous experience, learning of characteristics of three products, advertising, and marketing efforts by the companies, and motivation by companions, etc. According to LaTour and Peat (1980), three factors determine the comparison level of a product, which are similar product experience, situationally produced expectation, and the experience of other consumers. Later, tests by Swan and Martin (1981) and Schaefer and Kornienko (2010) revealed that the factors suggested by LaTour and Peat (1980) work well in analysing consumer satisfaction.

2.4.2.6 Equity theory

The comparative quantum of the input efforts and the outcomes in comparison to other consumers forms the basis of this theory (Adams, 1963; Walster et al., 1978). The equity is the ratio of what satisfaction was received by the consumer and what other people received, both relative to their inputs. The equity theory was tested by many authors and researchers (Fisk & Young, 1985; Oliver & DeSarbo, 1988; Oliver & Swan, 1989; Patterson et al., 1997; Hess & Hightower, 2002). Oliver and Swan (1989) employed equity theory in the context of consumer satisfaction with airline services. Their findings were that inequity results in dissatisfaction reduces the chances to repurchase the product/service. However, the validity of results was only for inexperienced customers whereas consumers having prior experience were not affected much. Thus, the equity theory may not prove useful under all conditions. Joshi (1990) also examined the equity theory and came with findings that this can improve user information satisfaction.

2.4.2.7 Value-percept disparity theory

Westbrook and Reilly (1983) proposed this theory claiming that the expectation-confirmation model cannot differentiate between cognitive and evaluative notions. Therefore, Yi (1990) suggested that expectations from a product could be different from what is desired by the consumers as well as the value in a product. Under such a case, product values will affect consumer satisfaction if these are different from expectations. Hence, according to this theory, the differences between consumer's desires, needs or wants (i.e. values) and product perceptions is the major determining factor of consumer satisfaction: the lesser the disparity, the greater will be the satisfaction and vice versa. Tests of the value-percept disparity model against the expectation-confirmation model by Westbrook and Reilly (1983) found that none of the models alone was sufficient to explain consumer satisfaction. They defined value-percept disparity as the extent to which the product performance and characteristics match consumers' needs and desires, which can be tested using a Likert scale. Despite their theory, they found that disconfirmation of expectation had stronger effects on satisfaction than desire disparity. However, their results were not declared as conclusive because of using a single indicator for measuring value-percept disparity. Aigbavboa and Thwala (2013), reviewing the literature on theories and models of consumers, concluded that satisfaction does not comprise a single variable, rather a set of interrelated variables affects it. Despite all the theoretical approaches, many were developed to find a relationship between positive disconfirmation and

dissatisfaction. All the theories are variants of the consistency theories focusing on the users' post-usage evaluation.

2.4.2.8 Hypothesis testing theory

As the dissonance theory mentioned the formation of some standards about the product to be used by the consumers, similarly hypothesis testing theory suggests consumers might form a hypothesis about the performance of a new product and just want it confirmed after purchase and utilization (Deighton, 1984; Yi, 1990). Thus, this approach to satisfaction testing is purely cognitive. This theory elaborates that the advertising efforts of companies might affect the minds of consumers by arousing weak and biased expectations and tending people to test the product. Thus, people are made ready to confirm their expectations. It is a sort of fuzzy hypothesis testing by consumers just like researchers who want to test their hypotheses before concluding the outcome of performance (Borjalilu et al., 2011).

2.4.2.9 Generalized negativity theory

Any disconfirmation of expectation (whether positive or negative) is perceived as less pleasant compared with a confirmation of expectations by the consumers. This understanding forms the basis of the generalized negativity theory (Carlsmith & Aronson 1963). It suggests that disconfirmation of consumers' expectations creates a negative state in individuals. A less favourable expectation of consumers can occur when their pre-determined expectations are not confirmed by the product's performance. The differentiating point is that positive as well as negative deviations from expectations reduce the evaluation of a product, thus the product evaluation depicts an inverse relation to the magnitude of confirmation. However, Oliver (1976) found that this theory works only under high ego involvement, commitment and interest. The research study of Almsalam (2016) showed that customer expectation had a positive effect on customer satisfaction, hence his expectation carries higher weight.

2.4.2.10 Cue utilization theory

Cue utilization theory argues that products or services comprise many cues which are indicators of the quality of a product or service. The cues might be intrinsic as well as extrinsic and are helpful for consumers to guess the quality. The intrinsic cues are providing information on the physical attributes of the product or service while extrinsic cues are related to brand and price information (Reimer & Kuehn, 2005). Thus, consumers can have an advanced perception of the product.

2.4.3 A comparison of the consumer satisfaction theories

Customer satisfaction has not been defined in a way that is universally accepted (McCollough, 2000) because it is a cognitive process or an emotional state. However, it is a complex human process involving cognitive, effective and undiscovered psychological and physiological dynamics (Howard & Sheth, 1969; Engel & Blackwood, 1982; Oh & Parks, 1997). Using these characteristics, various theories for explaining consumer satisfaction have been proposed. However, none of these cover all aspects of consumer satisfaction, and to some extent lack integration and empirical evidence on key processes (Schiebler, 2019). Nevertheless, disconfirmation paradigm and the expectancy-value concept may best explain consumer satisfaction (Barsky, 1992).

Both theories are widely accepted to explain consumer behaviour (Cardozo, 1965; Day, 1977; Oliver, 1980b; Beardon & Teel, 1983). Isac and Rusu (2014) claimed that a group of theories can explain the nature and the development of consumer satisfaction from various perspectives but all fall under the umbrella of the expectation disconfirmation paradigm.

2.4.4 Antecedents of user satisfaction

Consumer satisfaction is derived from various factors that directly or indirectly affect this behaviour. These factors are called antecedents of satisfaction or determinants of satisfaction (Fisk & Young 1985; Joshi, 1990; Yi, 1990; Mano & Oliver 1993; Spreng & Olshavsky, 1993). The antecedents are of critical importance for companies during their sales and marketing campaigns because they can handle and address these factors by advertisements. The higher the satisfaction of consumers means higher acceptance and consequently more sales of products and services. The important antecedents are discussed below.

2.4.4.1 Expectation

The anticipated expectations of consumers directly affect their satisfaction and are completely guessed before the consumption of a product or availing a service (LaTour & Peat, 1980; Oliver & DeSarbo, 1988; Yi, 1990). However, views of researchers are mixed with widespread disagreement (Yi, 1990; Spreng & Olshavsky, 1993), and some studies found direct effects (Oliver, 1980a; Oliver & Linda, 1981; Bearden & Teel, 1983) whereas other investigations have not confirmed the effects of expectations on consumer satisfaction (Oliver & Bearden, 1983). Nevertheless, Churchill and Surprenant (1982) further elaborated on the effect of expectation

on satisfaction because their results were positive in the case of non-durable products, but no effects could be recorded when the products were durable.

Scholars even do not agree with the nature of expectation because some consider it as a belief of the future (Olson & Dover, 1979; Bearden & Teel, 1983; Westbrook, 1987), while others refer it to the needs and wants of customers (Parasuraman et al., 1988). Still, some others include expectation as evaluation of beliefs (Oliver, 1980b; Tse & Wilton, 1988). Spreng et al. (1996) have listed different views about expectation considering past literature: expectation is the probability of occurrence of some event (Westbrook & Reilly, 1983; Westbrook, 1987) or an evaluation of goodness or badness of events (Oliver, 1981; Churchill & Surprenant, 1982).

2.4.4.2 Desires

A desire sprouts from the needs and wants of consumers and refers to their likeness (Parasuraman et al., 1988; Nevo & Chan, 2007). Spreng et al. (1996) mentioned various definitions of desire in the literature while due to its nature, conceptualization can be seen at the abstract level (fundamental needs) and a higher level. At a higher level, the desire may be meant to attain end-state needs. For example, at an abstract value, the desire of the customers may be rapid communication with their relatives and friends, which may be manifested as a desire to buy a mobile phone. Hence, a desire can be an abstract end-state. Thus, product attributes or benefits will be leading to higher-level values and desires of the consumer, and they will be tending to evaluate product attributes in attaining their end-state desires and the extent to which the product will be helping them to achieve their basic values (Spreng & Olshavsky, 1992; Spreng and Olshavsky, 1993; Spreng et al., 1996).

Wirtz and Mattila (2001) were of the view that needs, wants, desires and values all represent the same construct, which can be called 'desired expectations'. According to Gutman (1982) and Khalifa and Liu (2003), desires are formed based on inner emotional needs or wants rather than a realistic prediction of actual performance (means-end theory). Nevo and Chan (2007) defined desire by contrasting it with expectation because to them, desires are representing what people would like to happen in contrast to what will happen.

2.4.4.3 Previous experience

Many scholars mentioned that the concept of previous experience is more relative to job satisfaction where it is a major determinant (Irving & Meyer, 1994; Hom et al., 1999). However, Brown et al. (2007) found that prior expectations are not so much important in the determination

of satisfaction; rather the daily experience of the job directly affects satisfaction. Parasuraman et al. (1985) called the prior experience as a predictor of service expectations while Zeithaml et al. (1993) included experience as an antecedent of predicted expectation and desired expectation, both studies were theoretical with no empirical investigations. In the case of information system, Brown et al. (2007) found that using satisfaction comes from experience and usefulness expectations could be noticed.

2.4.4.4 Affect

According to Yi (1990), consumer satisfaction is not only formed from a cognitive evaluation process but also some effective aspects are part of it, although these have been little studied (Westbrook & Oliver, 1991; Mano & Oliver, 1993). Some research studies on affect have brought out the dimensionality of satisfaction and the role of affect in framing the concept of consumer satisfaction (Szymanski & Henard, 2001). Affect, by definition, is a "set of emotional responses elicited specifically during the product usage or consumption experience" (Westbrook & Oliver, 1991, p. 85). The emotions of customers can be expressed either as joy, anger or fear, or as categories: for example, pleasant/unpleasant, relaxation/stress, or calmness/excitement. Westbrook and Oliver (1991) differentiated between affective experience and the mood of consumers (mood is not as severe, urgent, motivational, and situationally specific). Thus, emotions emerging during consumption may leave a trace of affect in the memory of consumers which will help them during the formation of satisfaction perceptions. Mano and Oliver (1993), basing the dominating amount of work on effect, concluded that emotions have dimensions like pleasantness-unpleasantness, arousal-quietness, or positive and negative affectivity, creating a circular configuration called a circumplex. They were of the view that the previous researchers mostly considered negative feelings but did not take both dimensions into account. Oliver and Rust (1997) modified the affective framework put forward by Mano and Oliver (1993) and added the concept of delight into satisfaction, delight being an ultimate level of satisfaction.

2.4.4.5 Equity

The factor of equity is working per the equity theory and affects consumer satisfaction and dissatisfaction (Fisk & Young, 1985). Oliver and DeSarbo (1988) claimed that consumers can assume ratios of inputs and outcomes for themselves as well as the companies by making a comparison during various transactions. Their hypothesis in exact words (p. 496) is "when inputs are disproportionately higher for the focal person (the consumer), satisfaction should

increase as that person's outcomes increase relative to those of others and decrease as outcomes decrease relative to those of the others". Oliver and Swan (1989) changed the words to remove confusion and used fairness and preference. Fairness was referred to as an individual's perception (the ratios of input to outcomes for self to that of the merchant). They used the term 'preference' for maximizing the individual's outcome relative to that of the merchant. Their finding was that preference has a non-significant effect on satisfaction while fairness was strongly related to consumer satisfaction. Patterson et al. (1997) agreed with their results.

2.4.4.6 Perceived performance

Perceived performance denotes the actual performance of a product that consumers experience and are considered as a reference point to which expectation is compared in disconfirmation theories of satisfaction. A strong relationship has been reported between the perceived performance and satisfaction of consumers (Spreng & Olshavsky, 1992). However, Yi (1990) differentiated between objective and perceived performance. Objective performance is the actual product performance, the value of which remains constant for all consumers, whereas perceived performance refers to the performance assessed by individual consumers due to their differences. Churchill and Surprenant (1982), after experimentation, further clarified that perceived performance behaved as a strong predictor of satisfaction among other predictors in one of the products due to its relationship to satisfaction. Therefore, the only way to increase satisfaction with a product is by increasing its performance. Tse and Wilton (1988) confirmed the claim by Churchill and Suprenant (1982), by finding that the good performance of a product makes the consumer happy regardless of expectation or disconfirmation. Still, Spreng and Olshavsky (1992) divided perceived performance into two distinct constructs: perceptual performance and evaluative performance. Perceptual performance is a cognitive belief, while evaluative performance is the actual evaluation of products' attributes.

2.4.4.7 Service quality

Like most concepts in management science, the opinions of scholars are divided regarding a relationship between service quality and the satisfaction of consumers. Many of the past research clearly stated that service quality and consumer satisfaction are directly related and perceived service quality leads to the satisfaction of customers (Woodside et al., 1989; Bitner, 1990; Bolton & Drew, 1991; Cronin & Taylor, 1992; Oliver, 1993; Spreng & Mackoy, 1996; Lee et al., 2000; Ekinci & Sirakaya, 2004). However, some researchers are of the view that the association of service quality and customer satisfaction is mixed, which may be positive or

there is no relationship (Garvin, 1983; Parasuraman et al., 1988; Iacobucci et al., 1995). For example, according to Parasuraman et al. (1988), service quality is a long-term overall evaluation of service while satisfaction is a transaction-specific evaluation and positive evaluation of service satisfaction will be leading to perceptions of service quality in the long run.

However, triangulation studies of Iacobucci et al. (1995) revealed that from the customers' point of view, causal factors of service quality are purchase attributes of price, backstage and expertise, while timeliness, service recovery and physical environment might affect the satisfaction of the customer. Hence, service quality is controlled by management, and customers will decide about their satisfaction. Therefore, in achieving the satisfaction of consumers, service firms must satisfy the consumers by providing quality service. Nevertheless, service quality cannot be measured through indicators (Garvin, 1983), yet there are some unique service features like intangibility, heterogeneity, and inseparability that can make the service quality elusive (Parasuraman et al., 1988). They believe that perceptions of service quality are formed through individuals' comparison between what they think the service firm should offer (i.e. their expectation) and their perception of the service performance. Consumers usually make a comparison between the actual performance of a product, service or system and some already set standards in their mind which differ from one individual to the other (Parasuraman et al., 1988; Spreng et al., 1996).

2.4.4.8 Perceived value

Fornell et al. (1996) introduced the 'perceived value' concept as an antecedent of consumer satisfaction for including the price of the product/service into measures of satisfaction. The perceived value was argued as the performance/quality level of a product or service relative to the price paid by the customer. Perceived quality and customer expectations were included in antecedents of perceived value: higher perception will lead to higher perceived value, which subsequently might increase the satisfaction of consumers.

2.4.5 Models of consumer satisfaction

The efforts of researchers are visible in the literature in developing theoretical and empirical models to describe the various aspects of consumer satisfaction, considering different factors and antecedents as well as theories. The main models are summarized below.

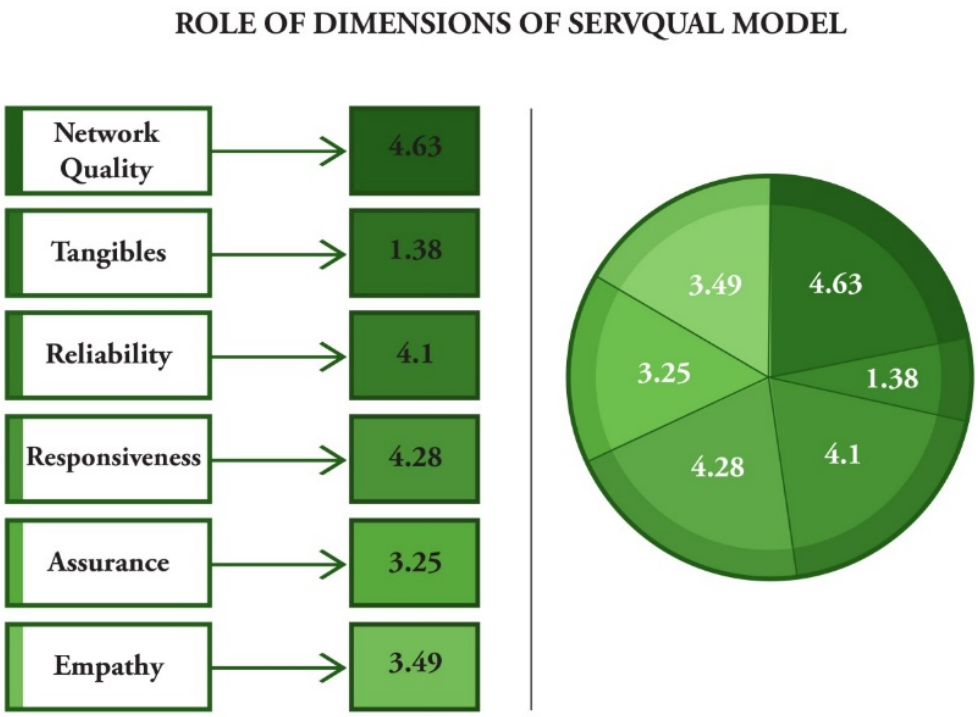
2.4.5.1 SERVQUAL model

The SERVQUAL model was developed by Parasuraman et al. (1988) to measure consumer perceptions of service quality and tested by many others (Parasuraman et al., 1988; Saleh & Ryan, 1992; Yoo & Park, 2007) in service industries like tourism and hospitality. This model was shaped into a 22-item instrument for measuring consumer perceptions of service quality. SERVQUAL can test many elements of service quality categorized into the dimensions of tangibility, reliability, responsiveness, assurance and empathy (Parasuraman et al., 1988). This model was most widely accepted for the expectancy disconfirmation theory of customer satisfaction (Barsky, 1992) that was developed by Oliver (1980a), proposing satisfaction level and the difference (positive or negative) between expected and perceived performance (Ivanka et al., 2009). An easy way suggested by Gilbert and Horsnell (1988) for determining the service preferences of customers is using guest comment cards (GCCs). Barsky and Huxley (1992) proposed having quality samples, using questionnaires and offering incentives for participants. Schall (2003) pointed out issues like question clarity, scaling, validity, survey timing, question order and sample size were important. Some authors (Mohsin & Ryan, 2005; Nadiri & Hussain, 2005; Roshnee & Ramsaran-Fowdar, 2007) elaborated the five dimensions of the SERVQUAL model as:

1. *Tangibility*: Tangibility refers to the physical characteristics associated with a service – for example, interior design, and the appearance of employees
2. *Reliability*: The service provider can provide accurate and dependable services
3. *Responsiveness*: It is the willingness of a company to assist its customers by providing fast and efficient service performances solving customer problems
4. *Assurance*: providing confidence to customers like polite and trustworthy behaviour from employees
5. *Empathy*: It is a firm's readiness to provide each customer with personal service

A study was conducted by Nguyen (2014) in France for assessing the importance of various dimensions of the SERVQUAL model and his data (see Figure 2.5) indicated that in the opinion of participants, network quality and responsiveness were the most important dimensions followed by reliability, empathy and assurance, while tangible issues remained at the bottom in importance evaluations.

Figure 2.5. The importance of various dimensions of the SERVQUAL model

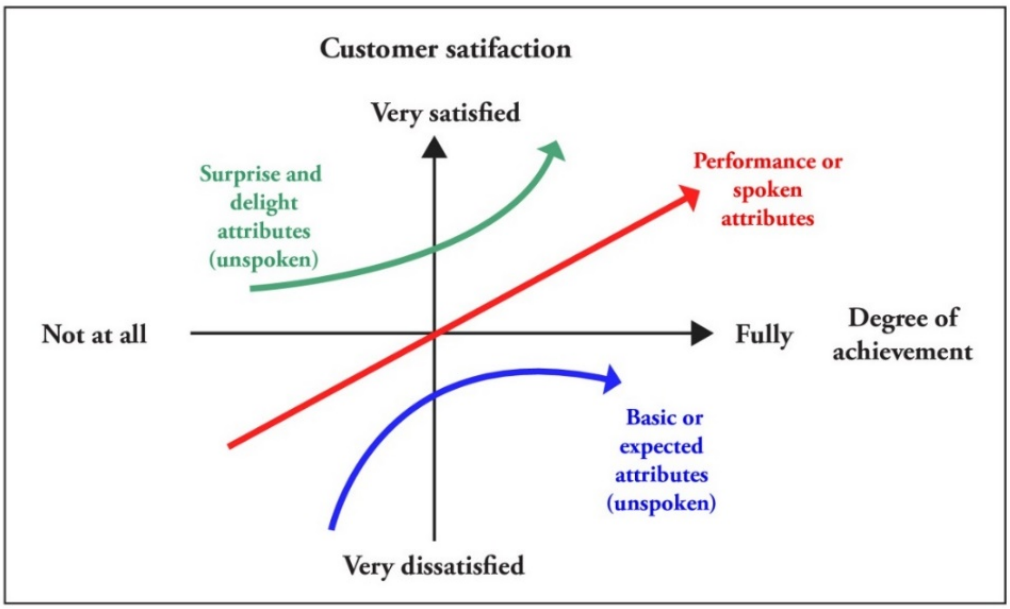


Adapted from Nguyen (2014)

2.4.5.2 The Kano model of consumer satisfaction

The Kano model was developed in the 1980s by Kano et al. (1984) for elaborating satisfaction attributes perceived by customers and how they affect customer satisfaction. This model is based on three types of attributes: basic or expected attributes, performance or spoken attributes, and surprise and delight attributes. Kano et al. (1996) explained that the performance or spoken attributes are the expressed expectations of the customer, the expected attributes are the basic attributes without any major significance, whereas the delight attributes are beyond the customers' expectations (see Figure 2.6). The model measures satisfaction against customer perceptions of attribute performance, grades the customer requirements, and determines the levels of satisfaction (Edvardsson & Gustafsson, 2000). Bilgili and Ünal (2008) explained that the underlying assumption behind Kano's method is that the higher quality may not necessarily lead to higher satisfaction for all products. They also mentioned some additional attributes, which are: indifferent attributes, questionable attributes, and reverse attributes.

Figure 2.6. Diagrammatical presentation of Kano model



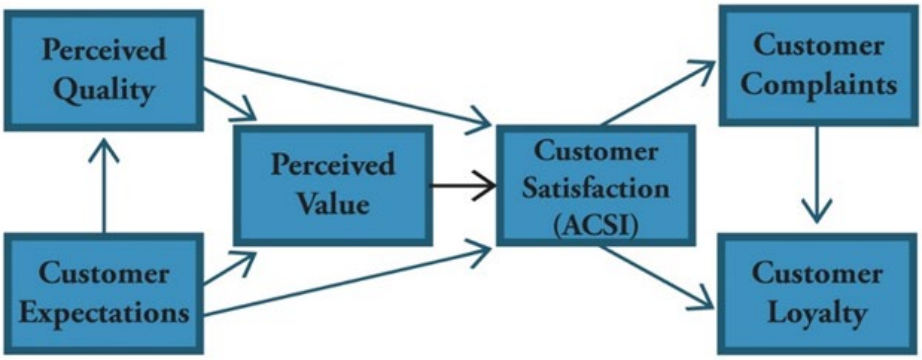
Adapted from Kano et al. (1996)

2.4.5.3 American Customer Satisfaction Index (ACSI) model

The American Customer Satisfaction Index (ACSI), a multi-equation econometric model, was proposed in 1996 by Fornell et al. (1996) at the Ross School of Business, University of Michigan. It is either based on or resembles the Swedish Customer Satisfaction Barometer (SCSB) model of Fornell (1992). The major purpose of the model is to measure the market-based performance of firms, industries and national economies. This is a cause-and-effect model, using interviews of consumers as an input (see Figure 2.7). The indices for drivers of satisfaction are on the left side (customer expectations, perceived quality and perceived value), the satisfaction index (ACSI) is placed in the centre, and outcomes of satisfaction are presented on the right-hand side (customer complaints and customer loyalty, including customer retention and price tolerance). The ACSI uses two interrelated and complementary methods to measure and analyse customer satisfaction: customer interviewing and econometric modelling (ACSI, 2005). Indeed, the ACSI is a survey process collecting data from individual customers and has two antecedents: customer complaints, and ultimately customer loyalty (Vavra, 1999). In the USA, about 80,000 Americans are interviewed annually, and data are put into this model which can be used by researchers, corporations and government agencies, market analysts and investors, industry trade associations, and consumers (Xueming & Bhattacharya, 2006). Vavra (1999) has described three primary objectives of ACSI:

1. Measurement for quantifying the quality of economic output based on consumer input
2. Contribution for providing a conceptual framework to understand how service and product quality relates to economic indicators
3. Forecasting for providing an indicator of future economic variability by measuring the intangible value of the buyer-seller relationship

Figure 2.7. American Customer Satisfaction Index (ACSI) model

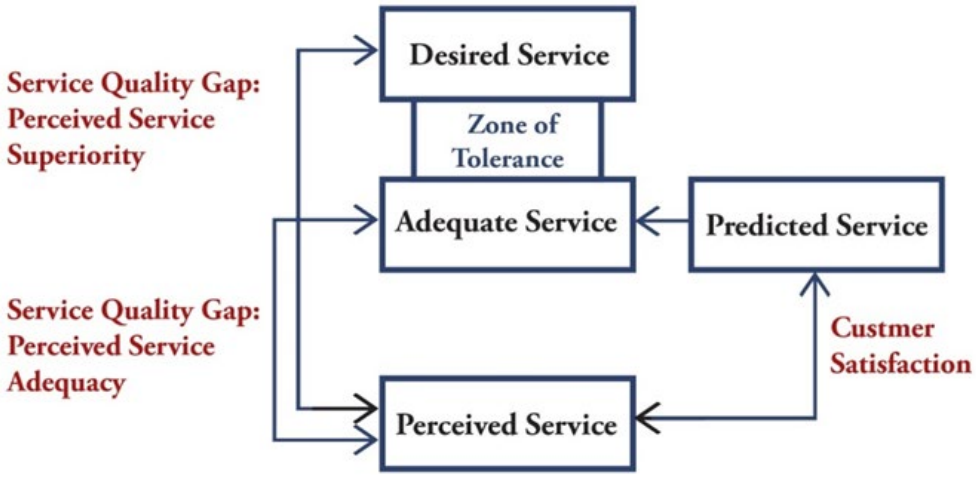


Adapted from Fornell et al. (1996)

2.4.5.4 HOTELZOT (a modified version of SERVQUAL)

The HOTELZOT is a conceptual model suggested by Zeithaml et al. (1993) for assessing hotel service by putting in the two levels of expectations: desired and adequate (see Figure 2.8). A level of service of the hotel is expected to be received by the customer, which is called the desired expectation. The desired expectation is a mixture of what a customer believes that 'can be' and 'should' be offered. Adequate service represents the actual level of hotel service. Thus, there could be a gap between desired and adequate services, which is called 'the zone of tolerance' in this model. The zone of tolerance is the extent to which customers recognize and are willing to accept heterogeneity. Thus, the HOTELZOT model is different from the SERVQUAL model of Parasuraman et al. (1988) that conceptualized only what the service 'should be'. Adequate expectations are usually at a lower level. Nadiri and Hussain (2005) found that there is always a gap between desired and adequate service expectations, and hotel management usually maintains a level of service that can be called an acceptable level of performance that the customers can accept. Desired expectations may become stable over time, whereas adequate performance expectations might vary.

Figure 2.8. HOTELZOT model of customer satisfaction



Adapted from Zeithaml et al. (1993)

2.4.5.5 SERVPERF model

The SERVPERF model was developed and proposed by Cronin and Taylor (1992) and is based on the performance of service quality. The authors claimed that their SERVPERF instrument is a relatively more concise, performance-based scale, and an alternative to the SERVQUAL model. Cronin and Taylor (1994) compared the effectiveness of SERVQUAL and SERVPERF for assessing service quality and were of the view that SERVPERF is a useful tool for measuring overall service quality.

Subsequently, Lee et al. (2000) also empirically compared SERVQUAL (performance minus expectations) with SERVPERF (performance-only model) and concluded that the results from the latter appeared to be superior to the former. However, Parasuraman et al. (1994) disagreed with this model and raised the point that performance-approach may limit the explanatory power of service-quality measurement. Nevertheless, Cronin and Taylor (1994) responding to Parasuraman et al. (1994) and claimed that the emerging literature supports their conclusions. An empirical study was conducted to compare SERVPERF and SERVQUAL efficiency by

Machado et al. (2014) through confirmatory factor analysis and the validation of the instruments using the same measures suggested by their creators. Their results indicated superior convergent and predictive validity of the SERVPERF scale to measure the quality of service compared to SERVQUAL.

2.4.6 Evaluation of consumer satisfaction

When a project is completed, it is delivered to operational and marketing units of an organization. At this stage, the major stakeholders (clients, customers, end-users, and the local community) might benefit directly or indirectly from the product/systems/services of a project. The real success of the project will be determined at this time which totally lies in the acceptance zone of users if the outcomes of the project brought some satisfaction to the consumers. Torbica and Stroh (2001) claimed that if end-users are satisfied, only then the project may be regarded as successful. Therefore, evaluation of consumers success is highly necessitated.

A new phase of a project starts when it is delivered to operational and marketing units of the organization for onward transfer to customers and end-users. This stage of the project lifecycle is called the post-delivery phase or influence phase. It is called post occupancy in construction projects because the occupants inhabit their buildings after completion. The acceptance and purchase of a project's outcomes is an indication of the real success because earlier assessments have measured only the performance of the project design and delivery.

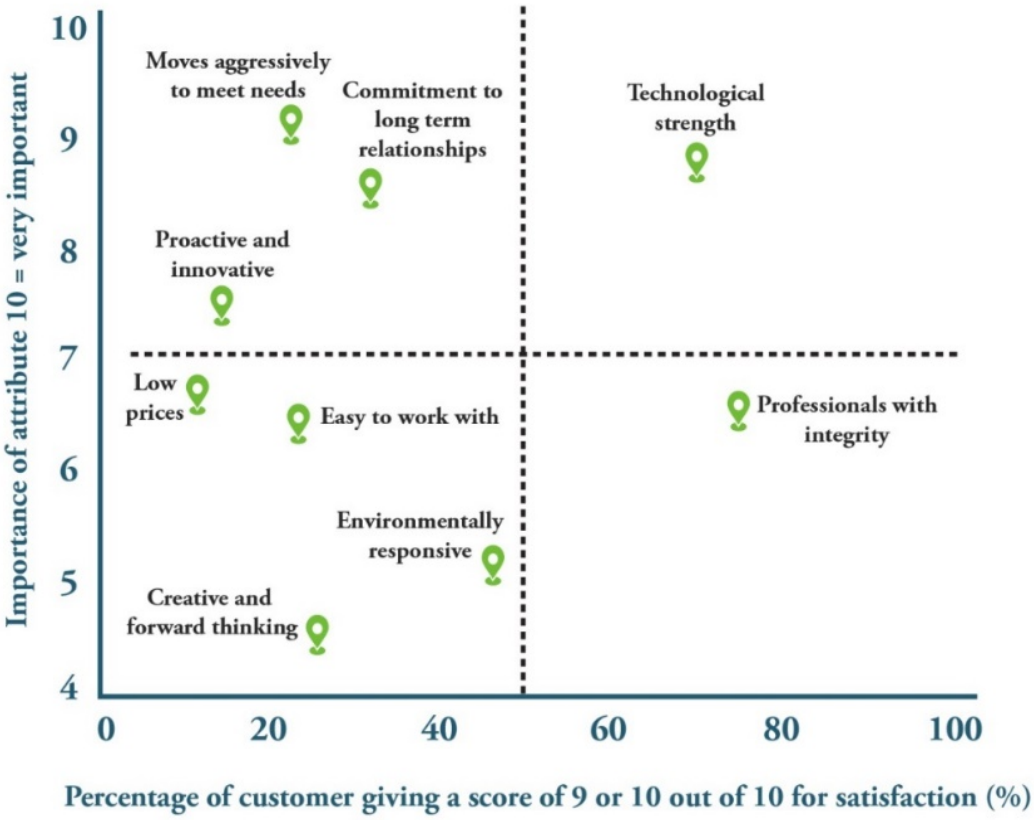
The purpose of delivering a project successfully is not only to furnish the intended work with the specified objectives but also either to match or exceed the expectations of all the stakeholders, especially the recipients. Torbica and Stroh (2001) were of the view that if end-users are satisfied and delighted, only then the project may be regarded as successful. During post-delivery tracking, some adjustments might be necessary to make it acceptable. Therefore, the quality of the product/services is of prime importance because it will be a guarantee for adaptation and long-term retention of customers and the end-users who are the major source of revenue generation. Quality and client satisfaction have a direct association, while material-related factors are significant (Zhao et al., 2018; Hussain et al., 2019). Quality assurance is imperative even after delivery. Project owners will be interested to know about the satisfaction of stakeholders, team members, and the end-users of a completed project (Asanad et al., 2018; Hussain et al., 2019; Gao et al., 2020). Furthermore, there may be some grey areas that may yet be blind and hidden and which will be highlighted through an evaluation at this stage.

The expectation and perception of customers are critical success criteria for both clients and other end-users. The prioritization of these parameters and participation during the execution of projects could result in the satisfaction of stakeholders in the post-delivery stage. Therefore, the evaluation of satisfaction can indicate the extent that the project achieved its objectives

(Terry et al., 2013; Rashvand & Abd Majid, 2014). The suggestion by Demirkesen and Ozorhon (2017) for the integration of knowledge, processes, staff, supply chain and change management with delivery performance, time, cost, quality, safety and client satisfaction can lead to success.

Synthesizing an attractive, versatile, good quality and sustainable project outcome, with potential for providing delight to the end-users, is usually the ultimate objective. Their satisfaction might motivate others, generating revenue, giving a return to the investors and justifying the initial investment. In this regard, a few authors (Dvir et al., 2003; Davis, 2014) suggested that project outcomes should be usable happily and achieve the hidden expectations, desires and wishes of end-users. A study by Hague and Hague (2021) revealed that almost 50% of customers appreciated characteristics like moving aggressively to meet needs, commitment to long-term relationships, proactive and innovative, low prices, easy to work with, environmentally responsive, and creative and forward-thinking. The other 50% appreciated technological strength and professionals with integrity (see Figure 2.9).

Figure 2.9. Opinions of customers regarding product characteristics



Source: Hauge & Hauge (2021)

Some other researchers have identified additional characteristics, such as price, product performance, brands, aesthetic design, services, marketing, financial performance, objective market acceptance, subjective market acceptance, and product-level measures. These factors positively correlated with an increase in market share (Huang et al., 2004; Setyaningrum et al., 2020). However, Nguyen and Chaudhuri (2019) favoured product innovation (rich-content communication, pre-announcement, and co-branding strengthen product innovativeness) which can generate more eWOM (electronic word-of-mouth) volume but surprisingly less positive sentiment. According to Sharabati et al. (2015), three factors – processing, content and usability – affect end-user satisfaction significantly. ISO 9000 certification makes products more attractive and increases the number of buyers (Wu & Wu, 2019).

Sole power lies with the consumers and customers for accepting or rejecting a product for use, thus deciding its fate for success or failure. Having an advanced idea of the expectation of end-users is not easy because it is highly variable and changes from case to case and person to person (Creusen et al., 2013; O'Cass & Sok, 2014). In this regard, the findings of Huang and Tsai (2013) signified that success predictors for products of Asian firms could be market orientation, marketing synergy, technological synergy, product advantage, product innovativeness, cross-functional integration, top management support, pre-development proficiency, technological proficiency, market potential, and technological turbulence. In general, low-technology products can perform better than high-technology products. Companies and businesses develop and launch new products to earn revenue and strengthen their organization as well meeting expenditures of various nature. However, it is not an easy job to take a risk and face fortunes of success or failure, but it is a requirement of running a business. Hence, managers, and stakeholders must use their full capabilities to produce an innovative quality product with a possible low price that can compete in the marketplace.

The network power of the firm could be able to sense and seize opportunities when a new product is being created and the factors impacting success are enterprise system, project management, marketing, market crises, customer's comments, and corporate social responsibility (Hanawalt & Rouse, 2010; Relich & Bzdyra, 2014; Song et al., 2018). Thus, the role of firms might prove extremely important during the manufacturing of products. Krikor (2011) expressed diagrammatically that product development and subsequent launching passes through eight stages: define, assess, fund, plan, develop, launch, manage, and market (see Figure 2.10). Hence, organizations should be aware of and concentrate on all these necessary

processes for guiding this process towards success (Yang, 2012; Creusen et al., 2013; Florén et al., 2018).

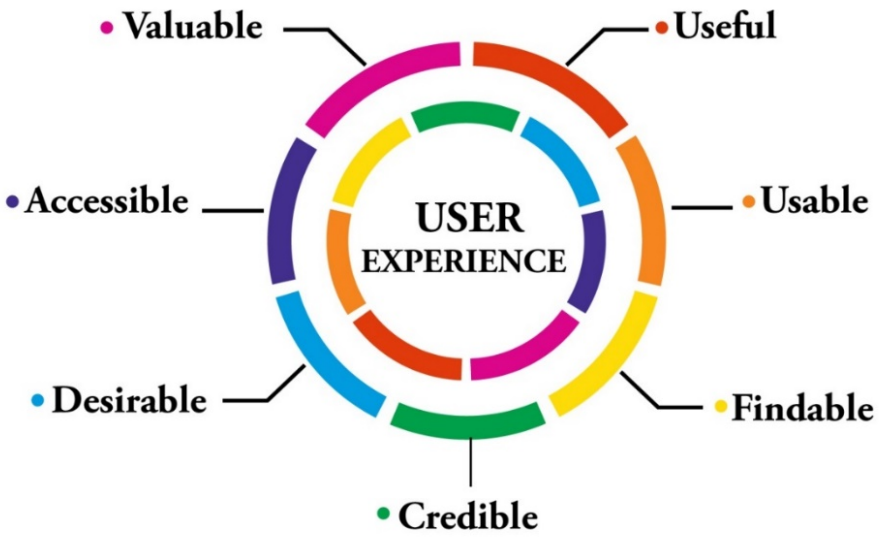
Figure 2.10. Cycle of developing and launching a new product

Adapted from Krikor (2011)

Projects are implemented to offer various services to communities, people and end-users by governments and business organizations. Högström et al. (2016) found that that public services' success depends on the creation of value that may ultimately attract users and customers. The strategic choices and prioritization of service requirements (service-oriented corporate culture, decentralized decision-making, and management commitment to services) affect the effectiveness and efficiency of service offerings, which can prove valuable for managers (Lexutt, 2020). However, the success of good service provision depends upon different factors: meeting customer needs, low facility investment costs, service competitiveness, support of the ecosystem, active marketing activities, absence of a business model (related to the partial success of services), and government policies that can also be responded to by customers and environmentalists (Beltagui et al., 2015). Um et al. (2020) found that many hotels are adopting sustainable service innovations and self-service technology (including robots, kiosks and chatbots for service automation) to gain competitive advantage. Almsalam (2016), Antons and Breidbach (2017) and Fuentes et al. (2019) identified that service innovation can be advanced through machine learning and addressing customer expectations as well as their satisfaction.

Costa (2020) expressed seven factors that impact user experiences for products and services (see Figure 2.11).

Figure 2.11. Experience of users for accepting a product or service



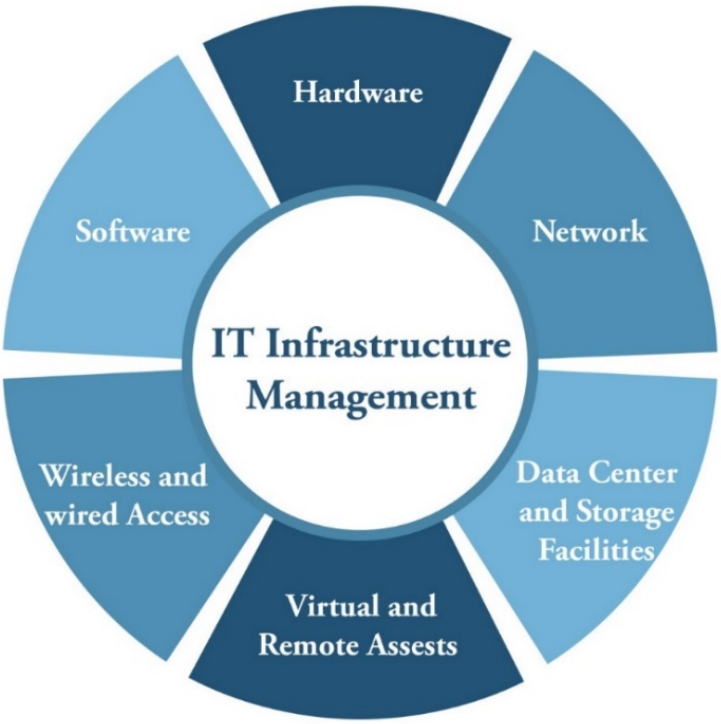
Adapted from Costa (2020)

Systems, such software, communication, information technology (IT), processes, and automated execution of programs and activities, are developed through various projects in the sectors of education, health, public offices, business services, travel and tourism, oil and energy industry, agriculture, air and space, forecasting, etc. Thus, programming and systematization are an integral part of almost all fields of life. For instance, Gao et al. (2020) claimed that enterprise resource planning (ERP) systems are necessary for better system quality, ease of use, and efficient logging and monitoring. A positive correlation between development processes (including user participation), human aspects (including user involvement) and system success was suggested by Abelein and Paech (2015), indicating the importance of customers and end-users in newly developed systems. System quality, service quality and trust of users are associated positively with user satisfaction (Vongsraluang & Bhatiasevi, 2017). Wang et al. (2019) suggested an e-commerce system model, the components of which are product quality, perceived price, perceived promotions, and eWOM. The systems for measuring the satisfaction of end-users have also been developed (Borjalilu et al., 2011; Hsu et al., 2011; Aggelidis & Chatzoglou, 2012; Kocherla, 2012; Akinnuwesi et al., 2013; Eichhorn & Tukel, 2018; Ershadi et al., 2020; Iriarte & Bayona, 2020).

Information and communication technology (ICT) has proven to be a game-changer technique in almost every field of life. The component factors of complex IT systems are external expertise and internal computer skills, also including ERP, whereas external expertise (an exogenous factor) and internal computer/IT knowledge (endogenous factors) are pertinent to enhance the success of the ERP systems in any organization (Ifinedo, 2011; Aggelidis & Chatzoglou, 2012). The health sector has benefitted from IT and software systems and many hospitals have implemented new hospital information systems for automation. The usability and the generalizability of end-user computing satisfaction systems have demonstrated a valid measure of computing satisfaction of end-users.

Travelling and tourism use many ICT processes and mechanisms for various routine activities (Moher et al., 2009; Laumer et al., 2017; Kurt, 2019; Iriarte & Bayona, 2020). Fang et al. (2017) emphasized that attraction and retention of the customer with travel applications are increasing due to the rising interest of people in traveling and tourism, and the design features (user interface attractiveness and privacy/security) and performance attributes (compatibility, ease of use and relative advantages). The integration of ICT and tourism has enabled more accessibility, visibility of information, availability of product variety and satisfaction of users (Bethapudi, 2013). IT infrastructure management supports six key roles as shown in Figure 2.12.

Figure 2.12. Major roles of IT in successful project outcomes



Adapted from Smartsheet (2021)

Programming and systematizing of the education sector have occurred in recent decades, especially for tertiary institutions, mobile library concepts, and e-learning (Nevo & Chan, 2007; Lin & Wang, 2012; Huang et al., 2015; Kurt, 2019; Zhang et al., 2020). Identification of a positive effect on behavioural intention by system quality, social influence, and facilitating conditions is an important consideration (Zhang et al., 2020).

The dissatisfaction of customers is highly detrimental to the project outcomes because unhappy customers mostly share their experience with others. The negative words may cause permanent damage to a brand name through word of mouth. It has been observed that acquiring a new customer is 6-7 times more difficult than retaining old customers (Xueming & Bhattacharya, 2006; Aigbavboa & Thwala, 2013; Vaezi, 2013; Torres, 2014; Zhao et al., 2018; Schiebler, 2019). Therefore, evaluation of satisfaction of customers is essential to understand how the outcomes of a project are behaving in the competitive market during the delivery phase, which is spread globally via online shopping. For testing, collection of data and yielding relevant information, certain assessing methods must be employed.

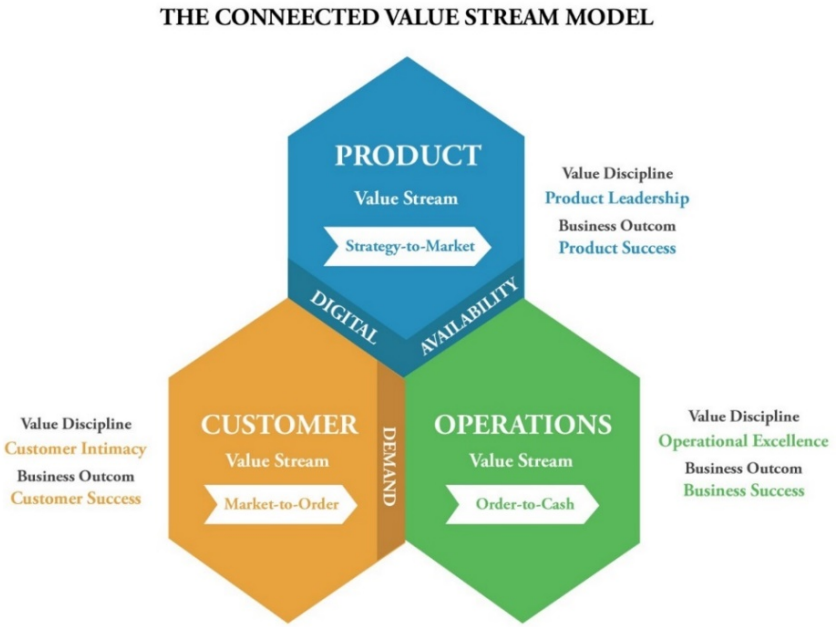
The satisfaction of consumers cannot be measured quantitatively as it is an abstract parameter. Hence, some indirect indicators have been employed for this purpose, like increasing demand in the market, buying more and more numbers/quantities of the product by end-users, and recommending or urging others for purchasing products and services. But these are very specific. The acceptance of the product by end-users increases if there are a less or no complaints, which is only possible if high quality is pursued (Slevin & Pinto, 1986; Pinto & Slevin, 1988; Pinto & Prescott, 1990; Belassi & Tukel, 1996; Wateridge, 1998; Müller and Turner, 2007; Turner & Zolin, 2012; Isac & Rusu, 2014; Machado et al., 2014; Nguyen, 2014; Haverila & Fehr, 2016; Wu et al., 2017). Questionnaires are the most used methodology for measuring customer satisfaction (Hoonakker et al., 2010).

In the case of construction projects, post occupancy evaluation studies are important for knowing whether building occupants are satisfied with the design, space and associated facilities. Mlecnik et al. (2012) included the summer comfort design and the quality of heating and ventilation systems (indoor air quality) as critical factors in their survey and found that these parameters are important to address and improve occupant satisfaction and acceptance of nearly zero-energy houses. The results of the investigations of Mustafa (2017) indicated an 88% correlation of building performance attributes to user satisfaction. Thus, the relevance of Post Occupancy Evaluation (POE) as a building performance measuring tool is very high.

Many stakeholders involve and contribute to large projects and the output of megaprojects is usually long-lasting. The interests and satisfaction of stakeholders is not only important but also necessary to manage, but gaps have been found between stakeholder expectations and actual fulfilment (Wang, 2010; Garcia & Adelakun, 2019) and change over time (Turner & Zolin, 2012; Zidane et al., 2015). Hence, identification of such indicators is required that can be used during anytime during the project lifecycle (Zoovu, 2017; Zarewa, 2019). Parameters like project planning, stakeholder engagement, stakeholder satisfaction, profitability, product specifications and efficiency could be useful but must be related but to initial design and include satisfaction dimensions, stakeholders, type of care, type of system, context and methodologies.

Project managers focus on issues such as customer relations, safety, schedule, cost, quality, productivity, finance, communication and collaboration, environment, and stakeholder satisfaction (Chan & Oppong, 2017; Ingle & Mahesh, 2020). Hans de Gier (2018) proposed a model (called the Connected Value Stream Model) to establish the relationship between the product of a project, the operational processes of the organization during marketing, and the customers (see Figure 2.13). The validity of all performance areas can be established by confirmatory factor analysis while information systems might prove helpful (Machado et al., 2016; Laumer et al., 2017; Iriarte & Bayona, 2020). Improper planning may lead to dissatisfaction of users and stakeholders (Rashvand & Abd Majid, 2014; Bughio et al., 2020).

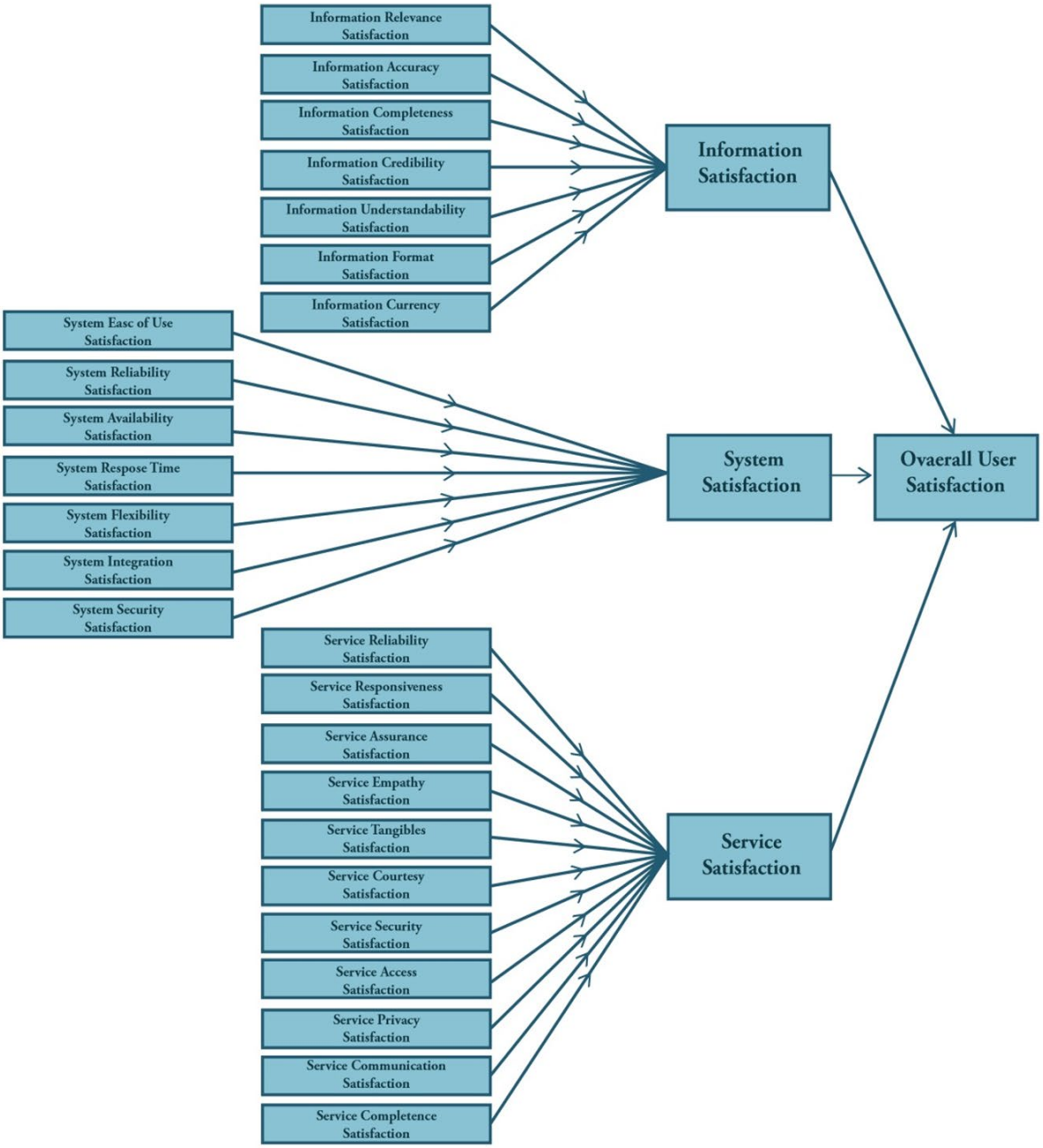
Figure 2.13. The Connected Value Steam Model



Adapted from Hans de Gier (2018)

The real value of any project lies in the satisfaction of the end-users and customers because they will be accepting outcomes of a project only after they are satisfied (Vaezi, 2013). He grouped attributes according to information, service and system satisfaction. These attributes cover almost all the aspects of customer satisfaction and are illustrated in Figure 2.14. Since then, Zoovu (2017) has proposed a list comprising of 15 factors, some of which are in common with Vaezi (2013). Both Almsalam (2014) and Williams et al. (2015) contend that customer satisfaction is affected positively by their expectation and perceived service quality.

Figure 2.14. Attributes associated with the satisfaction of customers and end-users



Adapted from Vaezi (2013)

Various scholars have indicated that the relationships between stakeholders and project managers can be useful for attaining satisfaction if the previous attributes are mutually addressed. Certain models and theories can prove useful in this regard. For example, the Actor-Network Theory (ANT) approach was found effective to analyze and engage stakeholders in any project, involving all the important critical attributes to measure project success among different stakeholder groups and making informed decisions (Isac & Rusu, 2014; Missonier & Loufrani-Fedida, 2014; Bragantini & Caccamese, 2015; Davis, 2018; Hussain et al., 2019). If multiple stakeholder groups interpret criteria according to their perceptions, failure of the project may occur (Doloi, 2011; Coventry, 2015; Damoah & Akwei, 2017; Ershadi, 2020). Any project not accepted by its customers and end-users cannot sustain itself in the market and earn revenue (Turner et al., 2009; Henoekl, 2015; Serrador & Turner, 2015; Williams et al., 2015; PMI, 2017a). The evaluation of success in the influence phase needs peculiar factors (Turner & Zolin, 2012; Henoekl, 2015; Serrador & Turner, 2015; Williams et al., 2015).

2.4.6.1 The mechanism and processes for satisfaction of consumers

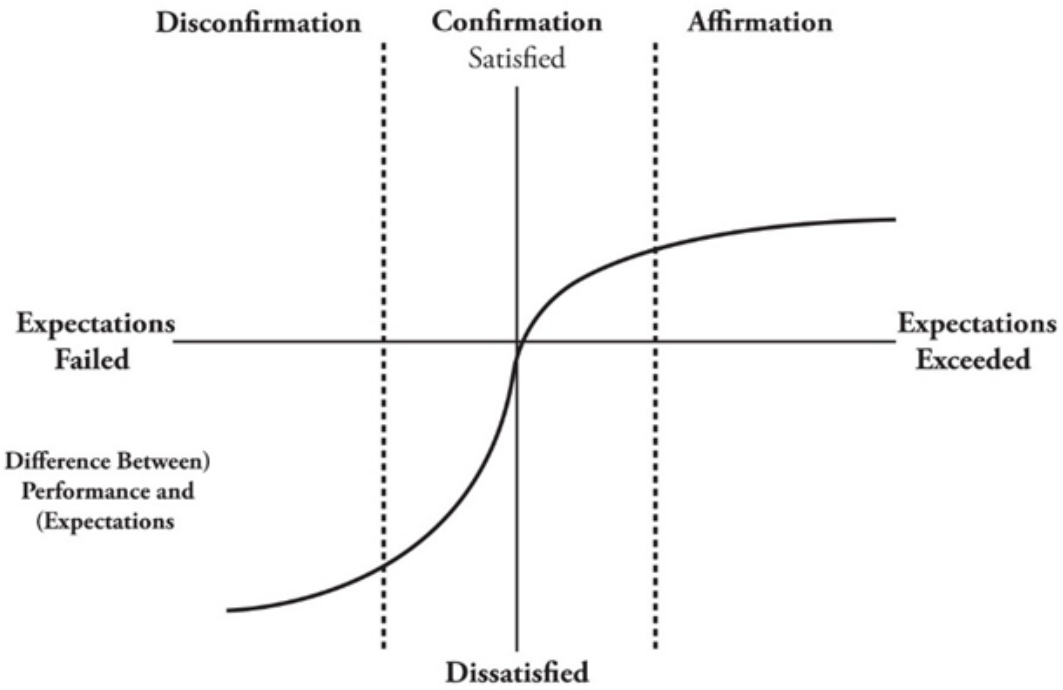
The satisfaction process is the comparison of the expected performance of the product or service and the real performance observed/assessed by the customer. Traditionally, this process has been narrated as a confirmation/disconfirmation process by researchers (Vavra, 1999). Normally, whenever customers are moved to purchase any product/system or avail/hire a service, they have some predetermined assumptions in mind that are associated with the product/service/system. When described in technical terms, according to Oliver (1980a), there are two presumptions: expectations (customers may form some forecasts before purchasing a product or service), and the consumption experience with the product or service (which produces a level of perceived quality that is influenced by expectations).

Vavra (1999) elaborated on the comparison of the utilization of a product after purchasing. His opinion is that if perceived performance is slightly less than expected performance, because of assimilation, perceived performance will slightly move upward for equalizing to the expectations. However, in case, perceived performance is substantially lower than the expectations, the shortfall in the perceived performance will be exaggerated.

Anderson and Sullivan (1993) elaborated on the concept of satisfaction diagrammatically (see Figure 2.15). They created three zones: disconfirmation, confirmation and affirmation; as well as a grading level of satisfaction: satisfied at the top and dissatisfied at the bottom (between are intermediate grades). Thus, the satisfaction level of any customer may fall anywhere in different

grades of this diagram and indicates the relationship between perceived quality and expectations as a function of satisfaction. Performance exceeding expectations means satisfaction will be increasing, but the falling of perceived performance might be causing shortfalls in expectations, consequence, and thereafter, into disconfirmation.

Figure 2.15. The mechanism of satisfaction



Adapted from Anderson & Sullivan (1993)

The quality of the product/services is of prime importance because it will be a guarantee for adaptation by the end-users who are the major source of revenue generation. The lack of project quality directly affects client satisfaction, while material-related factors were the most significant factors for making a project successful (Hussain et al., 2019). Zhao et al. (2018) also concluded that quality care is essential for the long-term retention of customers who are purchasing project outcomes. In their study, they found that clients are highly satisfied with their experiences of performance at the student-run clinics. Rashvand and Abd Majid (2014) urged consideration of expectation and perceptions of CSFs because these can derive and fulfill the satisfaction of both clients and customers. If these parameters are carefully kept under priority during the execution of projects, the clients will not remain devoid of their satisfaction and happiness during the post-delivery stage.

Terry et al. (2013) ascertained that sometimes special interests of various stakeholders can be affected positively or negatively by the implementation of an infrastructure project while their participation can solve this issue. The evaluation of the satisfaction of stakeholders can prove useful. Demirkesen & Ozorhon (2017) suggested that the integration of knowledge, processes, staff, supply chain, and changes; and management of performance, time, cost, quality, safety, and client satisfaction, make the project successful and can satisfy client and customers. Therefore, project managers must be asked to take care of these parameters for delivering a project successfully and satisfying the clients and end-users of their projects.

The satisfaction of stakeholders of a project is of primary importance in the evaluation of project success. For example, Garcia & Adelakun (2019) found that stakeholder satisfaction is often considered a key to the success of telemedicine systems. However, satisfaction evaluations vary in project designs and include satisfaction dimensions, stakeholders, type of care, type of system, context and methodologies. Project managers can play safe by acknowledging the stakeholder expectations and employ such strategies to curtail resulting impacts and maximize mutual benefits. The projects must enhance needs fulfilment and facilitate the evaluation of external stakeholder satisfaction (Chan & Oppong, 2017) like users of project outcomes.

Ingle & Mahesh (2020) suggested that stakeholder satisfaction is included in the ten areas for assessing project performance (customer relation, safety, schedule, cost, quality, productivity, finance, communication, collaboration, and environment). The validity of all performance areas was established by confirmatory factor analysis. The information systems might prove helpful to evaluate the satisfaction of users for which the quality of information should be very good (Laumer et al., 2017). Iriarte and Bayona (2020) claimed that time, budget, project management, system quality, user satisfaction, and economic value are the most important project success criteria. There are some soft attributes as well like involvement, support, communication and commitment. If the planning is improper, the users may remain unsatisfied and may not benefit from the project.

2.4.6.2 Using attributes for assessing consumers satisfaction

Gaps are present between stakeholder expectations and actual fulfilment because stakeholders are more concerned with reliability and safety dimensions during project implementation. Hence, a search of such parameters indicating usefulness for evaluation throughout the life cycle of a project is urgently required (Wang, 2010; Henoekl, 2015; Serrador & Turner, 2015; Williams et al., 2015; PMI, 2017a). Ivanka et al. (2009) explained that measurement of

satisfaction can be through subjective factors (e.g. customer needs and emotions) as well as objective factors (e.g. product and service features). The attributes are the characteristics of product, service, systems or assets of a project expressing their quality with respect to consumer satisfaction. Attribute satisfaction impacts overall satisfaction of consumers (Mittal et al., 1998).

According to Ting and Chen (2002), most researchers believed that the relationship between quality attributes and customer satisfaction is linear. However, attributes will be differing in various projects. For example, satisfaction attributes cannot be the same for a retail shop, hospital, an office, a hotel, or a mobile service shop. Yet, in general, these can be classified into attributes related to products, assets, services, and systems being generated by any project on its completion. Vaezi (2013) prepared separate lists for products, services, and systems of the project while reviewing past literature. These three lists for satisfaction attributes of consumers' satisfaction have been reframed and upgraded to include views from more recent literature.

2.4.6.3 Attributes relevant to product creation

The final target of the project is developing and synthesizing a successful and sustainable product (physical asset or artefact) that must give some satisfaction to end-users so that they are not only motivated to have that product in their possession but also, they suggest others for purchasing it. So, the product can generate revenue as well as remain alive in the customer market for a longer time until the company replaces by an improved product (Slevin & Pinto, 1986; Pinto & Slevin, 1988; Pinto & Prescott, 1988; Belassi & Tukel, 1996; Wateridge, 1998; Müller & Turner, 2007; Turner & Zolin, 2012; Wu et al., 2017). Dvir et al. (2003) and Davis (2014) claimed that the product should be usable happily and match the expected desires and wishes of the end-users.

The indicators of satisfaction are abstract parameters that are not measurable quantitatively but some indirect indicators like increasing demand in the market, inclining of end-users to buy more and more numbers/quantities of the product, and suggesting and motivating other users (friends, relatives and community members) for purchasing that product. The absence or lesser number of complaints also increases acceptance of the product. The satisfaction can only be found if the product was effectively delivered and matches end-users needs and wants.

As a first step of performance in the market, the product itself should possess good and innovative characteristics for impacting the users and attracting their intention to buy the

project. The study of Setyaningrum et al. (2020) utilized 304 products from the Indonesian market and suggested that six standardized factors of products that affect their success: (1) price, (2) product performance, (3) brands, (4) aesthetic design, (5) services and (6) marketing. These factors proved positively correlated to the increase in market share. However, Huang et al. (2004) enlisted only four such factors to support the marketing performance of products after investigations of 276 subject matter experts (SMEs) from the two most innovative industries: chemical and machinery industries of Australia. According to them, the four important factors for product success were financial performance, objective market acceptance, subjective market acceptance, and product-level measures. Whereas Nguyen and Chaudhuri (2019) emphasized that product innovation is highly important.

An analysis of millions of consumers regarding 345 automobile products indicated that more innovative products generate more eWOM (electronic word-of-mouth) volume but surprisingly less positive sentiment. However, the use of rich-content communication, pre-announcement, and co-branding strengthens product innovativeness. The certification of products plays a highly positive role in their attractiveness. Wu and Wu (2019), studying the performance of new products of 878 manufacturing and service firms, found that ISO 9000 certification helped to promote new product success, reduced the information asymmetry and increased the firm's buyers in the market. If the quality of local institutions is better, the local certification also creates a positive effect.

Consumers and customers are also highly important to accept and purchase a newly devised product for their use. The insights of the consumer are most important for new product success. The methods used to assess consumers' requirements are important and must be selected case to case (Creusen et al., 2013). According to O'Cass and Sok (2014), the exploitative product innovation and marketing is significantly better over separate left- and right-hand capabilities and creates distinct positional advantages to customers in the form of both differentiation and cost-efficiency. These positional advantages help to better explain the effects of exploratory and exploitative capabilities on new product market performance.

Huang and Tsai (2013) narrated that success predictors for products of Asian firms are market orientation, marketing synergy, technological synergy, product advantage, product innovativeness, cross-functional integration, top management support, pre-development proficiency, technological proficiency, market potential, and technological turbulence. The

major performance difference is the disparity between low-technology and high-technology products.

Management, managers, and capabilities of firms to produce a quality product that must be innovative, made available at an appropriate cost, be able to compete in the market, and sustain themselves until they are replaced by better products by the firm itself. Relich and Bzdyra (2014) identified the success factors in new product development and selecting a new product portfolio which are enterprise system, project management, marketing, and concerns of customer comments. The model of measuring the success of a product includes the indicators such as duration and cost of product development and net profit from a product, with the view that a firm's business network power to sense and seize opportunities and creating vital dynamic capabilities impacting the internal and external resources during. Such dynamic capability also plays an important role in the creation of a new product for the customers and consumers.

The green product is an innovation recently being added to the production industry. Song et al. (2018) studied 150 companies in China and found that corporate social responsibility can indirectly and positively affect new green product success and organizational identity. Therefore, managers must enhance their organizational sense of green identity and improve their organizational green adaptability resulting in their firm's sustainable development. The nature of the market and its position (deficit or surplus of a product) and leadership role are further important during the formation of a new and quality product.

Hanawalt and Rouse (2010) assessed factors associated with the automobile by seven experts and concluded that manufacturing is often born from financial and corporate responses to the market crisis. So, financial, and corporate responses in the market, coupled with leadership, are the central success factors. Thus, a firm’s role is extremely important during the manufacturing of products, and management should be aware of this fact and concentrate on bringing out quality and attractive products for the end-users for making it successful.

Table 2.2 summarizes the literature relevant to the attributes of a product. The list contains 37 different attributes, coded from A1 to A37. Each attribute includes the reasons for and significance of the attribute, and the source of their nomination divided into pre-2000 and post-2000 publication. The table is based on the work of Vaezi (2013), relating to information satisfaction for IT applications, updated with more recent publications.

Table 2.2. A summarized review of literature relevant to attributes of product creation

ID	Attributes	Reasons and significance	Suggesting authors before Year 2000	Suggesting authors Year 2000+
A1	Accessibility	The more easily approachable a product is, more satisfying it will be.	-	Chang & King, 2005
A2	Accuracy	The product of the project should be built so much accurately (meeting standards) so that the wish of consumers must be fulfilled without leaving any quench of satisfaction.	Ives et al., 1983; Doll & Tokzadeh, 1988; DeLone & McLean, 1992; Seddon,1997; Myers et al., 1997	Shaw et al., 2002; Wixom & Todd, 2005; Chiu et al., 2007; Halawi et al., 2007; Leclercq, 2007; Petter et al., 2008
A3	Aesthetic design	A good design will be attracting and satisfying users.	-	Setyaningrum et al., 2020
A4	Availability	According to the Contrast Theory, the satisfaction achieved from the product might be higher if the obtaining efforts are high, but it is against the marketing principle (making the assessment of the product easy). In fact, it will be varying from case to case.	Myers et al., 1997	Sedera et al., 2004
A5	Certification (Local or ISO)	A certification of the product will be attracting consumers and creating more trust which will be giving them more satisfaction.	-	Wu and Wu, 2019
A6	Comparability	A product comparable or better than those available in the market may be more satisfying the users.	-	Halawi et al., 2007
A7	Completeness	There should be no flaw and deficit in the structure and characteristics of a project to if the product is targeting higher satisfaction of the users.	Ives et al., 1983; DeLone & McLean, 1992	Shaw et al., 2002; DeLone & McLean, 2003; Wixom & Todd, 2005; Halawi et al., 2007; Chiu et al., 2007; Petter et al., 2008
A8	Conciseness	The product must not have any deficiency but at the same time sufficient-sized (neither too large nor short) for having a good satisfaction of consumers.	DeLone & McLean, 1992	Sedera et al., 2004; Halawi et al., 2007; Petter et al., 2008
A9	Confidence	If a product has already built a trust in the inner of users, they will be more satisfied using it.	Ives et al., 1983	-
A10	Content	More the content of the outcoming out of a project aligned with requirements of users, the more he will be satisfied with it.	Doll & Tokzadeh, 1988; Myers et al., 1997	Leclercq, 2007

A11	Contextual quality	The quality of a product with some reference (area, gender, age, education, or status of consumers, season, or time considerations) addresses specific satisfactions.	-	Chang & King, 2005
A12	Credibility/ Reliability	If the product is credible and its reliability is proved, the consumers will be trusting it and feel satisfaction in consuming it.	Ives et al., 1983; DeLone & McLean, 1992	Shaw et al., 2002; Chang & King, 2005; Halawi et al., 2007
A13	Currency	All products matching current requirements and not aging out in short span will be having more satisfaction of consumers.	Ives et al., 1983	Wixom & Todd, 2005; Halawi et al., 2007; Petter et al., 2008
A14	Flexibility	A product having more flexible properties to match varying conditions is preferable for the satisfaction of consumers.	-	Chang & King, 2005
A15	Format	A good format (shape, size, and general arrangement of constituting items of a product) can present a good look and satisfy the consumers of a product.	Doll & Tokzadeh,1988; DeLone & McLean, 1992	McKinny et al., 2002; Sedera et al., 2004; Wixom & Todd, 2005; Halawi et al., 2007; Leclercq, 2007
A16	Freedom from bias	If a product is of good quality without any bias, it will be satisfiable of consumers' needs.	DeLone & McLean, 1992	-
A17	Green product	An environment friendly product will be liked more by the users.	-	Song et al., 2018
A18	Importance	The product should be importance considerable by the customer for satisfying his wishes, needs or demands.	DeLone & McLean, 1992	-
A19	Innovative	An innovative product will be liked too much and will be giving more satisfaction.	-	O'Cass & Sok, 2014; Nguyen & Chaudhuri, 2019
A20	Intrinsic quality	A good natural quality of a product made up better characteristics satisfies a user.	-	Chang & King, 2005
A21	Marketable	Any product with good marketing potential will be satisfying the consumers.	-	Setyaningrum et al., 2020
A22	Matching expected desires	Any product matching the desires of users will certainly giving them satisfaction.	-	Dvir et al., 2003; Davis, 2014
A23	Meaningfulness	A quality product having a definite purpose can satisfy consumers.	-	Halawi et al., 2007
A24	Personalization	If all the consumers feel like that the product has been prepared for fulfilling their needs, they will be very happy and satisfied.	-	DeLone & McLean, 2003

A25	Precision	More the product is precise and accurate, more will it be satisfying the users.	Ives et al., 1983; DeLone & McLean, 1992	Shaw et al., 2002; Halawi et al., 2007; Leclercq, 2007
A26	Presentational quality	A packing and looking quality of products attracts customers for their satisfaction.	-	Chang & King, 2005
A27	Price	Comparative lesser price with good characteristics will be more satisfying the consumers.	-	Setyaningrum et al., 2020
A28	Quantitativeness	Products should be prepared to meet requirements of the whole customer community, any quantitative deficiency will be damaging its image.	DeLone & McLean, 1992	-
A29	Relevance	If the product's attributes are related to the demands and wishes of users, they will be more satisfied by using it.	Ives et al., 1983; DeLone & McLean, 1992; Seddon, 1997	McKinny et al., 2002; Shaw et al., 2002; DeLone & McLean, 2003; Sedera et al., 2004; Chiu et al., 2007, Halawi et al., 2007; Petter et al., 2008
A30	Scope	Only a product relevant to needs of a user might satisfy him.	DeLone & McLean, 1992	McKinny et al., 2002
A31	Security	When feeling secure to use a product, the customer satisfaction will be higher.	-	DeLone & McLean, 2003
A32	Sufficiency	The product should prove sufficient without any support from any other product to satisfy a particular need of the users.	DeLone & McLean, 1992	-
A33	Timeliness	The product should be available at the time of need for satisfaction of the consumers satisfaction.	Ives et al., 1983; Doll & Tokzadeh, 1988; DeLone & McLean, 1992; Seddon,1997	Shaw et al., 2002; Chiu et al., 2007; Leclercq, 2007; Halawi et al., 2007
A34	Understandability	If the features and using procedures of any product are not understandable easily by the users, they will be lesser satisfied with such an item.	DeLone & McLean, 1992	DeLone & McLean, 2003; Sedera et al., 2004; Wixom & Todd, 2005; Chiu et al., 2007; Halawi et al., 2007
A35	Usability	A product not usable by the users cannot bring any satisfaction to them.	-	Dvir et al., 2003; Sedera et al., 2004; Petter et al., 2008; Davis, 2014
A36	Usefulness	If a product is considered useful by a user for him, he will also be satisfied to use it.	-	McKinny et al., 2002; Chang & King, 2005
A37	Volume	Generally, big sized products are not liked by consumers because they are more satisfied with handy or small sized products.	Ives et al., 1983; DeLone & McLean, 1992	-

2.4.6.4 Attributes related to service provision

Various services are offered to communities by government entities to support local communities. The private sector is developing a comparatively lesser number of services in their business activities for sale and earning revenue in contrast to public services, which are mostly free or charging nominal fees. However, a few services in recent decades proved highly successful and profitable in the IT sector of private businesses; of these mobile and internet services can be quoted as examples. When the published literature on the provision of services through various projects in government and private sectors was reviewed, only five articles were found highly relevant to service success in the last decade (2010-2020). Högström et al. (2016) found that public services' success depends on the creation of value that may ultimately attract users and customers. The study involving 25 public services and 930 users indicated that strategic choices and prioritization between various service requirements affect both the effectiveness and efficiency of service offerings. Lexutt (2020) suggested that service-oriented corporate culture, decentralized decision-making and management commitment to services are the requirements for good services provided to communities.

The success of service projects, or the services that come out of a project, depends upon various factors. For instance, Park et al. (2017) identified the critical factors affecting market services in Korea. The success or failure factors were: (1) meeting customer needs, (2) low facility investment costs, (3) service competitiveness, (4) support of the ecosystem, (5) active marketing activities, (6) a business models, and (7) government policy affected service success or failure. Beltagui et al. (2015) were of the view that the customers perceive and can respond to the service employees and environment. These findings reinforce the traditional emphasis on a few dimensions: absorption, adventure, community, and spontaneity.

The hotel industry is one of the biggest and profitable industries of today's world because it is providing services of versatile nature to many travellers, visitors, and tourists while it is using innovative technologies during service provision. Um et al. (2020) studied this aspect and found many hotels are adopting sustainable service innovations (including robots, kiosks, and chatbots for service automation) to gain competitive advantages. The SST (self-service technology) showed more positive perceptions of customers' successful service situations in different hotels. The novelty and the need for interaction characteristics of customers showed significant differences in terms of service success or failure, respectively.

Table 2.3 summarizes the literature relevant to the attributes of a service. The list contains 38 different attributes, coded from B1 to B38. Each attribute includes the reasons for and significance of the attribute, and the source of their nomination divided into pre-2000 and post-2000 publication. The table is based on the work of Vaezi (2013) updated with more recent publications.

Table 2.3. A summarized review of literature relevant to attributes of service provision

ID	Attributes	Reasons and significance	Suggesting authors before Year 2000	Suggesting authors Year 2000+
B1	A good business model	If service provider company is dealing with the service as a good business model, the service become more efficient and effective to make the users happy.	-	Park et al., 2017
B2	Access	The more easily approachable a service is, more satisfying it will be.	Parasuraman et al., 1985	-
B3	Active marketing activities	If activities of a service are more visible in the market, it will be attracting the customers.	-	Park et al., 2017
B4	Assurance	The service capable of assuring of good characters will be liked by users and satisfying them greatly.	Ives et al., 1983; Kettinger & Lee, 1994; Pitt et al., 1995; Gefen & Keil, 1998; Myers et al., 1997	DeLone & McLean, 2003; Halawi et al., 2005; Petter et al., 2008
B5	Availability	According to the Contrast Theory, the satisfaction achieved from the product might be higher if the obtaining efforts are high, but it is against the marketing principle (making the assessment of the product easy). In fact, it will be varying from case to case.	Ives et al., 1983; Blanton et al, 1992	Parasuraman et al., 2005
B6	Communication	A good communication with the users of services will be satisfying them in a better way.	Ives et al., 1983; Parasuraman et al., 1985	-
B7	Compensation	Services providing compensation for the emerging complaints are liked by users.	-	Parasuraman et al., 2005
B8	Competence	The more competent a service is in satisfying the needs of users, more liked it will be.	Parasuraman et al., 1985	-
B9	Competitiveness	If a service has the potential to compete similar service providers, it will be favouring users to adopt it.	-	Park et al., 2017
B10	Cost/Benefit	A ratio with lower cost/benefit ratio will be liked by the users and satisfying them.	-	Chang & King, 2005

B11	Courtesy	The services sharing courtesy all times with the users are more successful.	Parasuraman et al., 1985	-
B12	Credibility	All services must prove them credible if to be accepted and adopted by the consumers satisfactorily.	Parasuraman et al., 1985	-
B13	Decentralized decision-making	Decentralized decision-making eases the users in solving their day-to-day problems which is liked by them.	-	Lexutt, 2020
B14	Effectiveness	An effective service will be only that which is meeting requirements of users in all respects without any complaints.	Blanton et al., 1992	-
B15	Efficiency	An efficient service taking lesser time to fulfill requirements of consumers can provide more satisfaction and they can stick to it.	-	Chang & King, 2005
B16	Empathy	If the service has the potential to understand the feelings of users, they will be more satisfied with it.	Kettinger & Lee, 1994; Pitt et al., 1995; Myers et al., 1997	DeLone & McLean, 2003; Chang & King, 2005; Halawi et al., 2005; Petter et al., 2008
B17	Facility low costs	A comparative low cost-service will be in favour of a good business because users will be paying less.	-	Park et al., 2017
B18	Flexibility	Any service having more flexible properties to match varying conditions and demands will be preferable for the satisfaction of consumers.	-	Ives et al., 1983; Chang & King, 2005
B19	Fulfilment	Services fulfilling needs of customers may prove satisfying them.	-	Parasuraman et al., 2005
B20	Importance	A service considering its users important while in response they are giving importance to service will be providing satisfaction to consumers.	Blanton et al., 1992	Aladwani, 2002
B21	Management commitment to services	The commitment of management to provide best services to customers makes these attractive.	-	Lexutt, 2020
B22	Meeting customer needs	A service addressing consumers' needs can be more successful.	-	Park et al., 2017
B23	Privacy	Any service protecting privacy of users may prove more successful.	-	Parasuraman et al., 2005
B24	Reliability	If the service is reliable, the consumers will be trusting it and feel satisfaction in consuming it.	Parasuraman et al., 1985; Kettinger & Lee, 1994; Pitt et al., 1995; Myers et al., 1997	DeLone & McLean, 2003; Chang & King, 2005; Halawi et al., 2005; Petter et al., 2008

B25	Responsiveness	Any service responding quickly will be satisfying the consumers.	Parasuraman et al., 1985; Kettinger & Lee, 1994; Pitt et al., 1995; Myers et al., 1997	DeLone & McLean, 2003; Chang & King, 2005; Parasuraman et al., 2005; Halawi et al., 2005; Petter et al., 2008
B26	Security	When feeling secure to use a service, the customer satisfaction will be higher.	Parasuraman et al., 1985	-
B27	Service-oriented corporate culture	If a corporate culture of an organization is good for providing services to users, the customers will like it and will be more satisfied after hiring this service.	-	Lexutt, 2020
B28	Staff attitude	A good and pleasing attitude of staff can create more satisfaction among users.	Ives et al., 1983	-
B29	Staff relationship	If the staff of a service develops good relationships with the customers, the user will be liking it.	Ives et al., 1983	Parasuraman et al., 2005
B30	Support of the ecosystem	Any service well fitting in the local ecosystem might be more successful.	-	Park et al., 2017
B31	Supporting	A service supporting the users to solve their problem in using will be giving good satisfaction to them.	-	Parasuraman et al., 2005; Chui et al., 2007
B32	Tangible	If the service seems to be real (not imaginary) the users will be trusting it and might be more satisfied.	Parasuraman et al., 1985; Kettinger & Lee, 1994; Pitt et al., 1995; Myers et al., 1997	DeLone & McLean, 2003; Halawi et al., 2005
B33	Technical competency	Any service having no technical deficiency will prove more satisfactory to users.	-	Petter et al., 2008
B34	Training	A service having in-built training component for the users will prove satisfactory to the users.	Igbaria & Nachman, 1997	Aladwani, 2002; Chang & King, 2005
B35	Understandability	If the features and using procedures of any service are not understandable easily by the users, they will be lesser satisfied with it.	Parasuraman et al., 1985	-
B36	Upgrading	The upgrading potential to adjust consumers' needs and changing occurring with the development of technology might be more satisfying.	Igbaria & Nachman, 1997	Aladwani, 2002
B37	Utilization	A service not usable by the users cannot bring any satisfaction to them.	Blanton et al., 1992	-
B38	Value	The created value of a service can attract users and they are satisfied as well after using it.	-	Högström et al., 2018

2.4.6.5 Attributes associated to system development

Various systems, especially software systems, are devised and developed through divergent projects to facilitate and automate practices in different sectors. The programmed systems are targeting utilization in special institutions (education, health, public services, etc.), business services (communication, IT, travel and tourism, oil and energy, etc.) and miscellaneous functions. Good planning is the first step for making a devised system successful. Gao et al. (2020) investigated that ERP (Enterprise Resource Planning) systems are successful for increasing system quality.

An overview by Abelein and Paech (2015) revealed positive correlations between aspects of development processes (including user participation), human aspects (including user involvement) and system success. Customers and end-users are highly important in any newly developed system. The success of a social commerce system is related significantly to its use and user satisfaction and can be measured in terms of organizational benefits. Three factors are associated positively with system use: system quality, service quality, and trust of users. These three factors lead to user satisfaction (Vongsraluang & Bhatiasevi, 2017). Wang et al. (2019) suggested components of a mobile application as product quality, perceived price, perceived promotions, and eWOM form an e-commerce system success model. It was found that perceived value influences eWOM more strongly than user satisfaction, while user satisfaction affects intention to reuse more strongly than perceived value.

Education is one of the biggest sectors which has been programmed and systematized in recent years, particularly university-level learning. For example, Lin and Wang (2012) found that learner behaviour is affected by internal factors of perceived usefulness/system satisfaction and the strategy adopted by the instructors. Hence, universities should invest in developing and maintaining their e-learning systems. They should also promote the system among lecturers and students. The mobile library is a concept that emerged in the early 2000s from which many students at remote places have benefitted. Huang et al. (2015) investigated this aspect of learning and found that mobile library service systems had a positive correlation with the usage status and student satisfaction. Thus, the system might help them for improving their work efficiency, like reducing time spent searching for books and the cost of obtaining electronic resources. The students were also willing to continue using the mobile library service system.

E-learning is the most modern concept of attaining education by the students of the present age after the introduction of IT. This aspect has also been evaluated by researchers. Kurt (2019)

found that the students' perception through e-learning systems employing the Information Systems Success Model is strengthening. Self-reported perception evaluation data of 144 students indicated that system quality significantly impacts system usage and user satisfaction, whereas information quality has a significant impact only on user satisfaction and may cause system success in turn. Zhang et al. (2020) identified that system quality, social influence, and facilitating conditions positively affect behavioural intention, while information quality has no impact on behavioural intention. Male college students were more susceptible to the impact of system quality and social influence.

IT has emerged as a transformational element in recent years and has helped nearly every field of endeavour. Ifinedo (2011) suggested that the essential factors for the success of complex IT systems are external expertise and internal computer skills, including ERP systems. The results of this research confirmed that external expertise (an exogenous factor) and internal computer/IT knowledge (endogenous factor) are pertinent to enhance the success of the ERP system of any organization.

Health is another sector that benefitted from the development of IT and software systems. Aggelidis and Chatzoglou (2012) reported that during the past decade, many hospitals have implemented new information systems for automation. The results of the study proved usability and the generalisability of end-user computing satisfaction systems. Robustness was a valid measure of computing satisfaction and a surrogate for system success in a variety of cultural and linguistic settings.

Travel and tourism have also benefitted from better systems. Fang et al. (2017) concluded that the engagement (attraction and retention) of the customer with mobile travel applications is highly important for travel-related companies. They demonstrated the effectiveness of application design and application performance attributes. It was noticed that two application design features (user interface attractiveness and privacy/security) and three application performance attributes (compatibility, ease of use, and relative advantages) were important drivers of users' engagement to mobile travel applications.

Certain attributes of system development with consumer satisfaction and delight are extremely important for good project management, marketing a project successfully and competitively, and earning good revenue by making the projects' outcomes acceptable to the end-users. In this regard, 15 factors were identified by Zoovu (2017): accessibility, navigation, page load speed

(online), language, memory, personalization, convenience, intuition, real-time processing, simplicity, logic, deliverability, choice, community, and moment of truth.

Table 2.4 summarizes the literature relevant to the attributes of a system. The list contains 44 different attributes, coded from C1 to C44. Each attribute includes the reasons for and significance of the attribute, and the source of their nomination divided into pre-2000 and post-2000 publication. The table is based on the work of Vaezi (2013) updated with more recent publications.

Table 2.4. A summarized review of literature relevant to attributes of system development

ID	Attributes	Reasons and significance	Suggesting authors before Year 2000	Suggesting authors Year 2000+
C1	Accessibility	The more easily approachable a system is, more satisfying it will be.	DeLone & McLean, 1992; Myers et al., 1997	McKinny et al. 2002; Wixom & Todd, 2005; Halawi et al., 2007;
C2	Accuracy	The system of the project should be built so much accurately (meeting standards) so that the requirements of users must be fulfilled without leaving any quench of satisfaction.	-	Sedera et al., 2004
C3	Adaptability	The system may be adaptable under various conditions.	-	DeLone & McLean, 2003
C4	Availability	According to the contrast theory, the satisfaction achieved from the product might be higher if the obtaining efforts are high, but it is against the marketing principle (making the assessment of the product easy). In fact, it will be varying from case to case.	Myers et al., 1997	McKinny et al. 2002; DeLone & McLean, 2003; Chiu et al., 2007
C5	Benefit	The users should see the clear benefits from the system	-	Zoovu, 2017
C6	Choice	There should be possibility of personal choices within the mainstream.	-	Zoovu, 2017
C7	Consistency	The system should be consistent in results with little variability.	Seddon, 1997	-
C8	Convenience of Decision	The system should help to reach at some decision regarding the results.	-	Zoovu, 2017
C9	Currency	All systems matching current requirements and not aging out in short span will be having more satisfaction of consumers.	-	Kositanurit et al., 2006

C10	Customer expectation	The system must meet reasonable expectation of the customer.	-	Almsalam, 2014
C11	Customization	Customization is a popular technique which should be available in the system.	-	Sedera et al., 2004
C12	Deliverability	The delivering of the system must be reasonable.	-	Zoovu, 2017
C13	Documentation	The results of the system may be documented.	Seddon, 1997	Kositanurit et al., 2006
C14	Ease of learning	The use and home maintenance should be easy to learn just by reading guidebook.	DeLone & McLean, 1992	Sedera et al., 2004; Petter et al., 2008
C15	Ease of use	The system should not be too complicated so that user cannot use it easily.	Doll & Torkzadeh, 1988; Seddon, 1997; DeLone & McLean, 1992	Sedera et al., 2004; Chang & King, 2005; Kositanurit et al., 2006; Leclercq, 2007; Chiu et al., 2007; Petter et al., 2008
C16	Flexibility	A more flexible system matching varying conditions and needs is preferable for the satisfaction of consumers.	Ives et al., 1983; DeLone & McLean, 1992; Myers et al., 1997;	Sedera et al., 2004; Wixom & Todd, 2005; Halawi et al., 2007; Leclercq, 2007; Petter et al., 2008
C17	Functionality	The functioning and operation of the system should be good.	-	Kositanurit et al., 2006; Leclercq, 2007
C18	Generalizability	The possibility should be there to generalize the system.	-	DeLone & McLean, 2003; Aggelidis & Chatzoglou, 2012
C19	Integration	The system can be integrated with other systems.	DeLone & McLean, 1992	Sedera et al., 2004; Wixom & Todd, 2005; Halawi et al., 2007
C20	Interactivity	The activities within the system should not be complicated and too long.	-	McKinny et al., 2002: Palmer et al., 2006
C21	Intuitiveness	An apparent observation of the system should give a good message.	-	Petter et al., 2008
C22	Investment utility	The utility of the system must justify the investment.	DeLone & McLean, 1992	-
C23	Logical	The working and results of the system must be logical.	-	Zoovu, 2017
C24	Memory	The system must possess good memory.	-	Zoovu, 2017
C25	Navigation	A system may be able to navigate accurately if required for its operation.	-	McKinny et al. 2002; Zoovu, 2017
C26	Page loading speed (online)	The page loading speed of the system should be good.	-	Zoovu, 2017
C27	Perceived quality	The quality of the system must meet certain standards.	-	Almsalam, 2014; Vongsraluang & Bhatiasevi, 2017
C28	Perceived value	The system should demonstrate good perceived value.	-	Wang et al., 2019
C29	Personalization	The system should be capable of personalization.	-	Zoovu, 2017

C30	Price	The price of the system should be reasonable.	-	Wang et al., 2019
C31	Privacy	The privacy of the user must be protected by the system.	-	Fang et al., 2017
C32	Real-Time	The system should observe and work in the real-time.	-	Zoovu, 2017
C33	Reliability	A system with proven reliability is more attractive by the consumers which will be increasing their trust and they feel satisfaction in using it.	Myers et al., 1997; DeLone & McLean, 1992	Chiu et al., 2007; Petter et al., 2008; Wixom & Todd, 2005; Chang & King, 2005; Kositanurit et al., 2006; DeLone & McLean, 2003
C34	Resource utilization	The required resources for operation of the system should not be too many and much costly.	DeLone & McLean, 1992	-
C35	Response time	All the customers like lesser response time.	DeLone & McLean, 1992; Myers et al., 1997	DeLone & McLean, 2003; Chang & King, 2005; Kositanurit et al., 2006; Halawi et al., 2007; Chiu et al., 2007; Petter et al., 2008;
C36	Responsiveness	Any system responding quickly to work with will be satisfying the consumers.	-	Palmer et al., 2006
C37	Security	The system should be secure from external people.	-	Fang et al., 2017
C38	Simplicity	The system should be simple to operate.	-	Zoovu, 2017
C39	Sophistication	The system should not be too complicated to operate.	DeLone & McLean, 1992	Petter et al., 2008
C40	Timeliness	The system working at the time of need for satisfaction of the consumers becomes attractive for them.	-	Halawi et al., 2007
C41	Trust of users	The system should meet trust of the users.	-	Vongsraluang & Bhatiasevi, 2017
C42	Usability	A system not easily usable by the users cannot bring any satisfaction to them.	-	McKinny et al. 2002
C43	Usefulness	If a system is considered useful by a user for him, he will be satisfied to use it.	DeLone & McLean, 1992; Myers et al., 1997	Halawi et al., 2007
C44	User requirement	The system must address a requirement of the user.	DeLone & McLean, 1992	Sedera et al., 2004; Halawi et al., 2007

2.4.6.6 Attributes related to post occupation evaluation

When a building is constructed and then occupied by owners/employees, the need for evaluation of that building is necessary to learn about their satisfaction. This process is called post occupancy evaluation (POE) and it is a specific instance of satisfaction measurement. Attributes must be selected for the evaluation to attain feedback about design success as well as the removal of any deficiencies or necessary improvement of futures (HMC Architects, 2020). The

POE can generate recommendations for all relevant stakeholders (Oseland, 2007). Abisuga et al. (2020) identified facility performance attributes belonging to four dimensions: ambient requirements (including daylight, exterior view, lighting, thermal comfort, acoustic quality, indoor air quality, environmental simulation, innovation, and environmental quality), spatial requirements (including movement within space, seating density, furnishing layout, interior visibility, working surface, furniture comfort, access to adjacent informal learning area, physical storage, privacy and quiet, transparency, and future flexibility), technology requirements (including electrical power, network connectivity, visual display, sound amplification, and desktop computer/printer), and building support and services requirements (including cleanliness, maintenance services, air conditioning services, entrance and emergency access, quality of elevation/stairways, wayfinding/directories, conveniences units, water supply/kitchenette, fire safety, security services, and training and development).

The POE study by Mlecnik et al. (2012) highlighted attributes for end-user satisfaction in zero-energy dwellings are summer comfort design and the quality of heating and ventilation systems (indoor air quality) for the acceptance of houses in the Netherlands. Liang et al. (2017) pointed out that for POE, major factors like economical, building and environmental information, sociocultural, technological, and policy and standards must be considered. Hassanain et al. (2020) proposed three main categories of performance elements that were relevant for higher education facilities in construction projects: technical, functional and behavioural. Under each element, there are numerous specific attributes. Bughio et al. (2020) found that users are dissatisfied with existing hot and humid indoor environment conditions caused by interactions of local outdoor climate conditions, the building's architecture, and inadequate ventilation within the building because the project planning was inappropriate to implement a successful project. Atkinson (1988) found cleanliness, security, value for money, and courtesy of staff that can determine the satisfaction of the customer. Another investigation by Knutson (1988) revealed the room's cleanliness and comfort, the convenience of location, prompt service, safety and security, and friendliness of employees as important factors appealing to the customers (Knutson, 1988).

POE attributes are complex and numerous. Table 2.5 summarizes some of the main items gleaned from the literature. These have been grouped and coded from D1 to D26.

Table 2.5. A summarized review of literature relevant to attributes of post occupancy evaluation

ID	Attributes	Reasons and significance	Suggesting authors before Year 2000	Suggesting authors Year 2000+
D1	Adaptability	Ability to accommodate change.	-	Abisuga et al., 2020; Li et al., 2018
D2	Aesthetics and image	Harmonious, neutral, iconic, powerful, bland.	-	Abisuga et al., 2020; Li et al., 2018
D3	Ambient requirements	Daylight, exterior view, lighting, thermal comfort, indoor air quality, environmental simulation, innovation, and environmental quality.	-	Abisuga et al., 2020; Hassanain et al., 2020
D4	Behaviour of employees	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-
D5	Behavioural Requirements	-	-	Hassanain et al., 2020; Liang et al., 2017
D6	Building support and services requirements	Cleanliness, maintenance services, air conditioning services, entrance access and emergency, quality elevation/stairways, wayfinding/directories, convenience units, water supply/ kitchenette, fire safety, security services, training, and development.	-	Abisuga et al., 2020; Hassanain et al., 2020
D7	Cleanliness	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-
D8	Courtesy of staff	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-
D9	Durability	Robustness, need for routine extensive maintenance, incidence of "downtime" for unplanned technical reasons.	-	Abisuga et al., 2020
D10	Economical	-	-	Liang et al., 2017
D11	Environmental	Temperature, air, humidity, odour, light, and noise.	-	Baird et al., 2014
D12	Functional Requirements	-	-	Hassanain et al., 2020; Liang et al., 2017
D13	Operational	Space in a building, space at a desk, furniture, cleaning, availability of rooms in the hotel, storage arrangements, and facilities.	-	Baird et al., 2014
D14	Personal Control	Heating, cooling, ventilation, lighting, and noise.	-	Baird et al., 2014
D15	Policy and Standards	-	-	Liang et al., 2017
D16	Prompt service	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-
D17	Room quality	-	-	Choi & Chu, 2001
D18	Satisfaction	Design, needs, comfort, health, and overall conditions.	-	Baird et al., 2014

D19	Security	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-
D20	Serviceability	Cleaning, routine maintenance, security, essential changes.	-	Abisuga et al., 2020
D21	Spatial requirements	Movement within space, seating density, furnishing layout, interior visibility, working surface, furniture comfort, physical storage, privacy and quiet, transparency, and future flexibility.	-	Abisuga et al., 2020; Hassanain et al., 2020
D22	Staff quality	-	-	Choi & Chu, 2001
D23	Technical Requirements	-	Seddon, 1997	Hassanain et al., 2020; Liang et al., 2017
D24	Technology requirements	Electrical power, network connectivity, visual display, and sound amplification.	-	Abisuga et al., 2020; Hassanain et al., 2020
D25	Timeliness	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-
D26	Value	-	Akan, 1995; Atkinson, 1988; Knutson, 1988	-

Source: various authors

2.5 Summary

This chapter covered the salient review of literature relevant to project management, project success, and the satisfaction of customers and consumers. Topics dealt with included definitions, metrics, models, theories, antecedents and attributes derived from a review of past literature. Thus, clues were identified to inform the measurement of end-user delight that is manifest during the project influence (post-implementation) phase of projects.

User satisfaction is highly important for accepting any outcome of projects by end-users. User satisfaction indicators included fulfilling their satisfaction, loyalty, requirements, specification of the product/service, benefits, usability, a service easy to operate, price benefit, features, competitive advantage, technological innovation, and upgrades over time (Shenhar & Dvir, 2007; Turner, 2009; Turner & Zolin, 2012). Almsalam (2014) identified the relationship between the two most important antecedents of customer satisfaction: customer expectation and perceived service quality, where data from 250 customers in the banking sector indicated that customer expectation and perceived service quality indeed have a positive effect on customer satisfaction.

Efforts have been made to keep the literature review as relevant as possible to end-user delight. The use of a systematic literature review helped in this regard. Mutually agreed and uniform definitions, understandings and elaborations of terms and concepts related to project success, critical success factors, success criteria, and end-user satisfaction are deficient in the published literature (Baccarini, 1999; Lim & Mohamed, 1999; Frese & Sauter, 2003; Shenhar & Dvir, 2007; Kerzner, 2011; McLeod et al., 2012; Turner & Zolin, 2012; Suprapto et al., 2015; Damoah, & Akwei, 2017). A clear fact noticed is the difference of opinion and thoughts regarding the explanation of concepts (Hough & Morris, 1987; Schwalbe, 2004; Cavarec, 2012), but these can be quite normal in social sciences in contrast to natural sciences. The reasons are dissimilarities in specified conditions (temporal and spatial), nature of projects and study specifications/limitations, size and complexity of projects, interactions of stakeholders, objectives and targets, time frames, priorities, limited budget allocations, available facilities, and experience and qualifications of project teams (Turner & Zolin, 2012). These issues are highly variable in the research studies reported in this chapter.

During this critical review of the literature, the following gaps in past research and publications were identified with particular concern to the present study:

1. Project success evaluations, when conducted, were done so after completion of projects.
2. Post-delivery satisfaction of projects was least assessed. The evaluation of project management success using simple cost, time and scope metrics was most common.
3. The perceptions of customers and end-users were neither considered very important nor often included in past studies. They provide an important opportunity to feedback to future design activity, with financial, social, ethical and environmental consequences offering a means of comparison.
4. End-user satisfaction is generally considered a function of the analysis of needs and wants.
5. A list of generic factors related to the satisfaction and delight of end-users for product creation, service provision, system development and post occupancy evaluation need to be rationalized into a generic survey instrument for measuring end-user delight.
6. Any tool to measure end-user satisfaction needs to be tested for validity and reliability.

The next chapter will develop a conceptual framework to support the generic measurement of end-user satisfaction and describe the method to collect primary data.

CHAPTER 3: RESEARCH METHODS

3.1 Purpose of this chapter

The purpose of this chapter is to address the knowledge gaps identified in Chapter 2 and chart a way forward for measuring end-user delight generically. No research has been uncovered to date suggesting that generic measurement has been achieved. Indeed, anecdotal evidence is that a generic list of satisfaction attributes for any project type is not possible.

An innovative conceptual framework is proposed and tested to calculate end-user satisfaction (EUS) based on wants (financial and social) and needs (ethical and environmental), recognizing that the latter is essential for our long-term well-being. These can be interpreted as desirable, adaptable, practicable and serviceable, respectively.

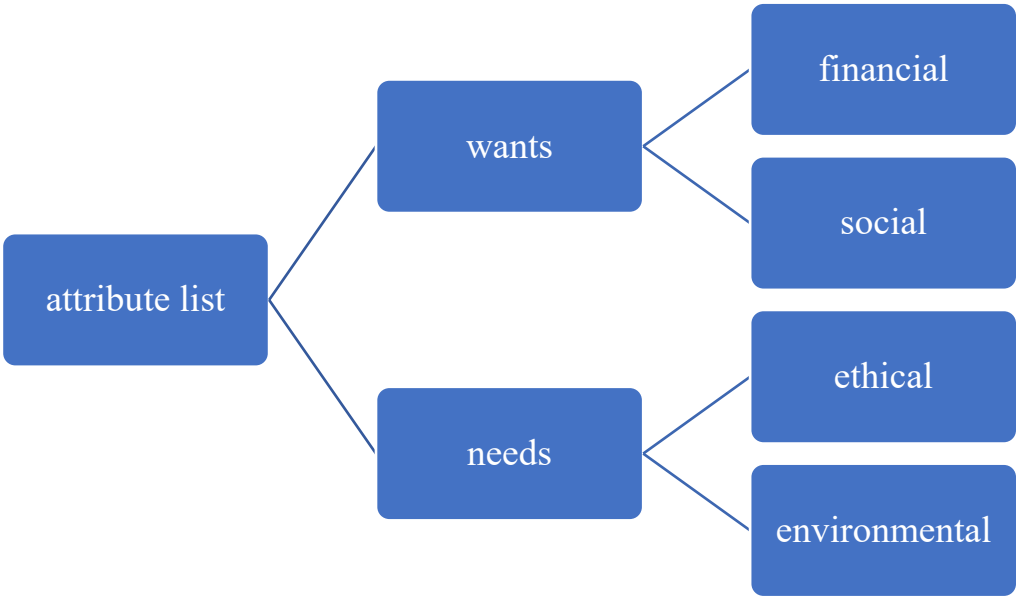
From a research design perspective, the case study method using project types covering product creation, service provision, system development and post occupancy evaluation is selected as the means to collect primary data. A Qualtrics® online survey has been prepared for this purpose. Ethics approval was achieved for administration of a two-step process for gathering end-user responses related to the identified case studies. The identity of the end-users is to remain anonymous.

3.2 Attribute consolidation

The attributes assembled from the literature are summarized in Tables 2.2 to 2.5 in the previous chapter. These correspond to different project types, identified as product creation, service provision, system development, and post occupancy evaluation, respectively. A total of 145 attributes are listed within these four groups. It is recognized that this list may not be exhaustive. Nevertheless, it provides a useful means of thinking about what may be missing.

The objective is to arrive at a smaller list of attributes that are generic (i.e. can be applied to any project type) and divided into needs and wants. Needs are defined as essential attributes whereas wants are defined as desirable attributes. Using the consequences of financial, social, ethical and environmental, Figure 3.1 sets out the adopted structure for attribute consolidation.

Figure 3.1. Generic attribute structure

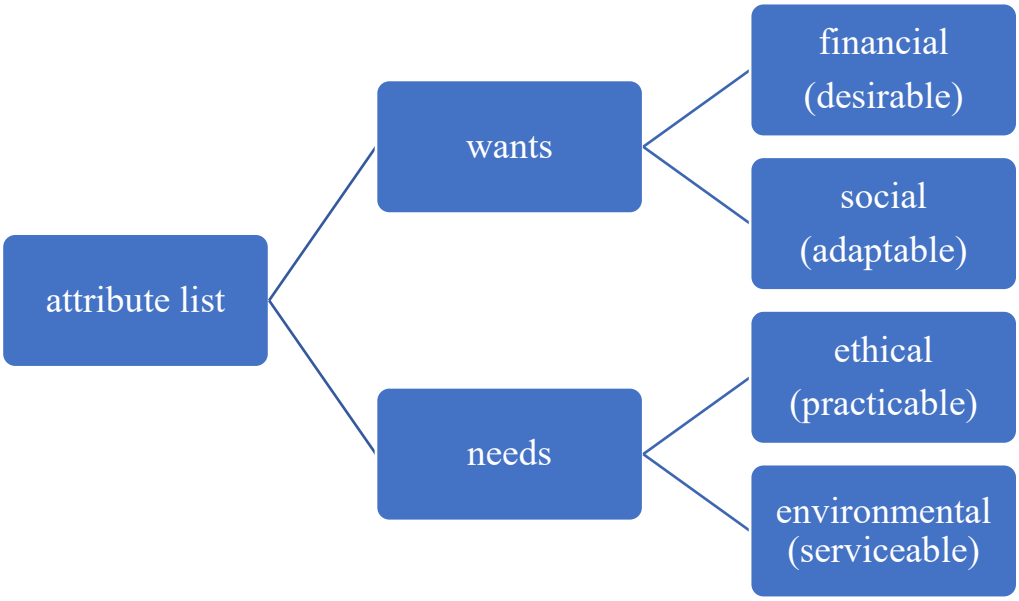


The rationale for this structure is that projects often involve a juxtaposition between progress and conservation, and good outcomes are not just one or the other but rather a balance between these opposing goals. Progress is generally considered as a means for improving our living standards (financial prosperity) and quality of life (lifestyle and well-being), while conservation is about fairness (intragenerational and intergenerational equity) and protecting our eco-habitat (natural environment). In this context, progress is the motivation for change and conservation is the baseline requirement. Therefore, 'wants' align with progress (financial and social) and 'needs' align with conservation (ethical and environmental).

3.2.1 Brainstorming exercise

The supervisory team met to review and allocate attributes into the four categories of financial, social, ethical and environmental. The meeting was run like a brainstorming session, listening to ideas and thinking about what options exist to best measure end-user delight. Measurement was thought to be facilitated by simple labels that end-users could understand without much technical knowledge. The team decided to rename the four categories as shown in Figure 3.2.

Figure 3.2. Revised attribute structure



Brainstorming is a useful exercise in developing creative answers and ideas and generating solutions in a short time (Osborn, 1957; Rawlinson, 1981). Brainstorming has been used to enlist end-user's requirements during the project design stage (Sengonzi et al., 2005), identify sets of indicators (Miceli et al., 2007) and develop framework dimensions (Pelzer, 2017).

Desirable was held to mean the attractiveness or value of the project. Adaptable means its flexibility in being adopted in various ways by different people. Practicable means whether the project is fit for purpose and safe to use. Serviceable means its enduring qualities and wise resource consumption and upkeep requirements. The 145 attributes were written on separate cards and put into an open container. Cards were drawn randomly, one at the time, discussed by the team and agreement reached on which category they belong to. There was a fifth category called 'trash can', but it was not needed. Once all the cards were allocated, they were then grouped, duplicates were removed, and similar attributes were merged to identify a 'top ten' list for each category. Figure 3.3 summarizes this attribute allocation outcome.

Figure 3.3. Attribute allocation

145	Desirable (41)				Adaptable (20)			
Wants (61)	A3	A6	A10	A11	A13	A14	A19	A24
	A15	A20	A21	A22	B18	B33	B36	C3
	A23	A25	A26	A27	C6	C9	C11	C12
	A37	B1	B3	B4	C16	C18	C23	C26
	B6	B7	B8	B9	C29	D1	D23	D24
	B10	B11	B16	B17				
	B19	B20	B28	B29				
	B32	B38	C5	C19				
	C22	C27	C28	C39				
	D2	D9	D10	D17				
	D26							
	Practicable (62)				**Serviceable (22)**			
Needs (84)	A2	A4	A5	A7	A1	A12	A17	B2
	A8	A9	A16	A18	B15	B21	B24	B27
	A28	A29	A30	A31	B30	C1	C33	C34
	A32	A33	A34	A35	D3	D4	D5	D6
	A36	B5	B12	B13	D7	D8	D13	D14
	B14	B22	B23	B25	D20	D22		
	B26	B31	B34	B35				
	B37	C2	C4	C7				
	C8	C10	C13	C14				
	C15	C17	C20	C21				
	C24	C25	C30	C31				
	C32	C35	C36	C37				
	C38	C40	C41	C42				
	C43	C44	D12	D12				
	D15	D16	D18	D19				
	D21	D25						

Note: 'Project creation' is coded A, 'service provision' is coded B, 'system development' is coded C, and 'post occupancy evaluation' is coded D. Each attribute is then numbered consecutively.

3.2.2 Success criteria (top 10 attributes)

After identification of the top ten in each category, they were renamed to better reflect their intake and to ensure applicability to any type of project as much as possible. The final list is shown in Table 3.1. Short names are used for each attribute to be easier for people filling out a survey form to interpret. Each attribute is expressed as a notion and a question mark (attribute?). The category headings represent the critical success factors for end-user satisfaction (EUS) and the attributes represent the various success criteria for their measurement. To allow for other factors, two user-defined attributes are provided for each category.

Table 3.1. Final attribute list (40 generic + 8 user-defined)

Desirable (10 + 2)
Nice to look at?
High quality?
Profitable?
Well-designed?
Valuable?
Prestigious?
Durable?
Popular?
Joyful?
Unique?
User-defined: _____?
User-defined: _____?

Adaptable (10 + 2)
Versatile?
Easily modified?
Able to be customized?
Multi-use?
Transportable?
Better with age?
Modular?
Scalable?
Technically clever?
Timeless?
User-defined: _____?
User-defined: _____?

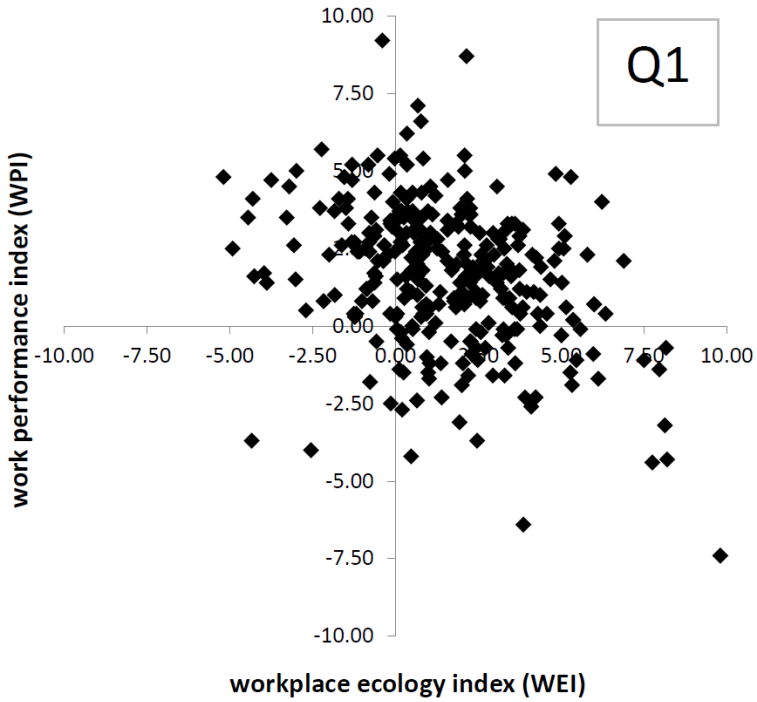
Practicable (10 + 2)
Functional?
Appropriate?
Robust?
Safe?
Healthy?
Problem-solving?
Easy to use?
Affordable?
Comfortable?
Ethical?
User-defined: _____?
User-defined: _____?

Serviceable (10 + 2)
Low maintenance?
Easily cleaned?
Recyclable?
Non-toxic?
Repairable?
Energy efficient?
Reliable?
Accessible?
Regenerative?
Habitat-safe?
User-defined: _____?
User-defined: _____?

3.3 Conceptual framework

The conceptual framework for calculation of EUS is drawn from research on workplace ecology by Langston and Al-khawaja (2018). They compared workplace ecology index (WEI), a form of satisfaction, with workplace performance index (WPI), a form of implementation. Each office worker responded to a set of questions about job satisfaction (organization), comfort (space), productivity (technology) and job complexity (expectation) to determine WEI and WPI. These values were plotted as a four-quadrant diagram using a scale of -10 to +10. The number of values that lie in the upper right-hand quadrant (Q1) compared to total responses is used to measure the success of workplace change. The change is deemed successful if at least 75% of respondents are plotted in Q1. Al-khawaja (2015) found that across four Australian case studies, 53.83% of respondents had a positive view of the change process. This was deemed to be a measure of project success (see Figure 3.4).

Figure 3.4. Workplace ecology model



Source: Al-khawaja (2015)

3.3.1 Four-quadrant diagram

A similar process is used to measure EUS. WEI is replaced with wants (mean of desirable and adaptable) and WPI is replaced with needs (mean of practicable and serviceable).

3.3.2 Opinion and relevance

Each critical success factor is assessed by averaging the scores across its 12 potential success criteria. For each criterion, respondents provide their personal opinion (Question A) and personal relevance (Question B) using a five-point Likert scale, as shown in Tables 3.2 and 3.3.

Table 3.2. Project criterion opinion

Question A:	*strongly disagree*	*disagree*	*no opinion*	*agree*	*strongly agree*
Opinion of project criterion	-2	-1	0	1	2

Table 3.3. Project criterion relevance

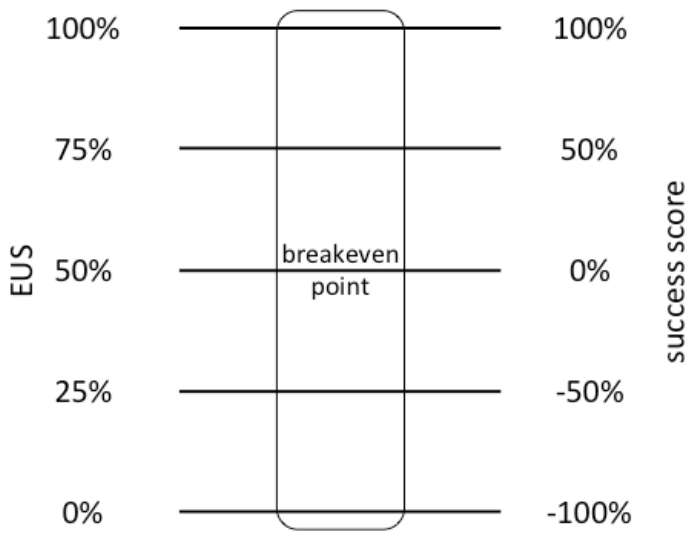
Question B:	*not important*	*slightly un-important*	*neutral*	*slightly important*	*very important*
Relevance of project criterion	1	2	3	4	5

Opinion and relevance scores are multiplied together to achieve the maximum scale range of +10 to -10. This enables each end-user combined satisfaction measure to be plotted on the four-quadrant diagram. If the opinion rating is zero (i.e. 'no opinion'), then the value is 'null' and ignored in the calculations.

3.3.3 End-user satisfaction (EUS)

A successful project should have a value of at least 50% for EUS, as shown in Figure 3.5.

Figure 3.5. EUS success scale



Source: CCCR (2019)

The influence that each critical success factor has on the overall score can be computed via the following equation, where *i* equals the number of responses per success factor and *n* equals the total number of responses across all success factors. These values are then used to proportion EUS across the success scores for each factor.

$$\text{Influence} = Q1 \,.\, \frac{\bar{x}\,(A \,.\, B)_i}{\bar{x}\,(A \,.\, B)_n}$$

An EUS model has been developed in Microsoft Excel to perform these calculations.

3.4 Research philosophy

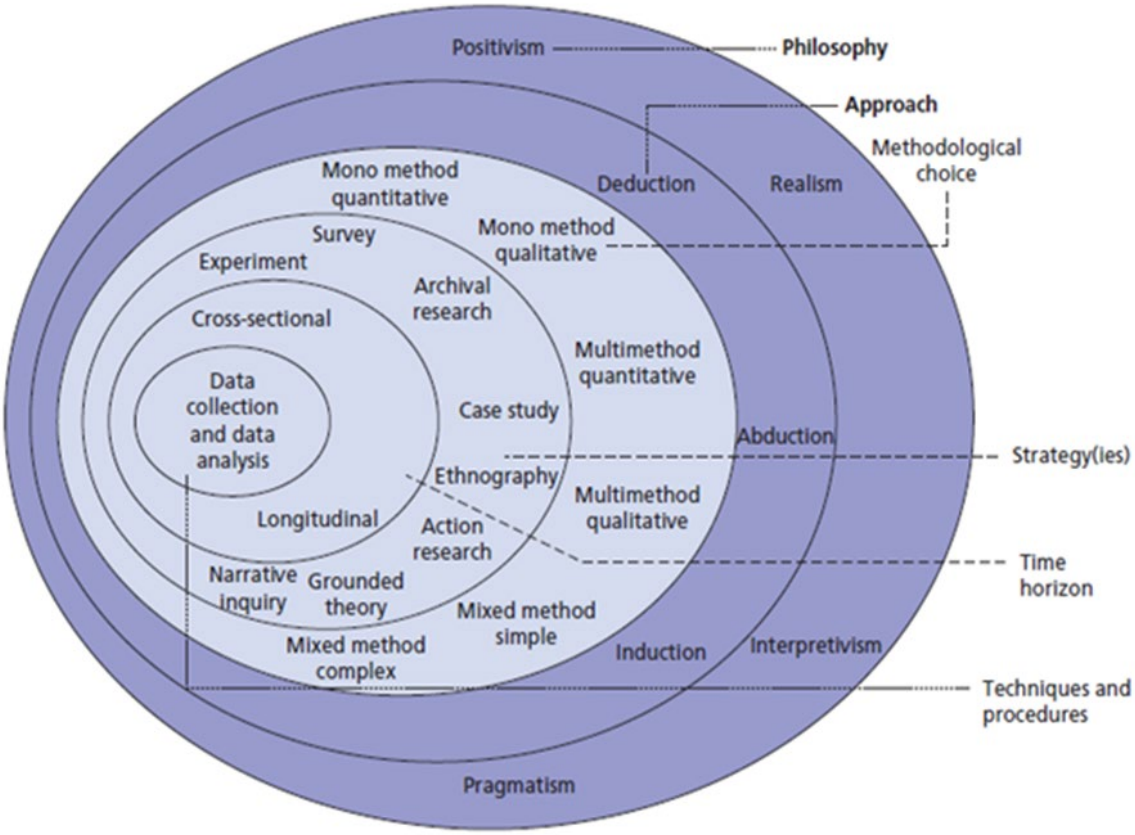
According to Saunders et al. (2019, p. 130), "the term research philosophy refers to a system of beliefs and assumptions about the development of knowledge". Thus, research activities and processes are developing knowledge in a particular field. The beliefs and assumptions concerning creation of knowledge are components of a research philosophy system (Bryman & Bell, 2015). A research philosophy is a broad level of understanding in relation to trust when conducting research. However, individual views of philosophy help to perceive the reality of philosophical systems (Burns & Burns, 2008).

The scientific method is the basis of the research for creation of new knowledge about the selected subject. It enables the design of a research strategy, identification of the problem, collection of data and subsequent processing and analysis works (van Maanen et al., 2007; Žukauskas et al., 2018).

3.4.1 Broad philosophies of research

There are extensive variations in different research disciplines as well as sources, nature and development of knowledge, resulting in so many research philosophies being reported. Four major research philosophies were identified in business studies by Bajpai (2011), which are positivism, realism, interpretivism (or interpretive), and pragmatism. Similar four classes have also been agreed by Saunders et al. (2012). These authors also diagrammed the whole research process in their famous ‘Onion Model’ in which research philosophies are placed in the outer-most layer while data collection and analysis are shown in the inner-most layer of the model (see Figure 3.6).

Figure 3.6. Onion model of research



Source: Saunders et al. (2019)

However, Saunders et al. (2019) included another research philosophy, postmodernism, in their latest onion model. Postmodernism is emphasizing the role of language and power relations when seeking questions and giving voice to alternative views of thinking. In contrast to Bajpai (2011) and Saunders et al. (2012), Andrew et al. (2011) proposed three classes: positivism, constructivism and pragmatism. Positivism states that knowledge is initiated in a scientific method whereas constructivism argues that knowledge is generated by scientists themselves through human intelligence interacting with their experiences. Pragmatism is just a mixture of positivism and constructivism philosophies. Neuman (2014) also identified three philosophies in social research using different wording: positivist (positivism), interpretive (interpretivism), and critical social (a mixture of positivism and interpretivism).

Research approaches are the second layer of the onion model, which has three categories of deduction, induction and abduction. The major difference between deductive and inductive approaches is the relevance of hypotheses to the study being conducted. The validity of assumptions (or theories/hypotheses) is tested in a deductive approach while the sequence

followed is theory, hypothesis. observation/test, and confirmation/rejection. However, the inductive approach is contributing to evolving new theories and generalizations, where the inline processes are observations/tests, pattern, and theory. Abductive research is commenced with surprising facts or puzzles and the research process is wholly devoted to the explanation of unknown facts (Bryman & Bell, 2015; Dudovskiy, 2018; BRM, 2020).

The third layer in the onion model is methodological choices: qualitative (mono and multi), quantitative (mono and multi), and mixed method (simple and complex). The qualitative research method is employed to understand individuals or groups, their thoughts and their opinions regarding a matter or human problem based on their skills and experience and ascribed to a social or human problem. The process of research involves asking direct questions from participants (interviews and group discussions) while the data gives rise to general themes and expression of views which are then interpreted. Quantitative is a research method for testing relationships between variables that can be measured and analyzed through statistical techniques. Mixed methods of research are a blend of quantitative and qualitative procedures. Data are a combination and integration of two forms of data: qualitative and quantitative. The triangulation approach is used to understand and interpret data and draw conclusions (Sale et al., 2002; Creswell, 2003; Tashakkori & Teddlie, 2003; Johnson & Onwuegbuzie, 2004; Cooper & Schindler, 2006; Williams, 2007).

3.4.2 Approaches and methods

As the present study is focusing on finding the reality of project success after delivery with relevance to end-users' satisfaction, it involves interactions between the researchers and respondents (participants of the survey study). Hence, the pragmatism philosophy is the most relevant. This helps in understanding and analyzing the perceptions and experiences of the respondents by actively participating in the process of fieldwork. The methodological choice is a mixed-method design for these investigations because it is useful to integrate the strengths of both qualitative and quantitative research methods and provide a more holistic understanding of a problem or phenomenon. It is suitable for a cross-sectional investigation.

3.4.3 Literature review

The components of the study consist of a two-stage process: (1) a qualitative systematic and integrated literature review, and (2) a quantitative survey involving end-users of the selected projects' performance.

Both qualitative and quantitative strategies possess strengths and weaknesses. Neither is considered complete or perfect, but a mix of both can be used to maximize the strengths and minimize the weaknesses of each (Johnson et al., 2007; Johnson & Onwuegbuzie, 2004). Some researchers call this mixed method a 'third wave' or 'movement' of study (Tashakkori & Teddlie, 2003). Almalki (2016) has articulated the following advantages of mixed methods:

- one method may identify issues that can only be addressed by the other approach
- one method could produce data to strengthen the data gathered by another method
- a preceding or proceeding method may prove useful to eliminate or neutralize differences in the results
- the quantitative and qualitative data generated by both sources can be incorporated into a single broader database

The literature review reveals a larger number of topics, frameworks, conclusions, gaps and deficiencies. The qualitative analysis provides themes, clues, and directions for developing specific research questions. Qualitative data analysis also helps in identifying meaningful quotations, codes, and developing larger themes. When the researcher moves from qualitative analysis to developing a survey or questionnaire, the identified codes become variables and the quotations become survey items.

The quantitative data collection can incorporate both open-ended answers as well as scale-based questions. Scales are defined as measurement instruments, or collections of items combined into a composite score to reveal levels of theoretical variables not readily observable by direct means (DeVellis, 2017). Hence, a Likert item in a survey might be used as one type of approach to measure these variables. A Likert scale presents the item in a statement, following by options indicating varying degrees of agreement.

In this study, the framing of questions and development of the questionnaire was based on the findings of the structured and integrative literature review.

3.4.4 Case study methodology

Case study research is a powerful method used for realizing practical and theoretical aims and as a standalone approach having a level of flexibility that is not readily offered by other methods and approaches. Case studies suit the investigation of real-world phenomena using research questions and multiple variables (such as the consolidated attribute list) relevant to completed projects. Case studies demonstrate wide diversity in study design (Hyett et al., 2014; Levy, 2014; Ebneyamini & Moghadamet, 2018; Yin, 2018).

3.5 Case studies

Case study method is therefore the selected approach for primary data collection into EUS for a range of project types. One case study for each project type is considered sufficient. While projects can take a multitude of forms, previous research supports the notion of product creation, services provision, system development and post occupancy evaluation as the four 'meta' typologies.

3.5.1 Two-step strategy

A two-stage strategy is adopted in this study. The first stage looks at four case studies reflecting each typology described above. These case studies are deliberately small projects that act as a pilot to test the survey instrument in different settings. A two-stage strategy provides the opportunity to modify the survey before undertaking further case studies on larger projects of matching typology. Both case study groups are statistically analyzed to test the validity and reliability of the survey instrument as it develops.

An online survey was used to collect the data from the end-users of these case studies. The survey was administered online, and in overseas locations was conducted face to face due to the need for language translation.

The online format used Qualtrics® survey software, for which a specific Qualtrics® URL link was circulated by email to a sample of end-users. The face-to-face format used a paper-based form administered by a research assistant, and to avoid bias, data were collected on different days of the week and at different times of the day. Case studies 5 and 6 required translations from English to the local language and were assisted by a third-party data collection agency.

The data were collected via cross-sectional sampling from people that interact with these projects. The data were then manually analyzed using Microsoft Excel.

3.5.2 Case study descriptions

Seven case studies form the primary data collection for this study. Four are in Group 1, but only three are pursued in Group 2. The reasons for this are explained in Chapter 4.

Each case study is briefly described in Table 3.4.

Table 3.4. Case study summary

Group	Project Type	Case Study	Number of valid survey responses
Group 1	Product creation	Bond University Sports Centre	92
	Service provision	Al Ghurair Cinema Complex, Dubai	121
	System development	Bond University iLearn Platform	68
	Post occupancy evaluation	Bond University HSM Building	61
Total valid survey responses included in the analysis			**342**
Group 2	Product creation	Hong Kong–Zhuhai–Macau Bridge (HZMB)	103
	Service provision	Bangladesh Electricity Upgrade Expansion (BEUE)	104
	System development	Gold Coast Light Rail (GCLR) Stage 1 and 2	138
Total valid survey responses included in the analysis			**345**

3.5.2.1 Bond University Sports Centre

Bond University Sports Centre was opened in mid-2016, comprising a fully equipped gymnasium, sports facilities, training sessions, fitness advice, group exercise classes rooms, 50-metre heated Olympic size swimming pool and related sports facilities. This centre is 2,700 square metres of indoor space supporting gym and fitness equipment, three group exercise

rooms, two beach volleyball courts, and a dedicated function area. The Centre was designed and built by ADCO Constructions. The design of the facility makes extensive use of timber, exposed concrete and natural light, and features a 'sports mural' on a perforated aluminium sheet spanning the front of the building. The centre adds to the university's suite of elite sporting facilities, including high-performance training. This case study is an example of product creation.

Figure 3.7 shows the front exterior of the sports centre, located directly opposite the sporting fields and recreational facilities.

Figure 3.7. Bond University Sports Centre

3.5.2.2 Al Ghurair Cinema Complex, Dubai

This project comprises a public cinema complex of 7,000 square metres (1,800 seats) as part of the Al Ghurair shopping centre in Dubai. It includes 18 cinema theatres, a serving food and beverage area within a self-contained, two-level wing, making extensive use of cutting-edge audio-visual technology. Moviegoers are entitled to an extra two hours free parking on top in

addition to the standard four hours allowed for the whole building complex. Cinemas are a place of leisure offering a full variety of theatre options along with platinum movie suites. The seats are comforted with pillows, blankets and personal service right to the seats. Reel Junior for the children and an ultra-high-tech, premium Dolby cinema screen dedicated to a family-friendly experience. Visitors can also get their snacks and meals of all kinds when movies are running. The building was opened for the public in April 2019 after completion. This case study is an example of services provision.

Figure 3.8 shows some of the interior spaces within the cinema complex, currently trading as Reel Cinemas.

Figure 3.8. Al Ghurair Cinema Complex, Dubai

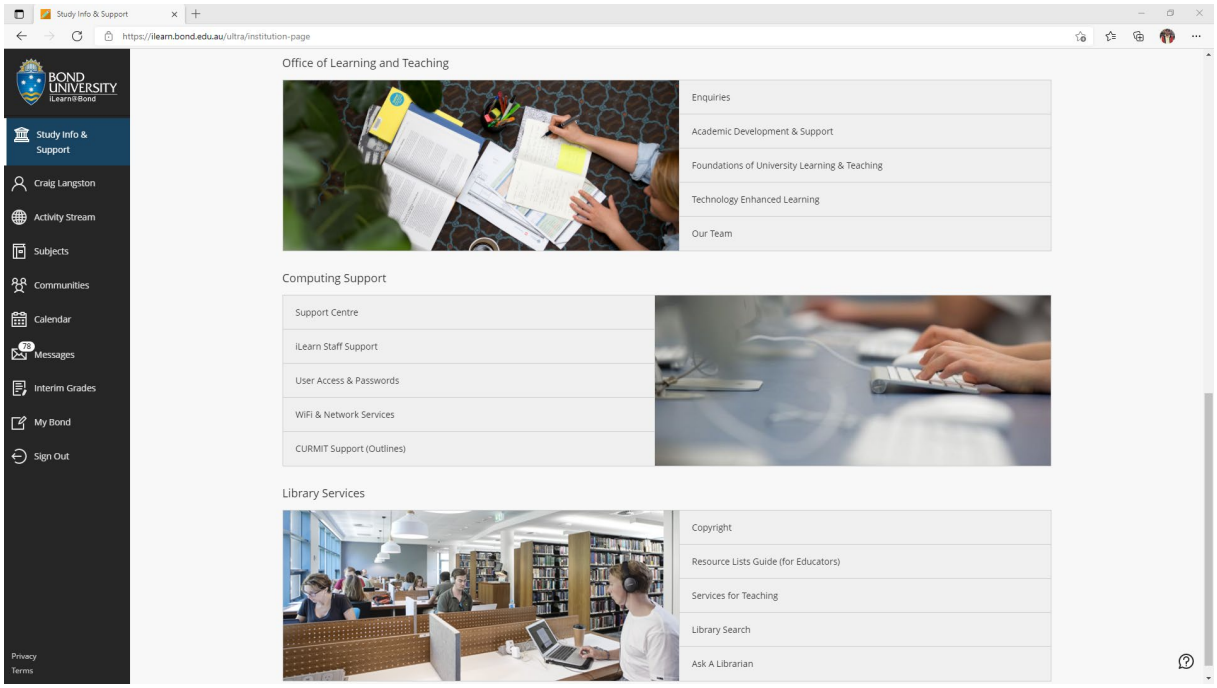
3.5.2.3 Bond University iLearn Platform

This project included the upgrade of the existing iLearn (Blackboard) learning management system at Bond University to the new Ultra platform. Students have access to their enrolled subjects, they submit assignments and receive feedback online, and participate in real time conferencing and break-out spaces. The platform provides a secure and personalized interface that brings the entire university together as a mission-critical operational system. All important

messages relating to the study of students are provided here as well as announcements on extracurricular activities and events around the university. The iLearn platform supports mobile and remote connectivity and is integrated into all the primary management systems that Bond University needs on a daily basis. This case study is an example of system development.

Figure 3.9 illustrates a screen shot of the iLearn Ultra interface used at Bond University that integrates the various services and software applications from a single portal.

Figure 3.9. Bond University iLearn Platform



3.5.2.4 Bond University HSM Building

Stage 2 of Faculty of Health Sciences and Medicine building at Bond University, Gold Coast, was completed in May 2019. This project effectively doubled the existing building area, providing new office accommodation, teaching rooms, laboratories, theatres, coffee, kitchens and collaborative workspaces. Students and staff at the university are benefitting from a state-of-the-art learning and teaching environment. The building serves as a place to bring partners and stakeholders together from government and the private sector. The building houses all staff in the faculty and a large number of students who pay fees to have the very best of infrastructure to support their studies. This case study is an example of post occupancy evaluation.

Figure 3.10 presents the entry to the HSM Building, which is located opposite the main teaching spaces and lecture theatres.

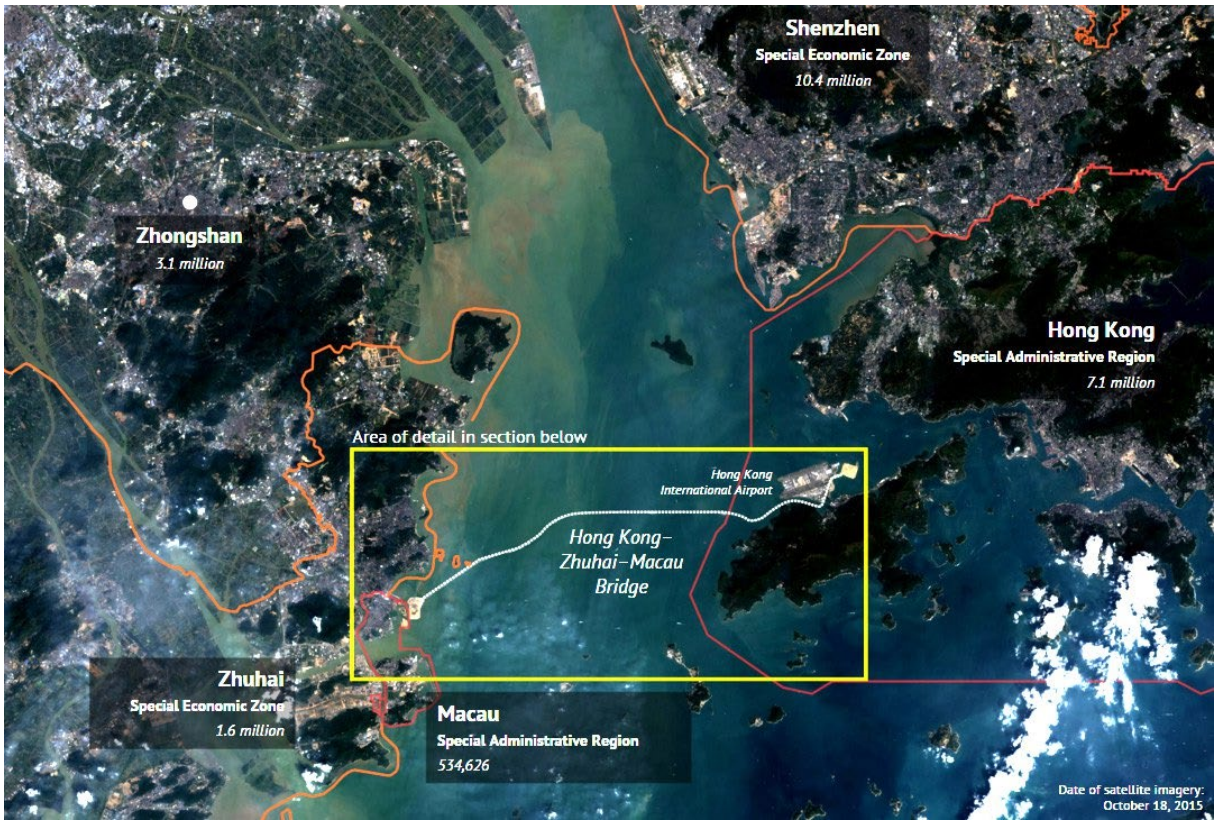
Figure 3.10. Bond University HSM Building

3.5.2.5 Hong Kong–Zhuhai–Macau Bridge (HZMB)

The HZMB is one of the most iconic infrastructure investments of this century. It is the longest sea-crossing in the world and is situated in the Pearl River Delta in the People's Republic of China. It connects Hong Kong, Zhuhai and Macau with a six-lane toll road including an elevated bridge deck, three large cable-stay spans, artificial islands, undersea tunnel, link roads, and border control facilities for each region. The engineering challenge was extremely complex and ambitious. However, its contribution to the economy of the region, to tourism and the productivity of transport and trade is significant. It is a beacon of ingenuity and human endeavour but took nearly nine years to construct. Nevertheless, it was delivered just prior to a period of civil unrest in Hong Kong SAR that has heralded closer connection to Mainland China at the expense of their previous democratic autonomy. This case study is an example of product creation.

Figure 3.11 shows a satellite image of the 55-kilometre route from Hong Kong to Zhuhai and Macau.

Figure 3.11. Hong Kong–Zhuhai–Macau Bridge (HZMB)



3.5.2.6 Bangladesh Electricity Upgrade Expansion (BEUE)

The Government of Bangladesh identified electricity supply as a major constraint to GDP growth and overall economic development. The Government has an ambitious target to achieve affordable electricity for all by 2021. The new generation capacity of electricity demands an upgrade of transmission and distribution networks as well as establishing connections for new consumers. The project was funded by the Asian Infrastructure Investment Bank to: (i) expand electricity coverage by providing 2.5 million new service connections in rural areas, and (ii) upgrade two grid substations (250 MVA to 480 MVA) and convert overhead distribution lines into 85 km of underground cables in northern Dhaka. It is expected to benefit about 12.5 million people in rural areas. This case study is an example of service provision.

Figure 3.12 shows life in rural Bangladesh before electricity was supplied to their homes.

Figure 3.12. Bangladesh Electricity Upgrade Expansion (BEUE)

Photo courtesy of World Bank

3.5.2.7 Gold Coast Light Rail (GCLR) Stage 1 and 2

GCLR is a complex infrastructure development project that involves construction of a dual track approximately 40km length for a light rail transit system between Helensvale and Coolangatta (Stages 1-4). Stages 1 and 2 are complete, while Stage 3 is about to enter the construction phase and Stage 4 is about to undergo design. The purpose of this ambitious project is to ensure a frequent, reliable, and affordable public transport system for the Gold Coast (Queensland, Australia) that can help reduce traffic congestion, speed up travel times, and save money on road widening and maintenance works. Gold Coast is one of the fastest growing cities in Australia and the traffic on several key roads are reaching capacity during peak hours. The project had its fair share of engineering challenges along with resistance from local community during the initial development. However, its contribution to the region's economy, to domestic and international tourism, and to improved productivity of community activities is expected to be significant. This case study is an example of system development.

Figure 3.13 displays the Broadwater Parklands Station, which is part of Stage 1 and one of nineteen access points to the light rail tram system.

Figure 3.13. Gold Coast Light Rail (GCLR) Stage 1 and 2

3.6 Survey design

A Qualtrics online survey form is developed to collect opinion and relevance data for each of the success criteria that contribute to the calculation of EUS. The survey was tested on Bond University colleagues before being used in the field. Some basic demographic data is collected to aid interpretation, if needed. The survey is published online with a specific URL for each case study and has a simple and clear design (refer to**: Appendix 2**).

3.7 Ethics

Ethical approval from Bond University is required before any data involving human subjects can be collected. Approval was received for case study data collection (Protocol Number BUHREC MA03051). The research must comply with the terms of this approval as set out in the approval letter from Bond University Human Research Ethics Committee dated 24 May 2019 (refer to: **Appendix 3**).

3.8 Summary

In this chapter, 145 potential attributes of EUS were consolidated into 40 and aligned against generic financial, social, ethical and environmental consequences. A conceptual framework for measuring EUS was proposed. A case study methodology was deemed the most appropriate vehicle for collecting data. Seven case studies, formed into two groups representing small (pilot) and large projects, were identified and summarized. A Qualtrics online survey was created that would permit approved ethics processes to be upheld.

The next chapter will collect, present and statistically analyze the case studies and test for validity and reliability.

CHAPTER 4: RESULTS

4.1 Purpose of this chapter

The purpose of this chapter is to describe the method for analysis of the case studies and to provide the results. The two-step process for data collection comprises small and large examples of each project type to be explored to ensure that the survey form is reliable. This is tested using a combination of reliability tests, confirmatory factor analysis, correlation analysis, canonical discriminant analysis and item response theory. If necessary, modifications to the survey can be made and the process repeated on another set of projects. The first step is to comprise small projects and the second step is to comprise large projects.

EUS is calculated for each case study as the mean of scores for each critical success factor: desirable, adaptable, practicable and serviceable. The statistical analysis is used to test the validity and reliability of the data and hence confirm that the survey is fit for purpose and robust. As part of this process, a range of challenges for data collection are traversed, including online (remote), verbal (face-to-face), non-English translation requirements and use of third-party data surveyors.

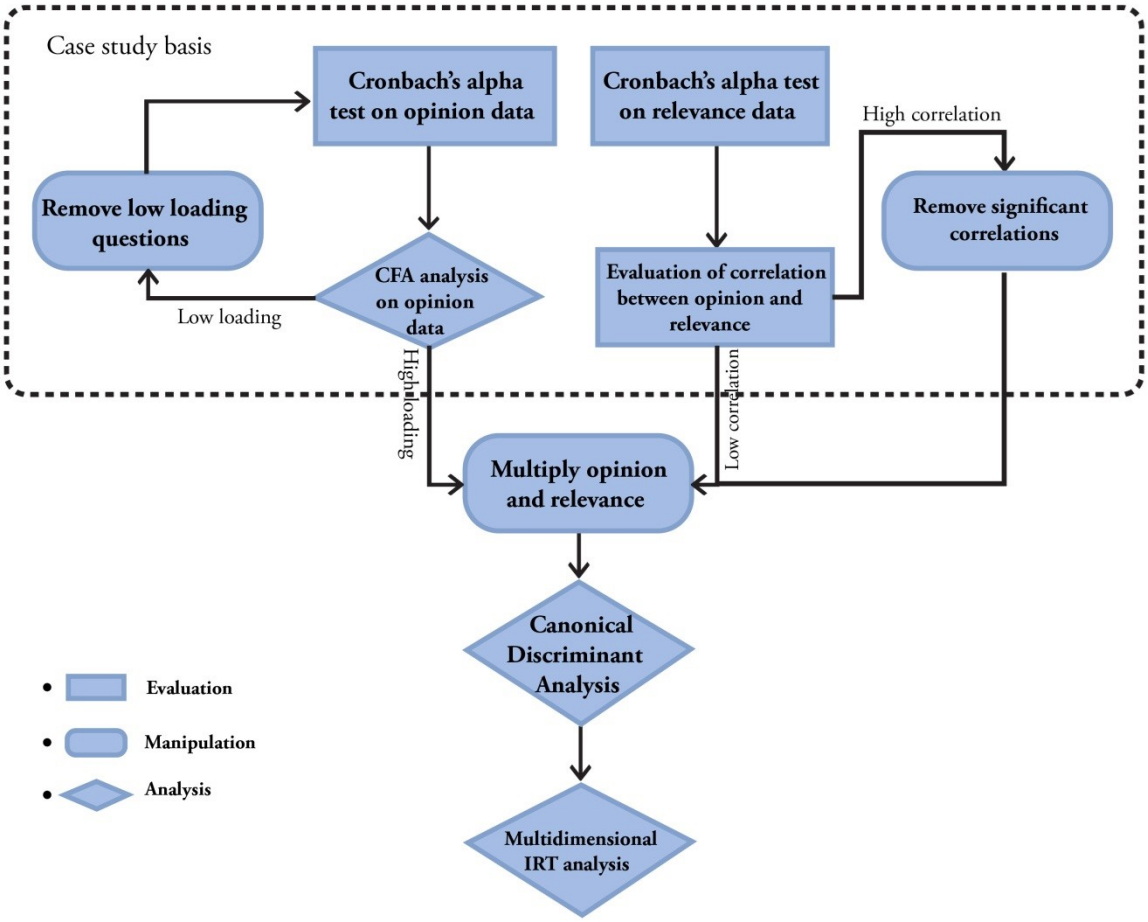
A Microsoft Excel template is created to process survey responses. The template supports up to 1,000 respondents. EUS is calculated as the mean of the four critical success factors: desirable, adaptable, practicable and serviceable.

Each factor is computed as: a x 4 x b/100 – (100 – b), where a = (100 – b/100) x c/100 + (b/4), b = %Q1 quadrant, and c = %influence for attractiveness.

4.2 Analysis explanation

Statistical analysis is to be completed in five steps: Removal of low loading questions, Cronbach's alpha test on opinion data, confirmatory factor analysis (CFA) on 'opinion' data, Cronbach's alpha test on 'relevance' data, evaluation of correlation between opinion and relevance, and removal of significant correlations. This process is illustrated in Figure 4.1.

Figure 4.1. The steps of statistical analysis pursued for validation of the survey data and the model



Reliability tests and CFA are performed for each case study independently. All data analysis is accomplished using R software (version 4.0.0) and SAS® 9.4 PROC CANDISC. Cronbach's alpha was calculated using the 'Psy' package. CFA was done using the 'lavaan' package. Canonical discriminant analysis was done using SAS® 9.4 PROC CANDISC because this software has more powerful tools for chart analysis. Item Response Theory (IRT) analysis was also done using SAS® 9.4 PROC IRT procedure. However, R packages (MIRT package) for this analysis were not employed, as the convergence results were unstable. All other analyses were done using base R functions (Paek & Cole, 2020). Validity denotes whether any concept, parameter, or data have been measured/assessed rightly or not (Sekaran & Bougie, 2016; Zikmund et al., 2013; Hair et al., 2019a; 2019b;). Validity determinations are important to know whether interpreted results are leading to real outcomes and are free from errors. There are three validity types of scale measurement: content validity, criterion-related validity, and construct validity (Sekaran & Bougie, 2016). Content/face validity ensures that the measure includes an adequate and representative set of items that tap the concept.

4.2.1 Reliability tests

Reliability is the dependability or consistency of a test measuring a characteristic of a product, service, system or POE for project success. It means that if a test is repeated, the test score is equal to or nearer to the first-time test (Hair et al., 2019a; 2019b). This is the characteristic reliability. If the reliability value is low, the reasons might be due to the temporary condition of the test taker, environmental or external impacts, changing forms of the test item, or the variation in testing instruments. The random error may also occur during repeated testing. Therefore, the reliability coefficient (r) indicates the reliability value of a test. The values of 'r' range from zero (no reliability) to 1 (fully reliable), while any intermediate value can be calculated during testing and analysis. The larger the value of 'r', the more repeatable or reliable the test scores can be regarded (Rousson et al., 2002; Weir, 2005; Johnson et al., 2007; Livingston, 2018).

Reliability test results of Cronbach's alpha are performed for each case study. A low value of alpha could be due to either poor inter-relatedness between items or heterogeneous constructs or less informed participants. However, in the case of a low alpha, the test should either be revised or discarded (Streiner, 2003). Good reliability is an indication of lesser bias (error) and ensuring consistency of measurements. Cronbach's alpha has been commonly accepted by different scholars for measuring the reliability of various tests.

The higher the value of Cronbach's coefficient alpha, the better will be the repeatability and consistency of measuring tests. To be desirable, the value of Cronbach's coefficient alpha should be at least greater than 0.07 because it is an indication of strong homogeneity and suggesting that the sampling domain was adequate (Churchill, 1979; Price & Mueller, 1986; Hinkin et al., 1997; Sekaran & Bougie, 2016).

For example, Stephanie (2021) suggested the following categorization of Cronbach's coefficient alpha (α) for interpretation of results (internal consistency) based on the calculated values of this parameter:

- $\alpha \geq 0.9$ (excellent)
- $0.9 > \alpha \geq 0.8$ (good)
- $0.8 > \alpha \geq 0.7$ (acceptable)
- $0.7 > \alpha \geq 0.6$ (questionable)
- $0.6 > \alpha \geq 0.5$ (poor)
- $0.5 > \alpha$ (unacceptable)

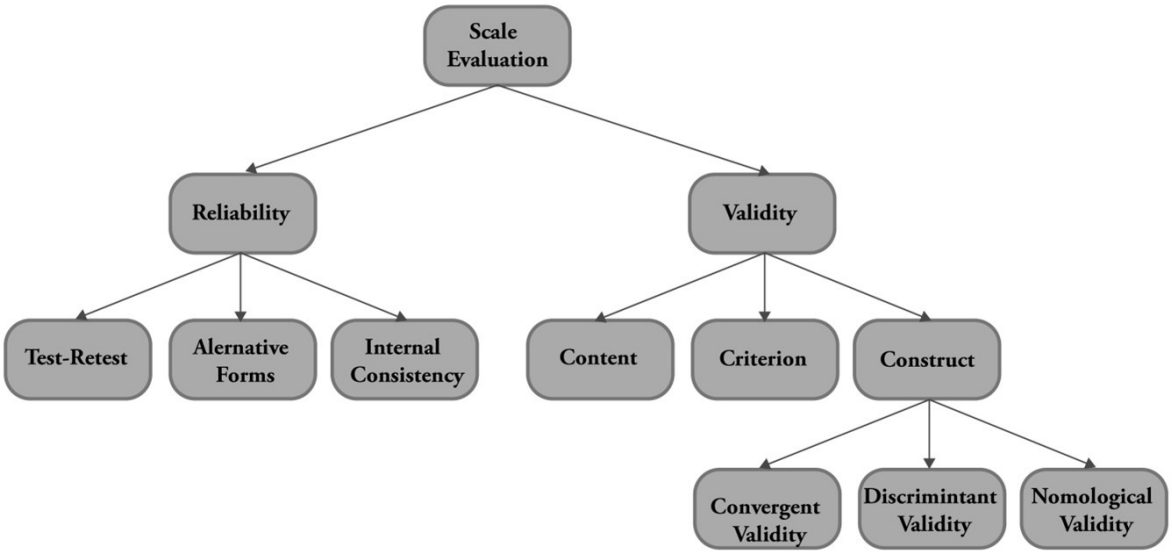
Thus, values lesser than 0.7 are not considered convincing for the assessment of internal consistency concerning answers to the questions being studied. However, this is not an all-agreed viewpoint.

Tavakol and Dennick (2011) have shown that a high coefficient alpha does not always mean a higher degree of internal consistency. They suggested addition of related items testing the same concept for increasing alpha. While they did not totally negate the general understanding attached to the alpha score, they urged researchers to improve the conditions of testing questions that are reliant upon a greater number of observations. The reliability of higher alpha scores was also claimed by Salkind (2015) was improved by deleting of abnormal values within the test (Cho & Kim, 2015).

The conditions of the present study are meeting these criteria because the attribute approach consisted of so many questions as well as a multiple number of case studies. The deleting phenomenon was also practised. Therefore, present scores of alpha coefficients are considered to be reliable.

Some of the relationships of reliability, validity, and scale evaluation are presented diagrammatically in Figure 4.2.

Figure 4.2. The relationships of reliability, validity and scale assessment



Adapted from Berdine, 2012

4.2.2 Confirmatory factor analysis

Confirmatory factor analysis (CFA) is a special form of factor analysis that is mostly used in social sciences research (Kline, 2010). The major use of CFA is for testing consistency of measures of a construct so the researcher understands the nature of that constructor factor. The objective of CFA is to test whether the data are fitting a hypothesized measurement model or not. This hypothesized model analyses the theory and/or previous analytical research work in a social science setting (Preedy & Watson, 2009). CFA is regarded as a powerful and flexible technique for statistical analyses which is becoming popular as a tool for researching psychology and education. It enables a focus on modeling the relationship between manifesting (observed) indicators and underlying variables (Gallagher & Brown, 2013).

4.2.3 Correlation analysis

Some sort of association between two quantitative variables is called correlation, for example, the correlation between height and weight of any person. The correlation may be positive when one quantity increases with an increase of the other, while it is negative when an increase in the quantum of one variable causes a decrease in the other quantitative variable. It is assumed in correlation that the association is linear, meaning that an increase in one quantity causes a proportional increase or decrease of the other. The parameter of correlation is different from estimating the best straight line between two quantities, thus summarizing the association. The

degree of association can be calculated by using various formulae and this parameter is called correlation coefficient which is denoted by 'r' (also known as Pearson's correlation coefficient). The correlation coefficient scale varies from -1 to +1. The complete correlation between two variables is indicated by either -1 or +1, negative or positive correlations respectively, while a complete absence of correlation is represented by zero. However, intermediate values may also occur, where values nearer to zero represent a weak correlation and values of 'r' nearer to 1 express a strong correlation (Nikolić et al., 2012; Mahdavi, 2013; Paek & Cole, 2020; Taylor, 2020).

4.2.4 Canonical discriminant analysis

Despite the individual participants in any research study, various groups may also participate. For the statistical analysis of such collected data, canonical discriminant analysis (CDA) is available. Indeed, CDA is a multivariate statistical analysis for identifying differences among various groups of individuals (or treatments) and improving the understanding of relationships among these variables by measuring differences within those groups. Fisher (1936) proposed this technique, also known as Fisher's discriminant analysis or canonical variate analysis (Everitt, 1978; Cole & Phelps, 1979; Mardia et al., 1979; Prins et al., 1990; Behe et al., 1992; Cruz-Castillo et al., 1992; Majer et al., 1992). The analytical approach of CDA is used to critically describe, interpret and explain how discourses construct, maintain and legitimize social inequalities (Dianna, 2018).

4.2.5 Item response theory

Based on item response theory (IRT) principles, a new generation of instruments is being developed, especially related to health outcomes (Reeve et al., 2007). IRT comprises modelling techniques for the analysis of item-level data obtained to measure inter-individual variation. This collection of techniques generates rich item-level information and offers many advantages over classical test theories. IRT can be used for evaluation of the psychometric properties of existing scales and their items, shortening the scale optimally, when necessary, and evaluation of the performance of the reduced scale. IRT modelling can produce precise, valid and relatively brief instruments for further use (Lord, 1980; Hambleton & Swaminathan, 1985; Wainer et al., 1990).

4.2.6 Model specification

Item information curves (IIC) are more straightforward to interpret the loading of each item on each construct. Higher IIC shows higher information on a specific item and vice versa. Test information curves (TIC) show whether all constructs gain the same amount of information from the defined items in each construct. This curve is the sum of information curves of the items in each factor. The shape of this curve implies between item information variation in each factor. Wide TIC implies higher variation in IIC curves in each factor and narrow TIC shows lower variation and higher homogeneity among IIC curves.

4.3 Group 1 case studies

Group 1 responses total 342, comprising 92 for the Sports Centre, 121 for the Cinema Complex, 68 for the iLearn Platform and 61 for the HSM Building.

4.3.1 Case study calculations

The four case studies for Group 1 are summarized in Figures 4.3 to 4.6. Refer to Chapter 3 for background on each case study.

Figure 4.3. Sports Centre EUS model

DELIGHT (EUS)	43	Sports Centre, Bond University, Gold Coast

SUCCESS FACTOR	desirable	43	adaptable	39	practicable	40	serviceable	52

Attractiveness:

	mean	influence
Nice to look at?	2.23	
High quality?	2.59	
Profitable?	2.65	
Well-designed?	3.44	
Valuable?	1.95	
Prestigious?	2.39	
Durable?	2.08	
Popular?	2.05	
Joyful?	2.58	
Unique?	1.76	
User-defined ...		
User-defined ...		
	2.37	24.19%

Flexibility:

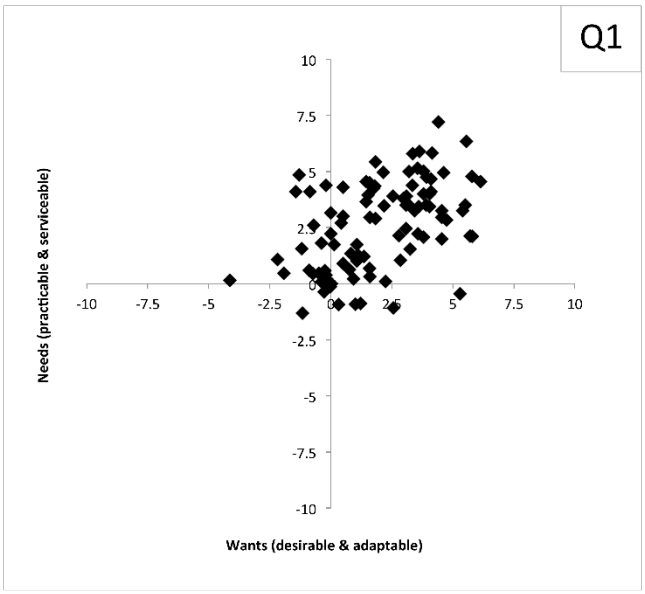
	mean
Versatile?	1.13
Easily modified?	1.89
Able to be customized?	2.15
Multi-use?	1.58
Transportable?	1.69
Better with age?	1.36
Modular?	2.19
Scalable?	2.60
Technically clever?	2.01
Timeless?	2.16
User-defined ...	
User-defined ...	
	1.87	19.11%

Fit for Purpose:

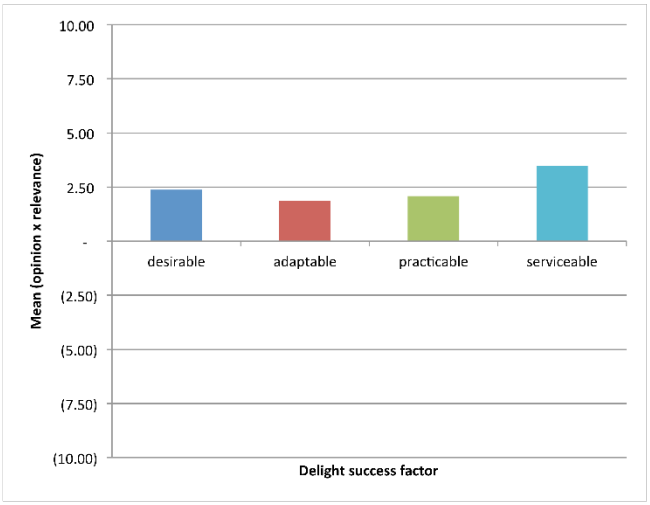
	mean
Functional?	1.52
Appropriate?	1.67
Robust?	2.56
Safe?	2.24
Healthy?	2.20
Problem-solving?	2.23
Easy to use?	2.22
Affordable?	2.31
Comfortable?	2.07
Ethical?	1.76
User-defined ...	
User-defined ...	
	2.08	21.20%

Enduring:

	mean
Low maintenance?	3.62
Easily cleaned?	3.57
Recyclable?	3.31
Non-toxic?	3.12
Repairable?	3.15
Energy efficient?	3.92
Reliable?	3.99
Accessible?	3.58
Regenerative?	3.27
Habitat-safe?	3.30
User-defined ...	
User-defined ...	
	3.48	35.50%
		100.00%



percent Q1	71.74	%
total responses	92	



sample		n/a
return rate		0%
expected delight (LPS)		0%
actual delight (EUS)	✔	43%

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Figure 4.4. Cinema Complex EUS model

DELIGHT (EUS)	-27	Al Ghurair Cinema Complex, Dubai, UAE

SUCCESS FACTOR	desirable	-18	adaptable	-33	practicable	-30	serviceable	-28

Attractiveness:

	mean	influence
		5.07
Nice to look at?	1.82	
High quality?	2.32	
Profitable?	2.09	
Well-designed?	1.86	
Valuable?	1.31	
Prestigious?	1.86	
Durable?	0.97	
Popular?	1.40	
Joyful?	2.36	
Unique?	1.80	
User-defined ...		
User-defined ...		
	1.78	35.11%
	31.44	

Flexibility:

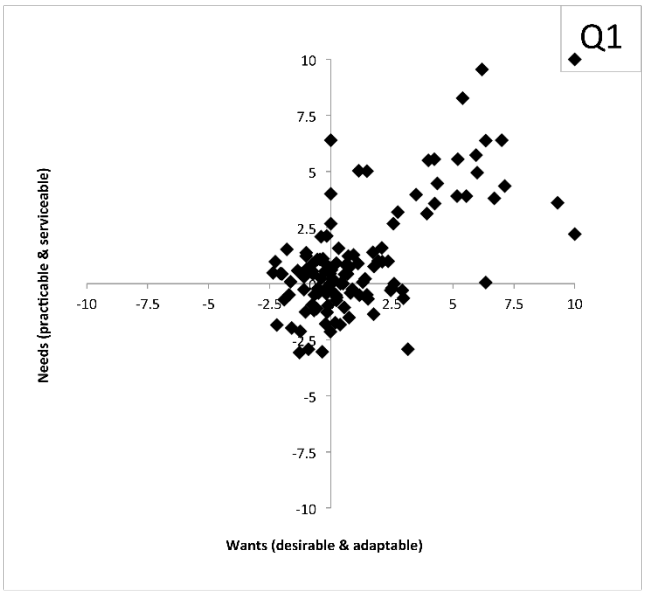
	mean
Versatile?	1.39
Easily modified?	0.90
Able to be customized?	1.64
Multi-use?	0.14
Transportable?	0.83
Better with age?	1.25
Modular?	1.25
Scalable?	0.35
Technically clever?	0.57
Timeless?	0.98
User-defined ...	
User-defined ...	
	0.93	18.36%
	29.78	

Fit for Purpose:

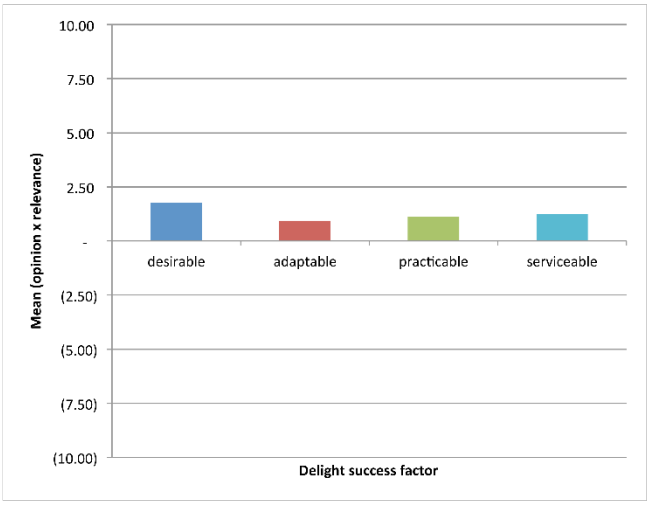
	mean
Functional?	1.08
Appropriate?	0.58
Robust?	0.61
Safe?	1.84
Healthy?	1.58
Problem-solving?	1.38
Easy to use?	0.90
Affordable?	0.47
Comfortable?	1.84
Ethical?	0.86
User-defined ...	
User-defined ...	
	1.11	21.97%
	23.07	

Enduring:

	mean
Low maintenance?	1.16
Easily cleaned?	1.98
Recyclable?	0.64
Non-toxic?	1.08
Repairable?	1.30
Energy efficient?	1.54
Reliable?	0.83
Accessible?	1.20
Regenerative?	1.22
Habitat-safe?	1.50
User-defined ...	
User-defined ...	
	1.24	24.55%
	24.71	100.00%



percent Q1	36.36 %
total responses	121



sample	n/a
return rate	0%
expected delight (LPS)	0%
actual delight (EUS)	-27%

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Figure 4.5. iLearn Platform EUS model

DELIGHT (EUS)	-9	iLearn Ultra Platform Upgrade, Bond University

SUCCESS FACTOR	desirable	-26	adaptable	-8	practicable	6	serviceable	-8

Attractiveness:

	mean	influence
Nice to look at?	0.92	
High quality?	0.54	
Profitable?	0.37	
Well-designed?	0.64	
Valuable?	(0.31)	
Prestigious?	0.38	
Durable?	0.30	
Popular?	1.11	
Joyful?	0.30	
Unique?	0.80	
User-defined ...		
User-defined ...		
	0.51	7.83%

Flexibility:

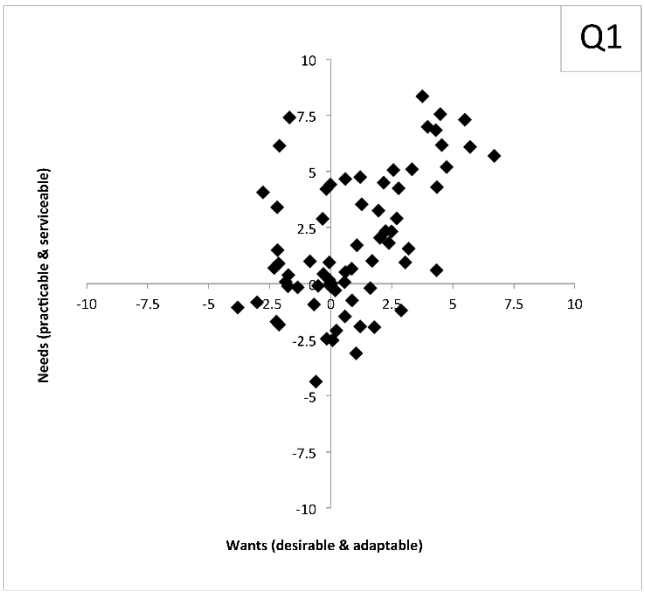
	mean	
Versatile?	1.74	
Easily modified?	1.98	
Able to be customized?	1.90	
Multi-use?	1.28	
Transportable?	2.24	
Better with age?	1.90	
Modular?	1.87	
Scalable?	1.26	
Technically clever?	1.35	
Timeless?	1.25	
User-defined ...		
User-defined ...		
	1.68	25.96%

Fit for Purpose:

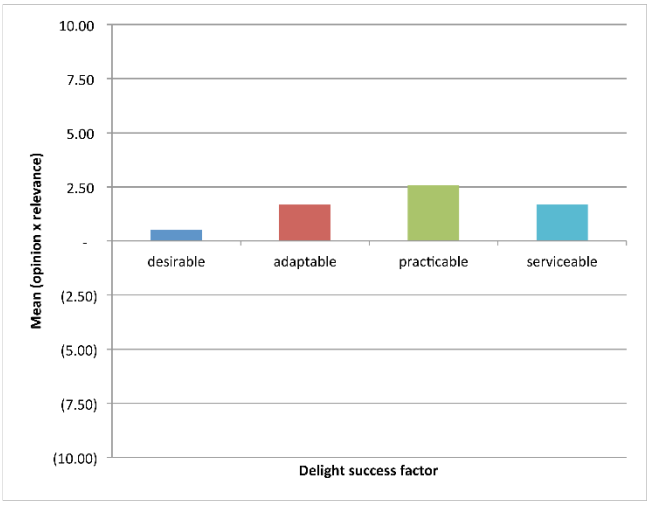
	mean	
Functional?	1.95	
Appropriate?	2.22	
Robust?	3.27	
Safe?	3.00	
Healthy?	4.56	
Problem-solving?	2.84	
Easy to use?	1.76	
Affordable?	1.86	
Comfortable?	1.78	
Ethical?	2.58	
User-defined ...		
User-defined ...		
	2.58	39.98%

Enduring:

	mean	
Low maintenance?	1.80	
Easily cleaned?	2.00	
Recyclable?	1.31	
Non-toxic?	3.33	
Repairable?	1.56	
Energy efficient?	1.60	
Reliable?	1.02	
Accessible?	0.90	
Regenerative?	0.96	
Habitat-safe?	2.46	
User-defined ...		
User-defined ...		
	1.69	26.24%
		100.00%



percent Q1	45.59 %
total responses	68



sample	n/a
return rate	0%
expected delight (LPS)	0%
actual delight (EUS)	-9%

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Figure 4.6. HSM Building EUS model

DELIGHT (EUS)	57	HSM Building Extension, Bond University

SUCCESS FACTOR	desirable	55	adaptable	53	practicable	60	serviceable	61

Attractiveness:

	mean	influence
Nice to look at?	3.34	
High quality?	3.75	
Profitable?	3.79	
Well-designed?	4.97	
Valuable?	5.13	
Prestigious?	3.72	
Durable?	3.63	
Popular?	3.35	
Joyful?	3.57	
Unique?	3.65	
User-defined ...		
User-defined ...		
	3.89	21.65%

Flexibility:

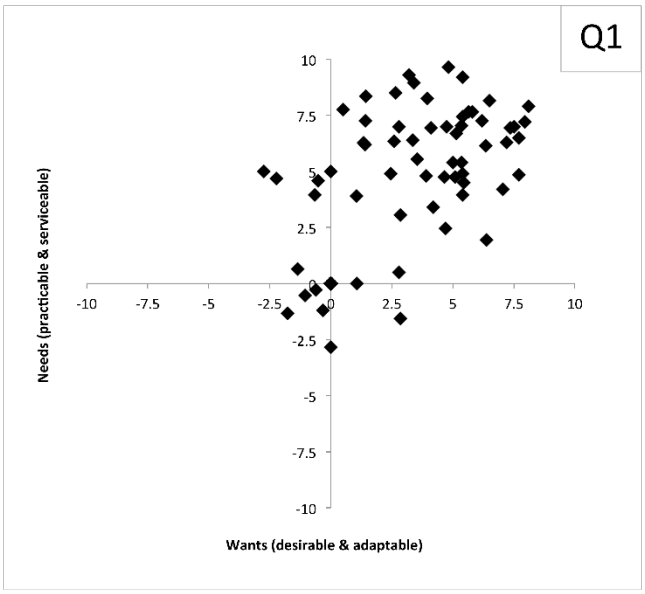
	mean
Versatile?	2.62
Easily modified?	4.18
Able to be customized?	3.33
Multi-use?	3.09
Transportable?	3.26
Better with age?	3.66
Modular?	3.64
Scalable?	3.25
Technically clever?	3.97
Timeless?	3.21
User-defined ...	
User-defined ...	
	3.42	19.04%

Fit for Purpose:

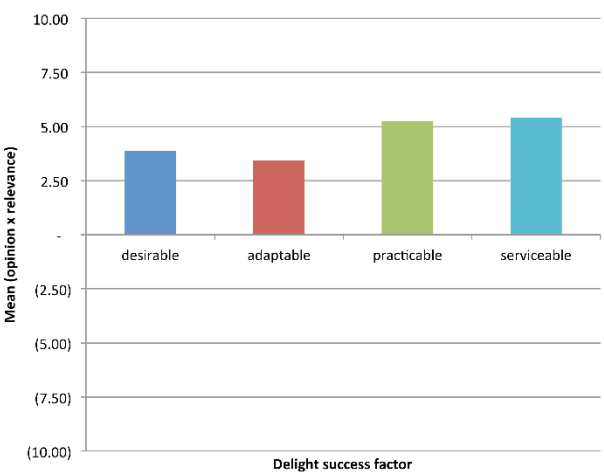
	mean
Functional?	5.35
Appropriate?	4.95
Robust?	5.61
Safe?	5.69
Healthy?	5.40
Problem-solving?	5.36
Easy to use?	4.90
Affordable?	4.88
Comfortable?	5.41
Ethical?	4.85
User-defined ...	
User-defined ...	
	5.24	29.18%

Enduring:

	mean
Low maintenance?	5.00
Easily cleaned?	5.34
Recyclable?	5.76
Non-toxic?	5.61
Repairable?	5.74
Energy efficient?	4.66
Reliable?	5.48
Accessible?	5.14
Regenerative?	5.61
Habitat-safe?	5.75
User-defined ...	
User-defined ...	
	5.41	30.12%
		100.00%



percent Q1	78.69	%
total responses	61	



sample		n/a
return rate		0%
expected delight (LPS)		0%
actual delight (EUS)	✔	57%

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4.3.2 Statistical analysis

The analysis that follows had assistance from a colleague in learning how to use the software to produce the tables and figures that follow. This assistance is gratefully acknowledged. The finished work was checked by the colleague for accuracy, and changes were made where required to ensure that the findings are robust and dependable. Each aspect of the analysis is discussed according to the steps that were set out earlier (see Figure 4.1).

4.3.2.1 Reliability tests

Relatively higher values of Cronbach's alpha (ranging from 0.5807 to 0.9125) in each case study revealed that in most of the cases, the reliability of collected data for opinion and relevance observations are significantly better. The testing of Cronbach's alpha for relevance is to find out whether all end-users have a common thought on the relevance of each item. Although the Cinema Complex case study had two times more subjects than the HSM Building, its Cronbach's alpha was calculated low for the Serviceability construct, while other constructs have acceptable, though low coefficients. Higher coefficients on relevance compared to opinion show that end-users have closer ideas about relevance despite differences in their opinions (see Table 4.1).

Table 4.1. Calculated Cronbach's alpha for Group 1 case studies

		Sports Centre	**Cinema Complex**	**iLearn Platform**	**HSM Building**
Construct	Sample size	92	121	68	61
	Number of Items	10	10	10	10
Desirable	Opinion	0.876	0.6734	0.6682	0.8314
	Relevance	0.8684	0.6804	0.8719	0.8752
Adaptable	Opinion	0.8676	0.6497	0.82	0.8882
	Relevance	0.8822	0.733	0.8366	0.8905
Practicable	Opinion	0.8666	0.6251	0.7685	0.9087
	Relevance	0.8774	0.7232	0.8557	0.9125
Serviceable	Opinion	0.7979	0.5807	0.8101	0.8778
	Relevance	0.8872	0.7869	0.8547	0.9248

As the Cronbach's alpha for any construct is not low in any case studies, none of the items are removed for the next level of analysis.

4.3.2.2 Confirmatory factor analysis

CFA fit summaries for each case study are shown in Table 4.2. According to CFI and TLI, the model is showing a non-significant relationship (CFI < 90%), which is a desirable result in the

present investigation due to the study of different aspects of each construct. As can be implied from the survey items, one case study can be desirable due to its popularity, but rather have different quality or profitability levels. Root mean square error of approximation (RMSEA) also shows the significance of the CFA model. As can be seen, RMSEA of the Cinema Complex has a very good value of 0.062 (lower than 0.08) with a narrow confidence limit. Considering the number of items and subjects, RMSEA is higher than the threshold of 0.08 because of the low sample size in the other three case studies.

Although the fit parameters of the CFA model show the medium quality of the models, factor loadings are at good conditions with almost all the item loadings having a significance level of lower than 0.01. As non-significant factor loadings are not common among the case studies (only the second and third items for the Desirable construct and the first item for the Serviceable construct for the iLearn Platform and Cinema Complex, respectively), none of the items were removed from the analysis (see Tables 4.3 and 4.4).

Table 4.3. Fit parameters of the CFA models for Group 1 case studies

Fit Parameter	**Sports Centre**	**Cinema Complex**	**iLearn Platform**	**HSM Building**
Number of Parameters	86	86	86	86
Fmin	8.555	4.428	9.925	14.408
Chi-square	1574.065	1071.599	1349.85	1757.765
DF	734	734	734	734
P-value	0	0	0	0
Baseline chi-square	2766.474	1554.03	1865.563	2718.116
Baseline DF	780	780	780	780
Baseline P-value	0	0	0	0
CFI	**0.577**	**0.564**	**0.433**	**0.472**
TLI	**0.551**	**0.537**	**0.397**	**0.439**
Log likelihood	-5205.7	-7985.29	-4226.83	-3058.427
Unrestricted log likelihood	-4418.67	-7449.49	-3551.9	-2179.545
AIC	10583.4	16142.59	8625.655	6288.855
BIC	10800.27	16383.02	8816.533	6470.39
Sample size	92	121	68	61
BIC2	10528.81	16111.12	8545.713	6199.852
RMSEA	**0.112**	**0.062**	**0.111**	**0.151**
RMSEA Lower bound	**0.104**	**0.054**	**0.102**	**0.142**
RMSEA Upper bound	**0.119**	**0.069**	**0.12**	**0.16**
RMSEA P-value	0	0.01	0	0
SRMR	0.093	0.084	0.11	0.118

Table 4.4. Loadings of each item in each construct for Group 1 case studies

Latent Variable	Items (Opinion)	Sports Centre	Cinema Complex	iLearn Platform	HSM Building
Desirable	O1	0.66**	0.66**	0.43**	0.49**
	O2	0.6**	0.58**	0.3^{ns}	0.5**
	O3	0.57**	0.41**	0.33^{ns}	0.47**
	O4	0.63**	0.72**	0.58**	0.43**
	O5	0.81**	0.61**	0.6**	0.45**
	O6	0.77**	0.46**	0.89**	0.86**
	O7	0.98**	0.58**	0.45*	0.78**
	O8	1.08**	0.49**	0.56**	0.73**
	O9	0.85**	0.54**	0.58**	0.72**
	O10	0.84**	0.43**	0.46**	0.69**
Adaptable	O11	0.81**	0.4**	0.45**	0.8**
	O12	0.54**	0.55**	0.44**	0.57**
	O13	0.87**	0.51**	0.6**	0.78**
	O14	0.91**	0.36**	0.72**	0.54**
	O15	0.68**	0.61**	0.73**	0.89**
	O16	0.95**	0.43**	0.93**	0.68**
	O17	0.69**	0.52**	0.71**	0.82**
	O18	0.65**	0.76**	0.79**	0.8**
	O19	0.83**	0.56**	0.84**	0.78**
	O20	0.76**	0.36**	0.84**	0.95**
Practicable	O21	0.7**	0.43**	0.47**	0.61**
	O22	0.7**	0.5**	0.61**	0.69**
	O23	0.44**	0.45**	0.49**	0.6**
	O24	0.8**	0.61**	0.48**	0.6**
	O25	1.03**	0.53**	0.65**	0.5**
	O26	0.84**	0.32**	0.57**	0.65**
	O27	0.89**	0.51**	0.67**	0.88**
	O28	0.86**	0.47**	0.86**	0.77**
	O29	0.88**	0.65**	0.83**	0.77**
	O30	0.79**	0.39**	0.67**	1.02**
Serviceable	O31	0.53**	0.25^{ns}	0.51**	0.5**
	O32	0.3**	0.5**	0.7**	0.43**
	O33	0.47**	0.4**	0.82**	0.59**
	O34	0.55**	0.58**	0.69**	0.55**
	O35	0.7**	0.49**	0.68**	0.72**
	O36	0.43**	0.39**	0.66**	0.8**
	O37	0.57**	0.6**	0.9**	0.42**
	O38	0.62**	0.68**	0.76**	0.72**
	O39	0.65**	0.47**	0.74**	0.8**
	O40	0.64**	0.36**	0.63**	0.72**

*Significance levels **: 0.01, *: 0.05, ns: non-significant*

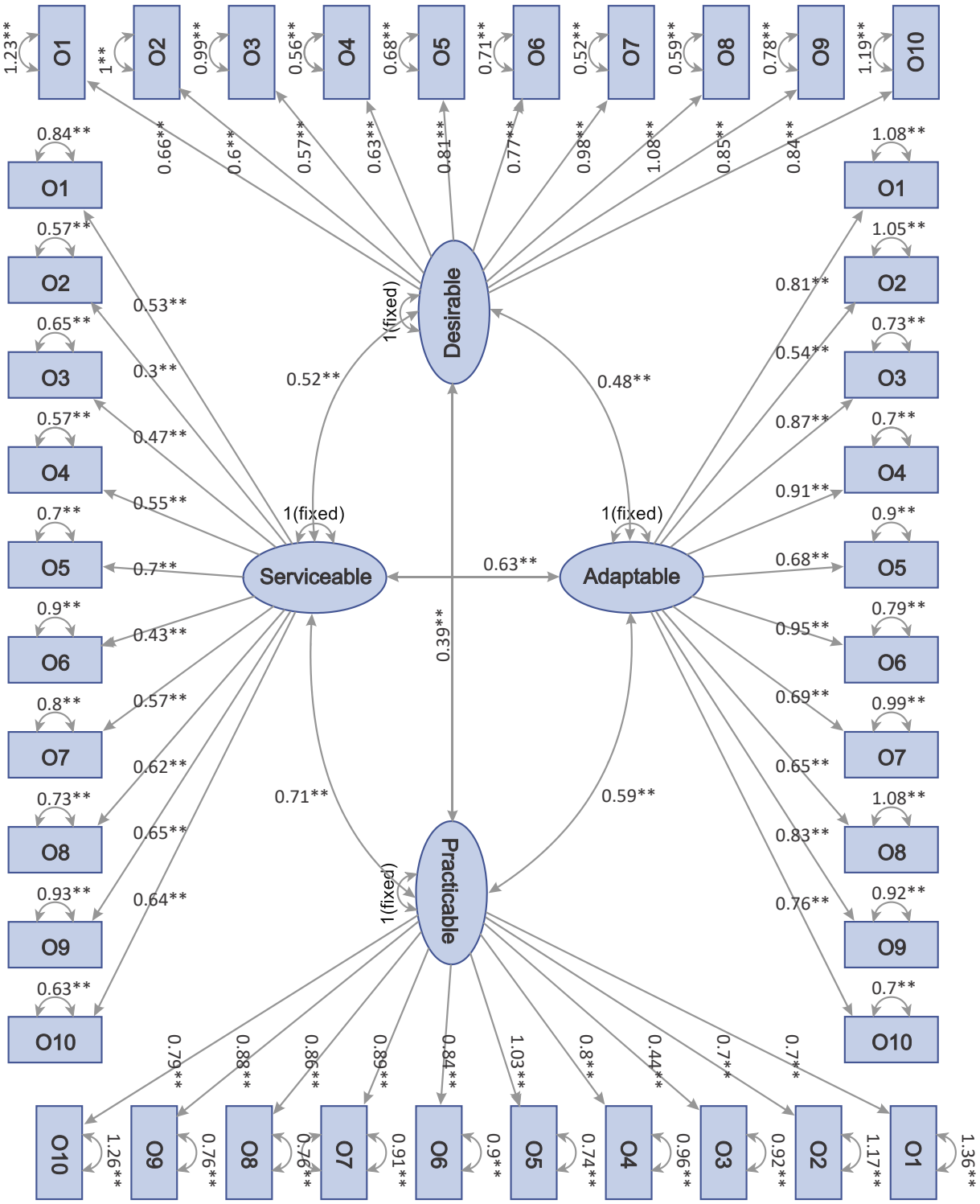
Table 4.5 shows the co-variance matrix of studied constructs in each case study. All the co-variances are significant at a level of P-value < 0.01, except for Serviceable against Desirable in iLearn Platform and Practicable against Desirable in HSM Building. Significantly higher co-variances in the Cinema Complex show the high relevance of constructs compared to the other three case studies (Figures 4.7 to 4.10).

Table 4.5. Co-variance matrix of constructs (internal variances fixed at 1) for Group 1 case studies

Case Study	Constructs	Desirable	Adaptable	Practicable	Serviceable
Sports Complex	Desirable	1			
	Adaptable	0.48**	1		
	Practicable	0.39**	0.59**	1	
	Serviceable	0.52**	0.63**	0.71**	1
Cinema Complex	Desirable	1			
	Adaptable	0.86**	1		
	Practicable	0.84**	0.84**	1	
	Serviceable	0.88**	0.68**	0.92**	1
iLearn Platform	Desirable	1			
	Adaptable	0.55**	1		
	Practicable	0.54**	0.63**	1	
	Serviceable	0.32*	0.53**	0.59**	1
HSM Building	Desirable	1			
	Adaptable	0.41**	1		
	Practicable	0.33*	0.35**	1	
	Serviceable	0.38**	0.53**	0.61**	1

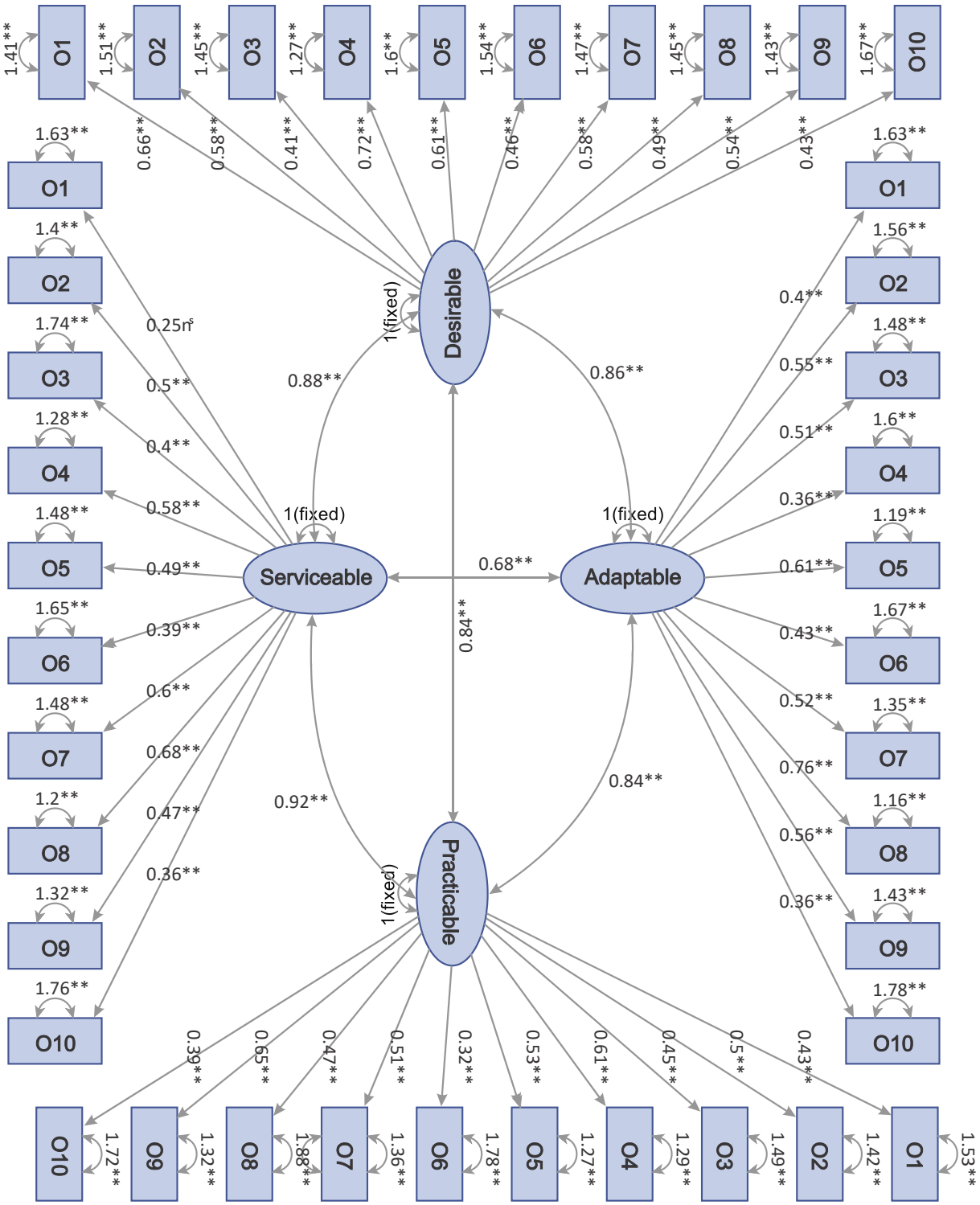
*Significance levels **: 0.01, *: 0.05, ns: non-significant*

Figure 4.7. Confirmatory factor analysis solution for Sports Complex (internal variances and factor loadings)



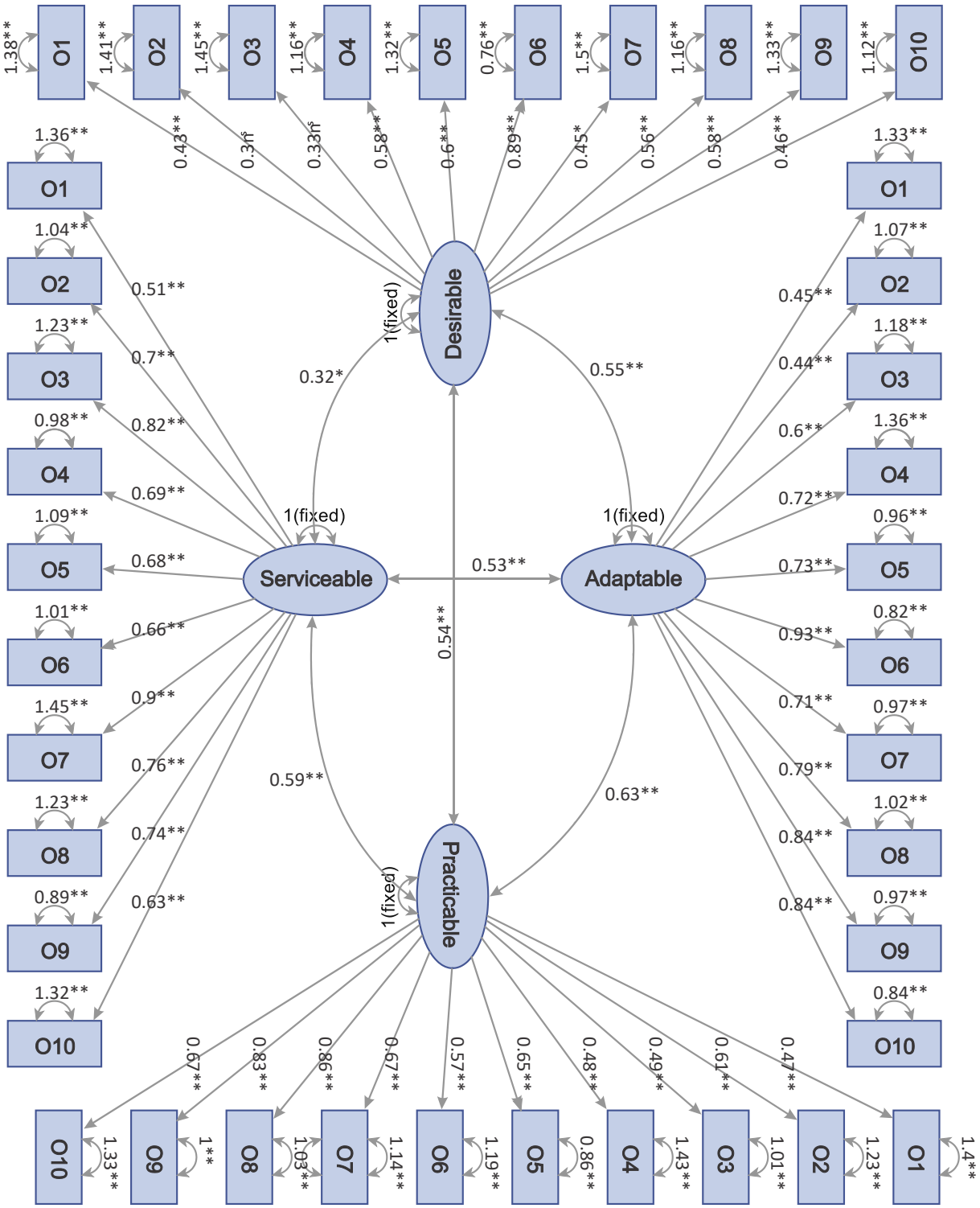
*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

Figure 4.8. Confirmatory factor analysis solution for Cinema Complex (internal variances and factor loadings)



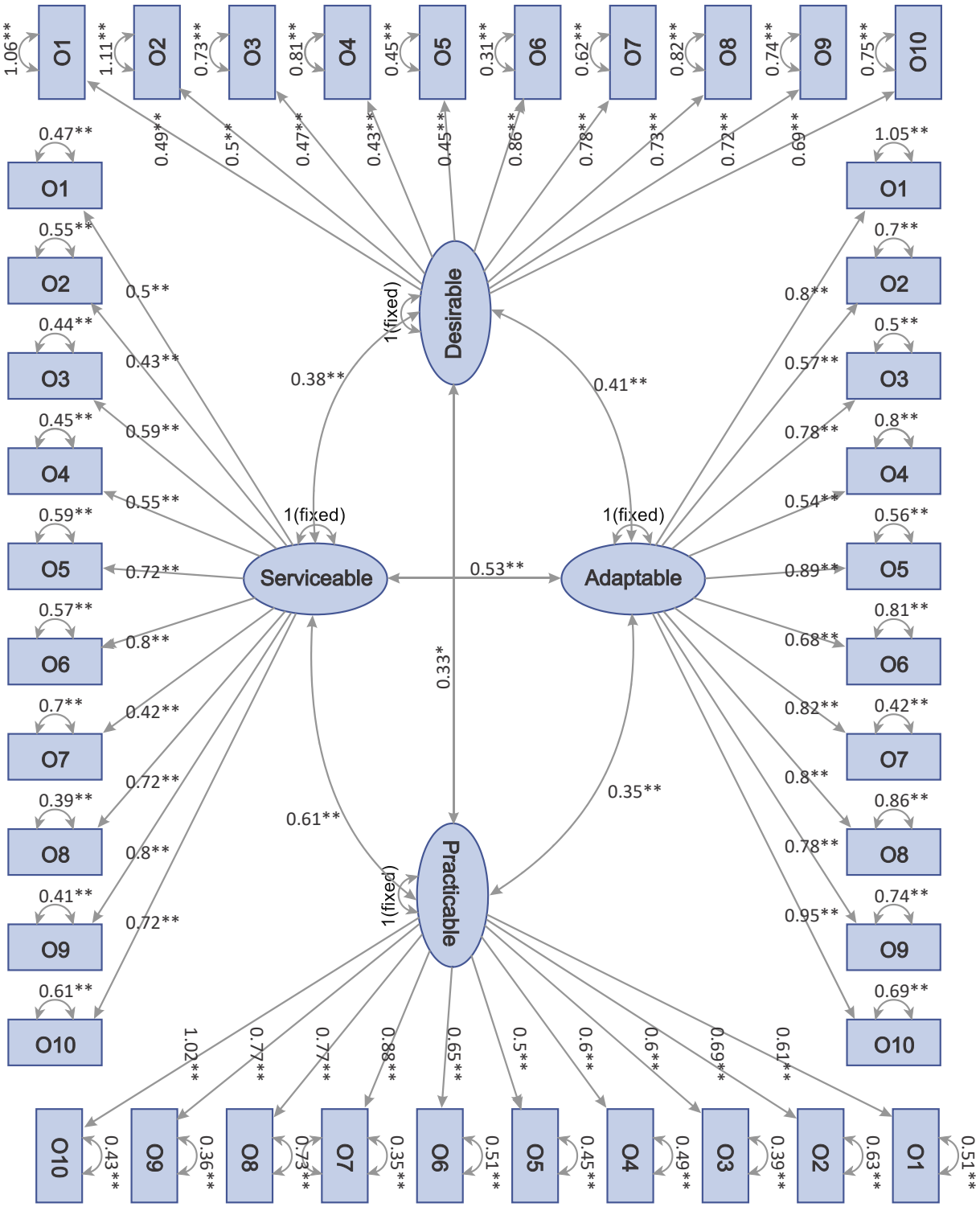
*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

Figure 4.9. Confirmatory factor analysis solution for iLearn Platform (internal variances and factor loadings)



*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

Figure 4.10. Confirmatory factor analysis solution for HSM Building (internal variances and factor loadings)



*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

4.3.2.3 Correlation analysis

Because both the opinion and relevance (weightage) of each item are asked from the end-users, there is a possibility of a correlation between the two. As required under the testing procedure for the next step of the analysis, opinion and relevance should be multiplied, therefore, prior removal of the correlation between opinion and relevance to reduce variance inflation to an acceptable level is required. The correlation analysis shows a significant correlation in 80 items in all case studies between opinion and relevance. To remove this correlation, a linear model is fitted for each item and the residuals are rescaled according to the following equation so that the range of the obtained relevance is between 1 and 5. The calculation of adjusted relevancies is using the raw relevance:

$$R'_{ijk} = \frac{Res_{R_{ijk}} + |Res_{minjk}|}{Res_{maxjk} + |Res_{minjk}|} * 4 + 1$$

where R'_{ij} is the adjusted relevance for subject i of item j in construct k, Res_{Rij} is the residual of a linear model for subject i of item j in construct k, Res_{minijk} is the minimum residual of item j in construct k, and Res_{maxijk} is the maximum residual of item j in construct k. Multiplication of the fraction part by 4 and adding the result to 1 gave a linear conversion of the scale.

Table 4.6 shows the reduction in Pearson's correlation coefficient after rescaling the relevance and removal of the correlation. This also shows that in Sports Centre and HSM Building, most Serviceable items have significant correlations between opinion and respective relevance. Note that bold numbers are significant coefficients at 0.05 level, *: removed correlation for this item.

Table 4.6. Correlation analysis between opinion and relevance

		Before removal				After removal			
		Sports Centre	Cinema Complex	iLearn Platform	HSM Building	Sports Centre	Cinema Complex	iLearn Platform	HSM Building
Desirable	1	**0.24**	**0.27**	-0.11	0.23	0.01	0.00	-0.11	0.23
	2	**0.33**	**0.28**	0.02	**0.35**	0.00	0.00*	0.02	-0.02
	3	0.09	**0.29**	-0.21	**0.26**	0.09	0.00	-0.21	-0.01
	4	0.13	**0.18**	-0.05	**0.46**	0.13	0.01	-0.05	-0.02
	5	**0.25**	**0.19**	**-0.29**	0.12	0.00	0.01	0.00	0.12
	6	0.19	0.06	-0.04	**0.31**	0.19	0.06	-0.04	-0.01
	7	0.06	0.10	0.02	0.10	0.06	0.10	0.02	0.10
	8	0.12	0.11	0.12	0.15	0.12	0.11	0.12	0.15
	9	**0.21**	0.13	0.04	**0.35**	0.00	0.13	0.04	0.00
	10	**0.22**	**0.20**	0.10	**0.38**	0.00	0.00	0.10	0.00
Adaptable	1	0.14	**0.36**	0.02	0.18	0.14	0.00	0.02	0.18
	2	0.13	0.12	0.10	0.12	0.13	0.12	0.10	0.12
	3	0.09	**0.34**	-0.06	**0.39**	0.09	-0.01	-0.06	0.00
	4	**0.33**	0.06	0.22	-0.02	0.01	0.06	0.22	-0.02
	5	0.16	**0.31**	0.09	0.16	0.16	0.00	0.09	0.16
	6	**0.30**	**0.28**	**0.26**	**0.43**	-0.01	0.00	0.00	0.02
	7	**0.27**	0.11	0.22	**0.33**	0.01	0.11	0.22	-0.02
	8	**0.25**	**0.19**	0.15	**0.39**	0.01	0.00	0.15	0.03
	9	0.17	0.09	**0.25**	0.24	0.17	0.09	0.00	0.24
	10	**0.31**	0.00	0.01	**0.45**	0.01	0.00	0.01	-0.02
Practicable	1	**0.31**	0.04	0.07	**0.26**	0.00	0.04	0.07	0.00
	2	**0.22**	0.11	0.15	**0.49**	0.00	0.11	0.15	0.00
	3	0.17	-0.03	0.13	0.22	0.17	-0.03	0.13	0.22
	4	**0.36**	**0.32**	0.17	**0.36**	-0.01	-0.01	0.17	-0.01
	5	**0.40**	**0.23**	**0.28**	0.22	0.00	0.00	0.00	0.22
	6	0.12	0.17	0.04	0.21	0.12	0.17	0.04	0.21
	7	**0.25**	0.12	**0.32**	0.25	-0.01	0.12	0.00	0.25
	8	**0.30**	0.05	0.23	**0.26**	0.00	0.05	0.23	0.01
	9	**0.22**	**0.30**	0.21	**0.48**	0.01	0.01	0.21	0.02
	10	0.19	**0.20**	0.19	**0.52**	0.19	0.00	0.19	0.04
Serviceable	1	**0.22**	0.12	0.08	**0.36**	0.00	0.12	0.08	-0.01
	2	**0.36**	0.10	0.17	**0.30**	-0.01	0.10	0.17	-0.01
	3	**0.30**	-0.04	0.01	**0.59**	0.00	-0.04	0.01	0.01
	4	**0.34**	**0.18**	**0.35**	**0.47**	0.00	-0.01	0.01	0.01
	5	**0.51**	**0.25**	0.19	**0.52**	-0.01	0.00	0.19	0.03
	6	**0.40**	**0.26**	**0.31**	0.21	0.00	0.00	0.00	0.21
	7	0.16	**0.21**	0.14	0.12	0.16	0.00	0.14	0.12
	8	**0.26**	0.11	0.12	**0.42**	-0.01	0.11	0.12	0.00
	9	**0.40**	**0.26**	**0.28**	**0.28**	0.01	-0.01	0.00	-0.01
	10	**0.31**	**0.21**	-0.04	**0.42**	0.01	0.00	-0.04	-0.02

4.3.2.4 Canonical discriminant analysis

Results of the canonical discriminant analysis (CDA) show that three canonical variables (CV) can explain all the variations between the four case studies. The first and second CVs have significant correlations of 0.64 and 0.46, respectively. However, the third CV has a non-significant correlation of 0.39 with the class variable which here are case studies of the experiment. Significantly low R-squares (lower than 0.85) show that all case studies have significant overlap on every CV (Table 4.7). Eigenvalues values in Table 4.8 also show that the first CV accounts for 61% of explained variations and the second CV accounts for 24% of the variation. The third CV only accounts for 15% of the variation among items which are statistically non-significant. Table 4.9 shows the ANOVA test of canonical correlations.

Table 4.7. Results of correlation between canonical variables and the class variable for Group 1 case studies

	Canonical Correlation	Adjusted Canonical Correlation	Approximate Standard Error	R-Square
1	0.643983	0.587363	0.031695	0.414714
2	0.462398	0.359789	0.042574	0.213812
3	0.386054	0.280766	0.046082	0.149038

Table 4.8. Eigenvalues of canonical correlations and model expression proportions

	Eigenvalue	Difference	Proportion	Cumulative
1	0.7086	0.4366	0.6131	0.6131
2	0.272	0.0968	0.2353	0.8485
3	0.1751	0.1515		1

Table 4.9. ANOVA test of canonical correlations

	Likelihood Ratio	Approximate F Value	Numerator DF	Denominator DF	Pr > F
1	0.391566	2.75	120	896.67	<.0001
2	0.669016	1.71	78	600	0.0003
3	0.850962	1.39	38	301	0.0718

Canonical variable scatterplots in Figures 4.11 to 4.13 show high overlaps among all case studies and no clear border can be drawn between them, 95% confidence limit ellipse also shows that some case studies have an overlap of more than 80% (e.g. iLearn Platform and HSM Building). Therefore, a non-significant difference among the case studies can be considered in terms of satisfaction. Hence, all case studies can be entered into IRT analysis in one group.

Figure 4.11. Scatterplot of canonical variable 1 vs canonical variable 2

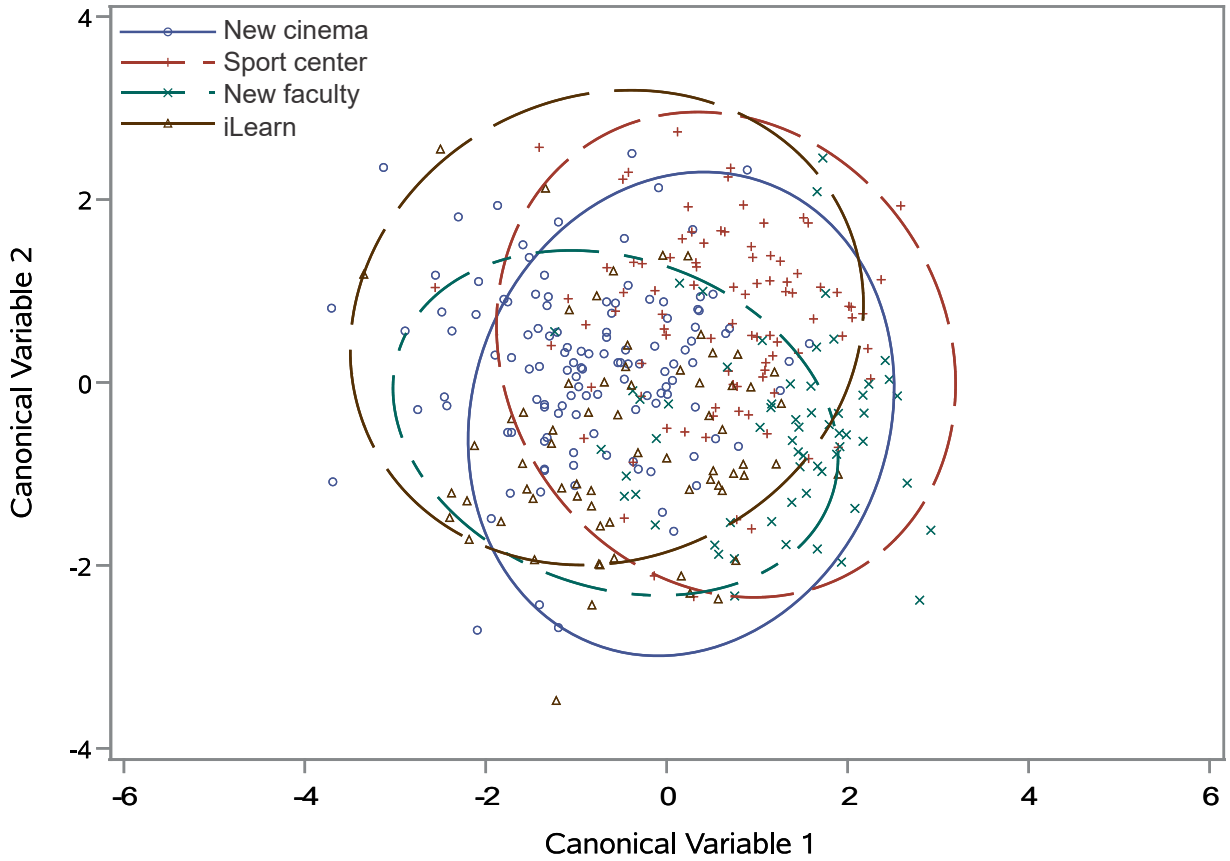


Figure 4.12. Scatterplot of canonical variable 1 vs canonical variable 3

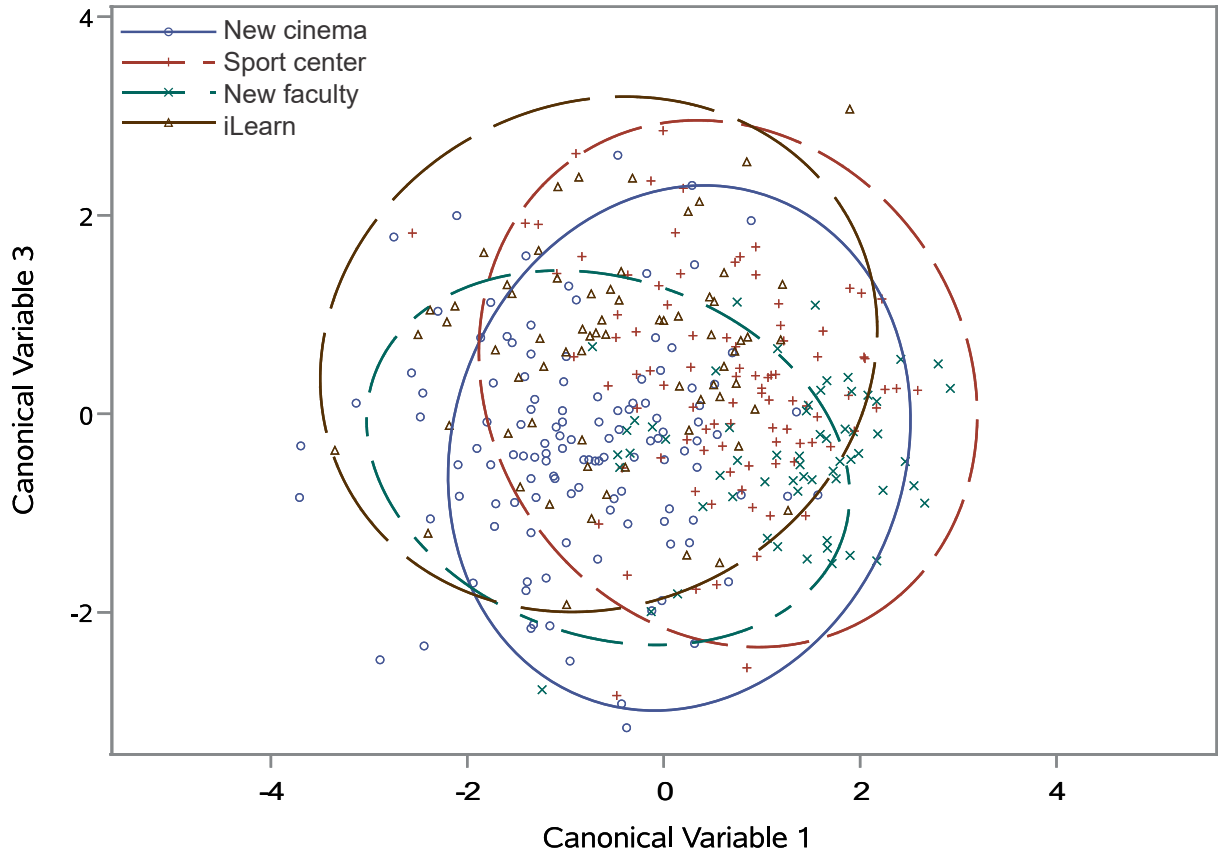
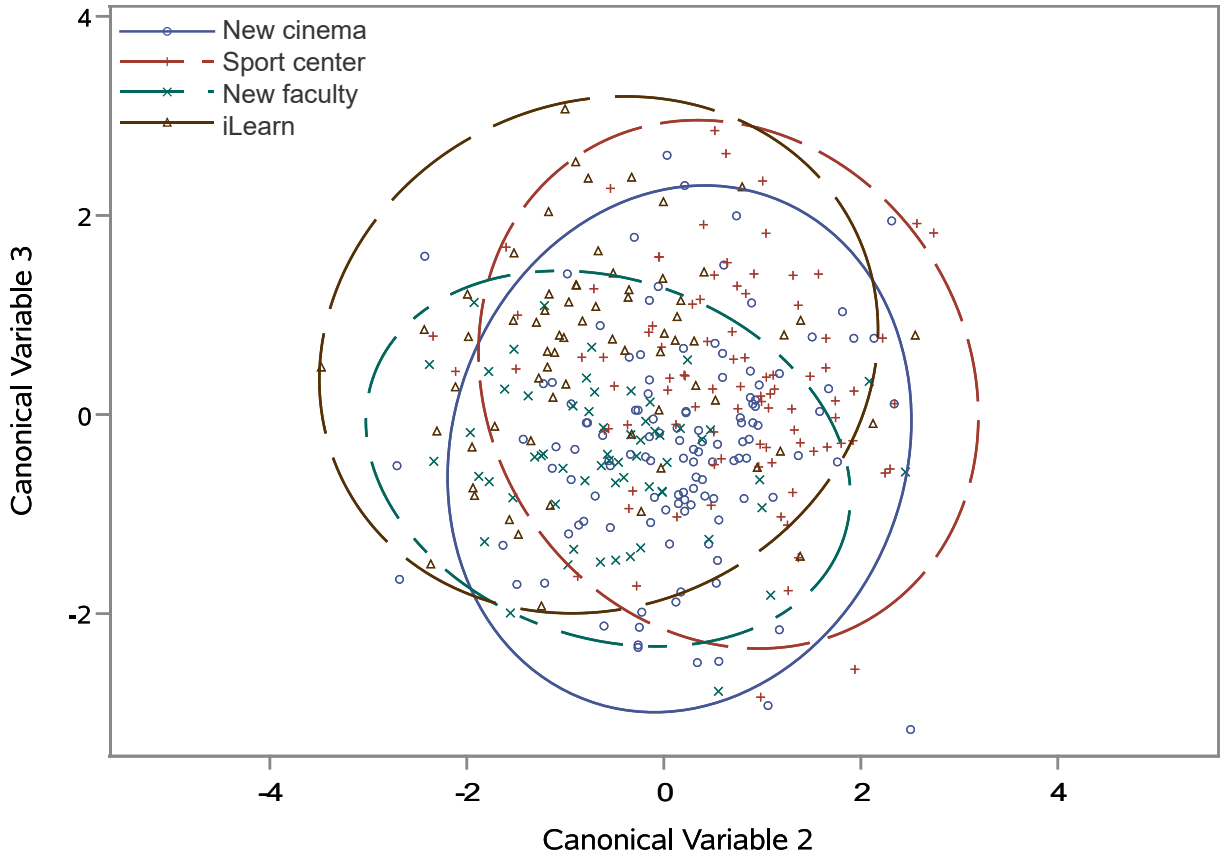


Figure 4.13. Scatterplot of canonical variable 2 vs canonical variable 3



4.3.2.5 Item response theory

IRT item scores are analyzed using the logit link function and graded response model with 40 items and 4 factors (constructs). A total of 342 subject data are entered into the model. Marginal Maximum Likelihood was selected as the IRT estimation method, which is a common model for survey satisfaction analysis. The log-likelihood of the model was calculated as -26757 with a linear chi-square of 49552 (Table 4.10).

The polychoric correlation result in Figure 4.14 shows that the internal correlation in the first three factors is significantly high as the squares of each 10 scores item show obvious borders. However, polychoric correlation in the last factor (Serviceable, Sc31 to Sc40) has faded borders which is the result of the higher difficulty of the items. Therefore, item difficulties are the lowest in Desirable and applicable constructs and highest in Serviceable construct. Factors score plots (Figures 4.15 to 4.20) show that all case studies are completely mixed that shows no differences like the data. The scatterplots also show a positive correlation between all four factors, as they stretched along the diagonal of the scatterplot.

Table 4.10. Model fit properties and statistics after 194 iterations

Link Function	Logit
Response Model	Graded Response Model
Number of Items	40
Number of Factors	4
Number of Observations Read	342
Number of Observations Used	342
Estimation Method	Marginal Maximum Likelihood
Optimization Technique	Quasi-Newton
Likelihood Approximation	Adaptive Gauss-Hermite Quadrature
Number of Quadrature Points	5
Number of Free Parameters	437
Log-Likelihood	-26756.57242
AIC	54387.14484
BIC	56062.95713
LR Chi-Square	49522.1343
LR Chi-Square DF	3.40E+41

Figure 4.14. Polychoric correlation heatmap of scores (Sc) against each other

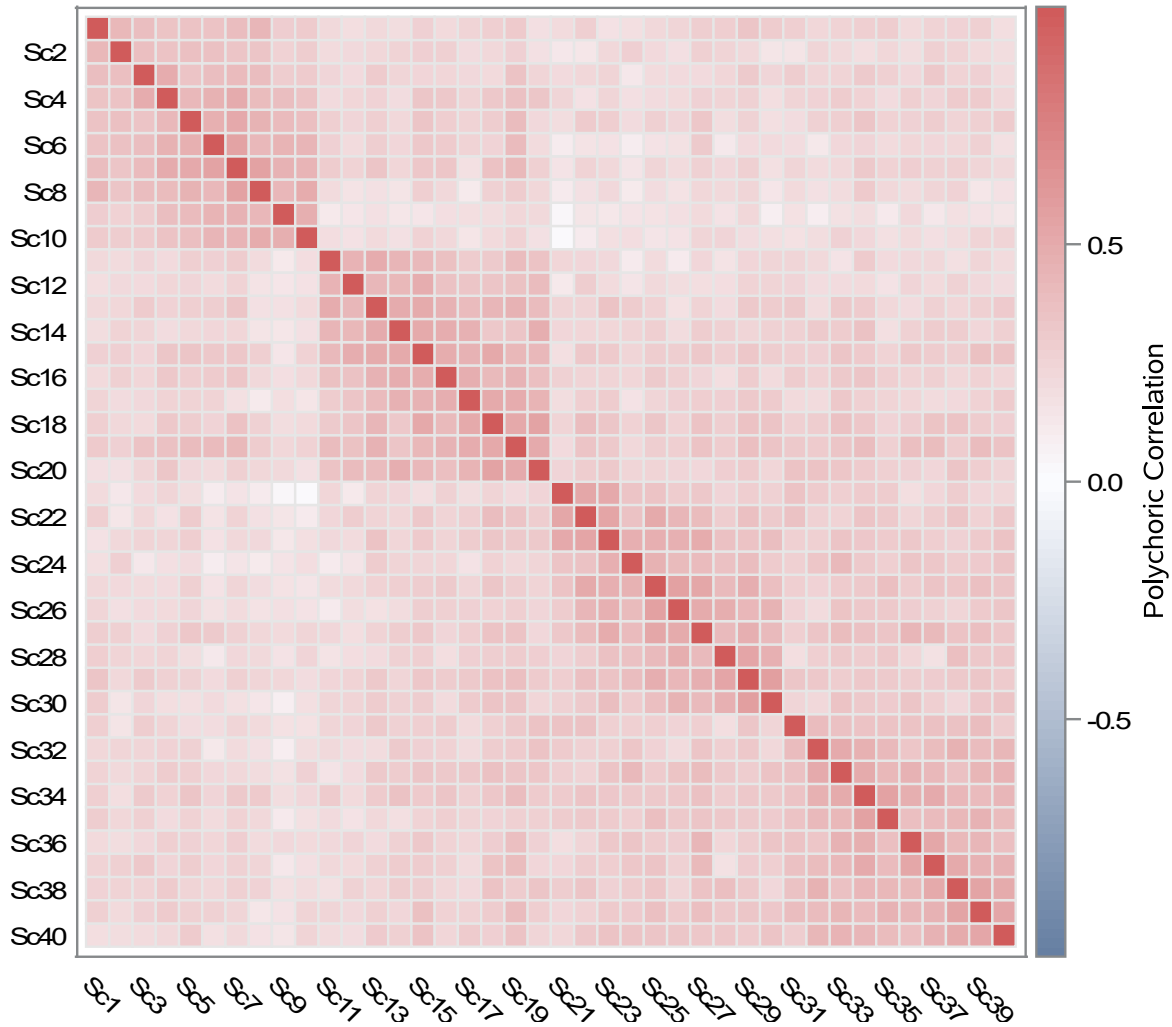


Figure 4.15. IRT scatterplot of Desirable vs Adaptable constructs

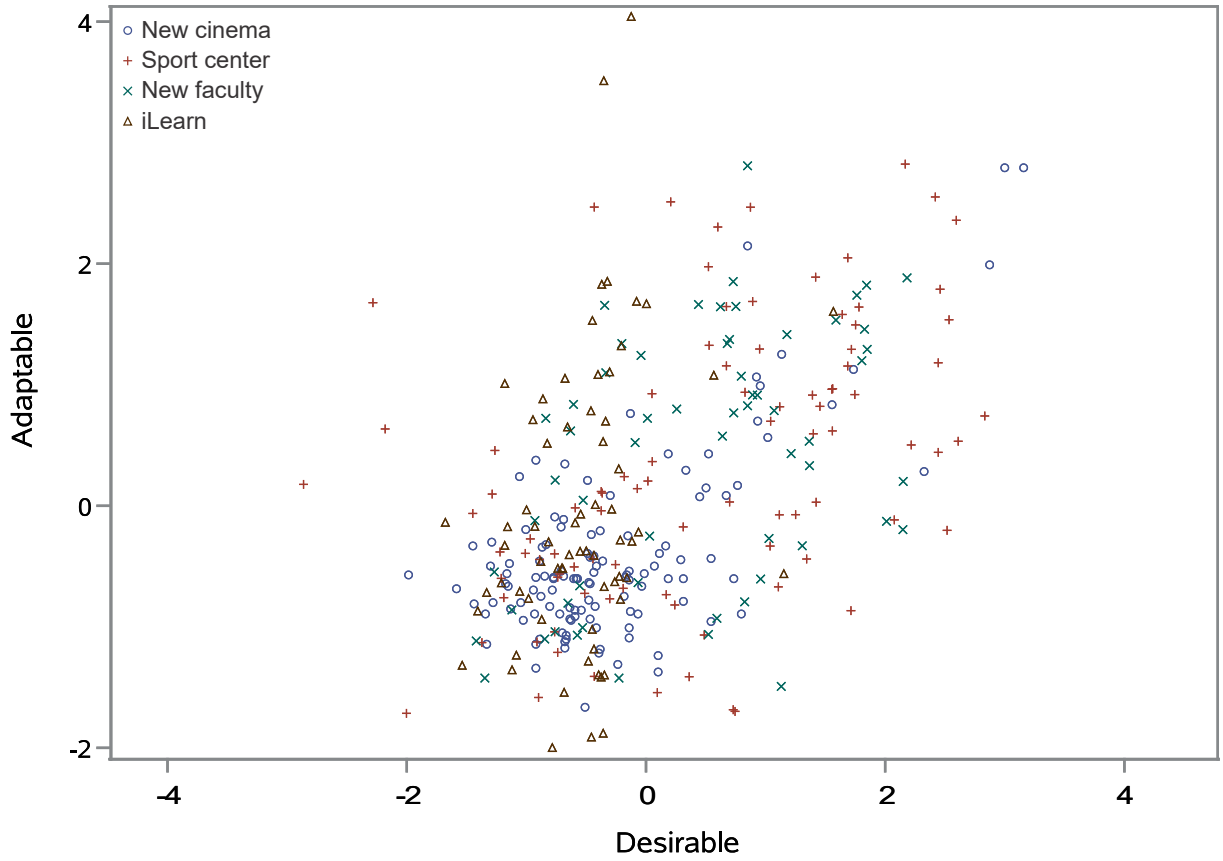


Figure 4.16. IRT scatterplot of Desirable vs Practicable constructs

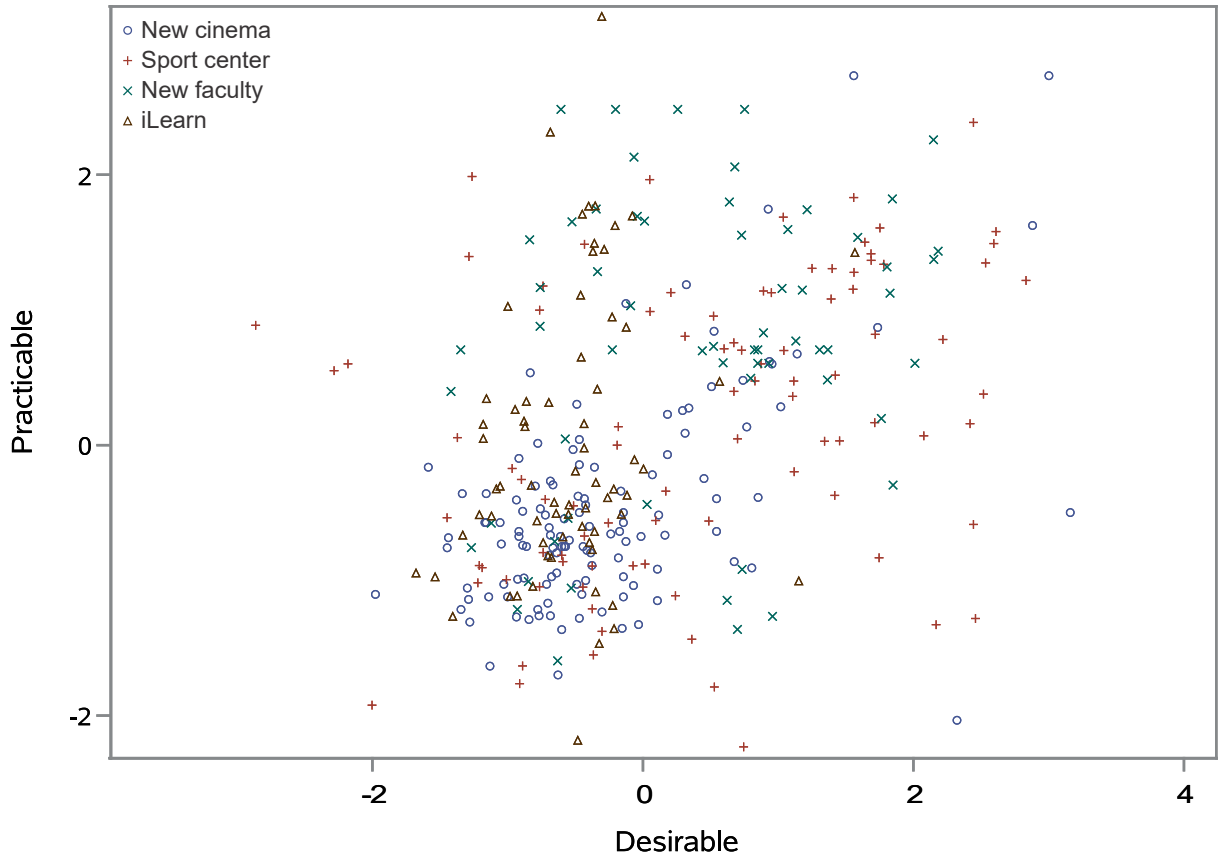


Figure 4.17. IRT scatterplot of Desirable vs Serviceable constructs

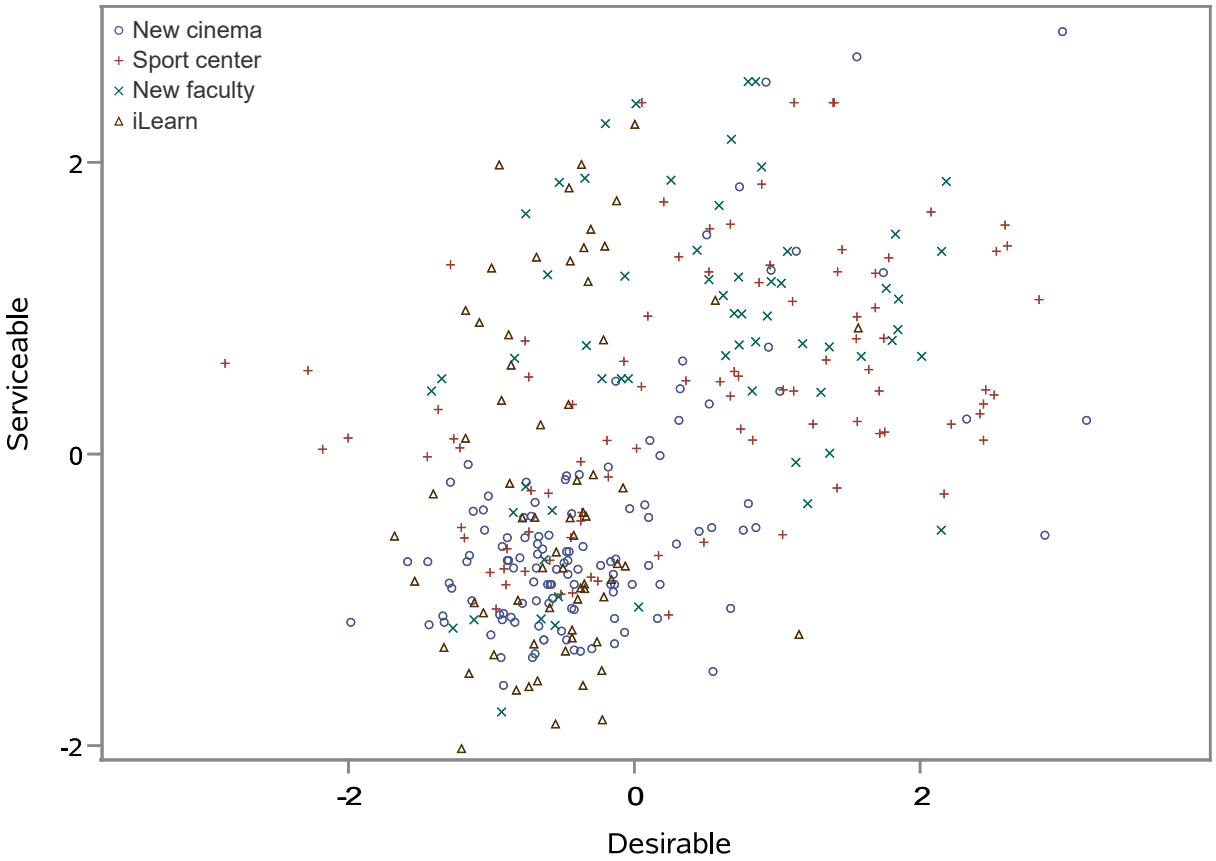


Figure 4.18. IRT scatterplot of Adaptable vs Practicable constructs

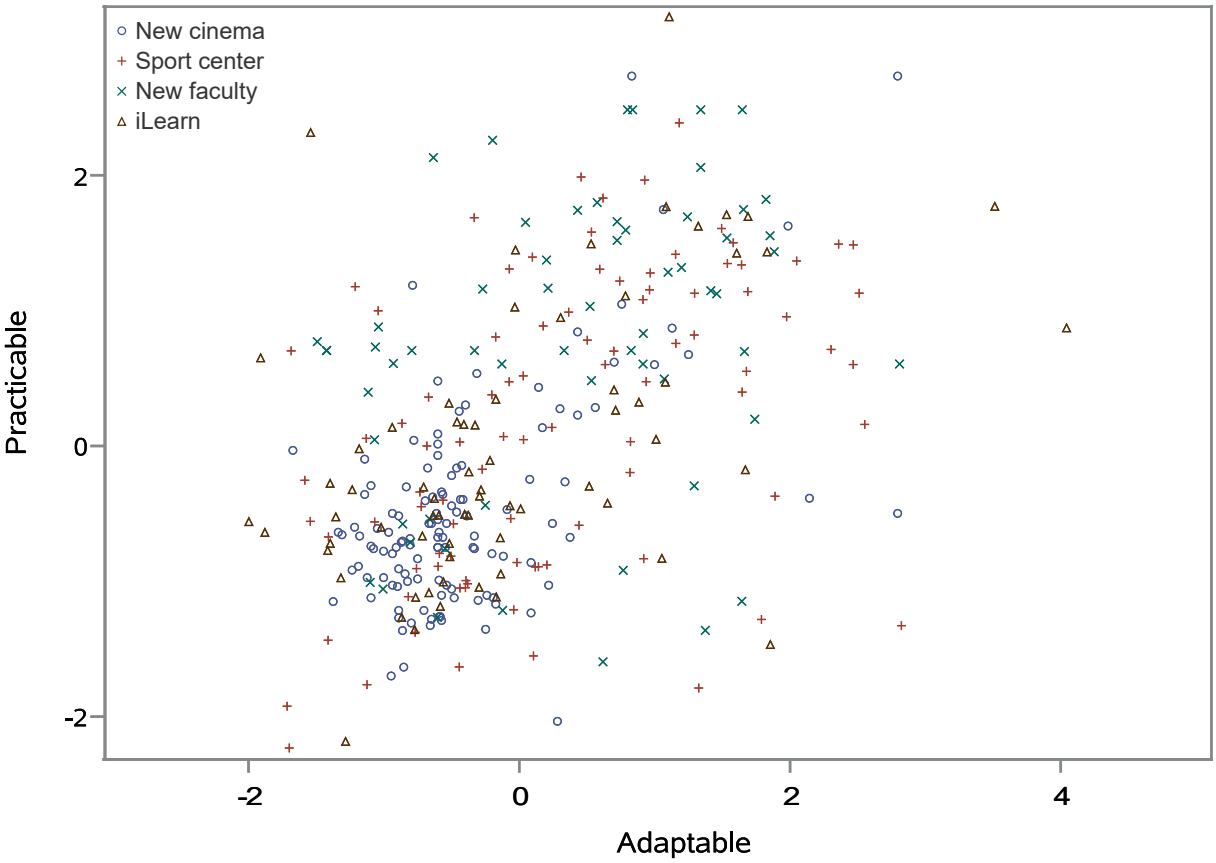


Figure 4.19. IRT scatterplot of Adaptable vs Serviceable constructs

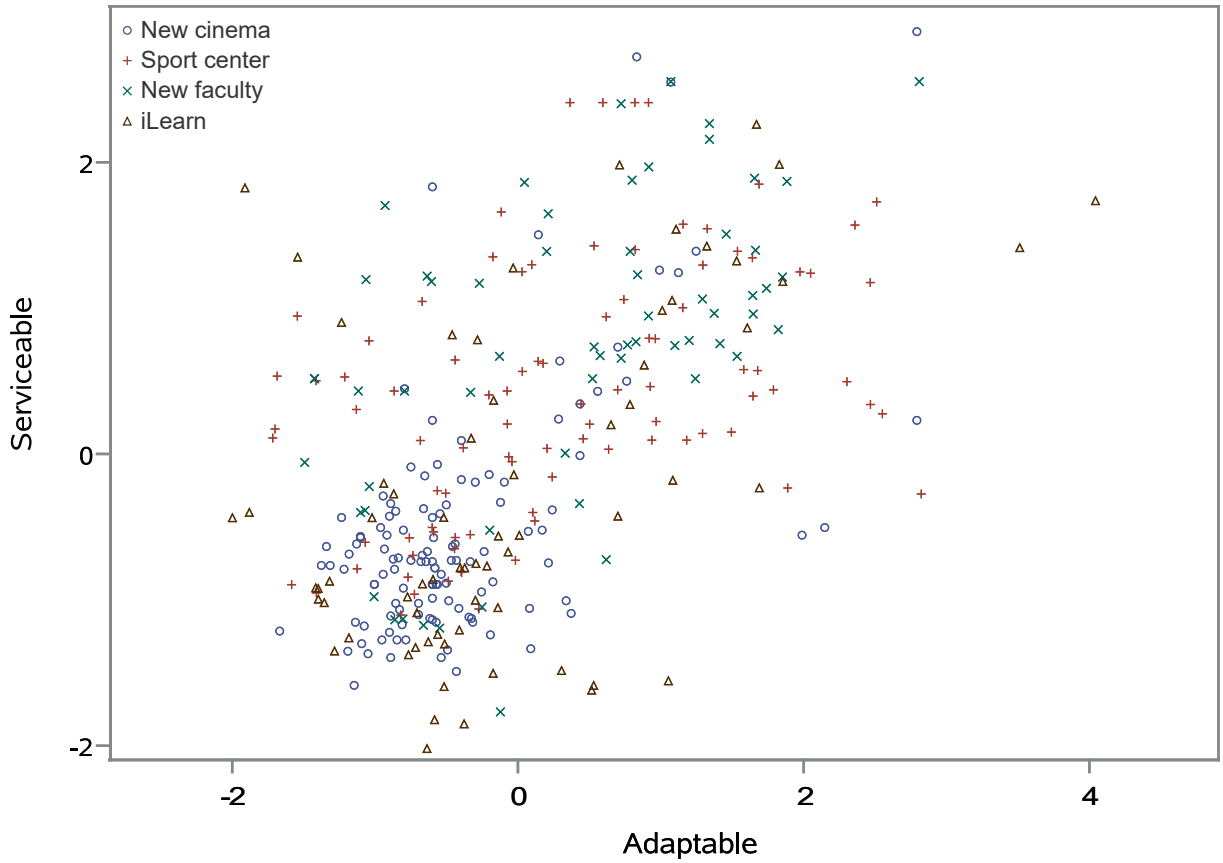
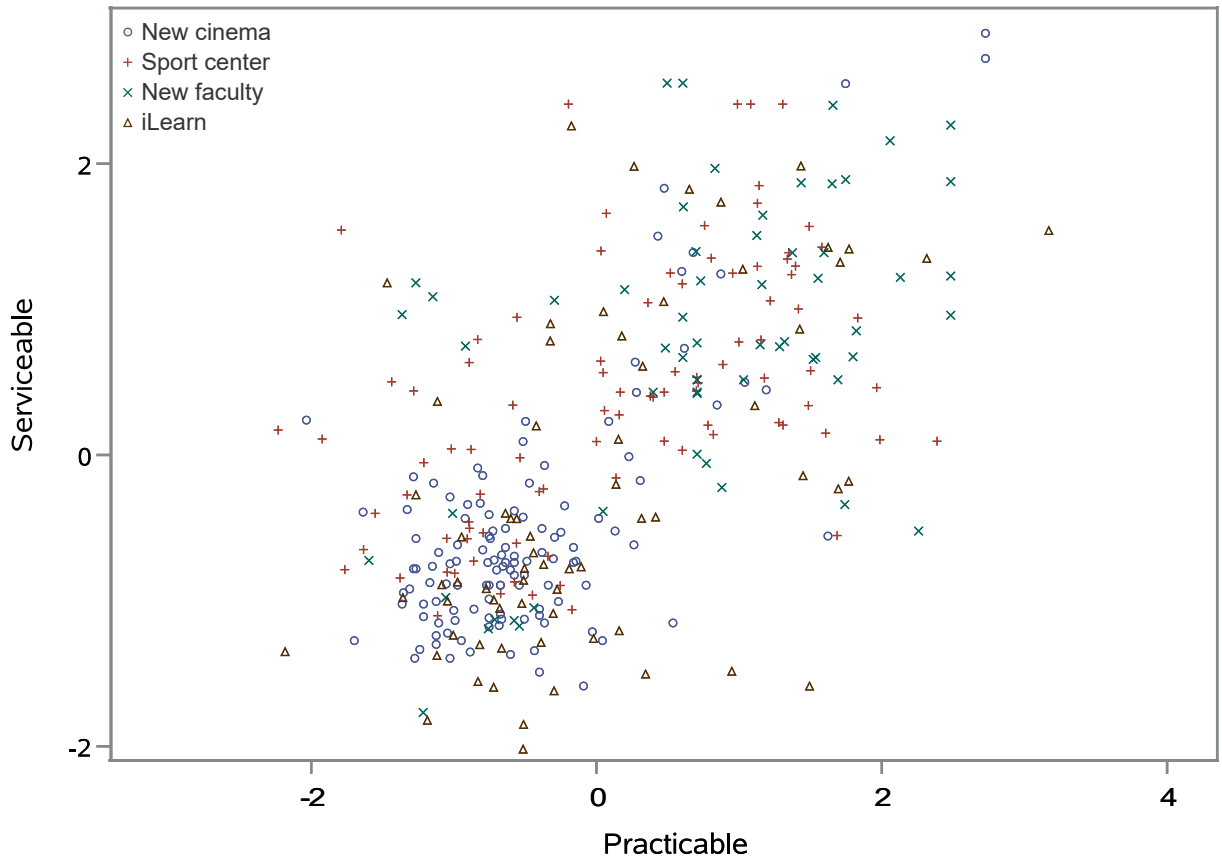


Figure 4.20. IRT scatterplot of Practicable vs Serviceable constructs



4.3.2.6 Model specification

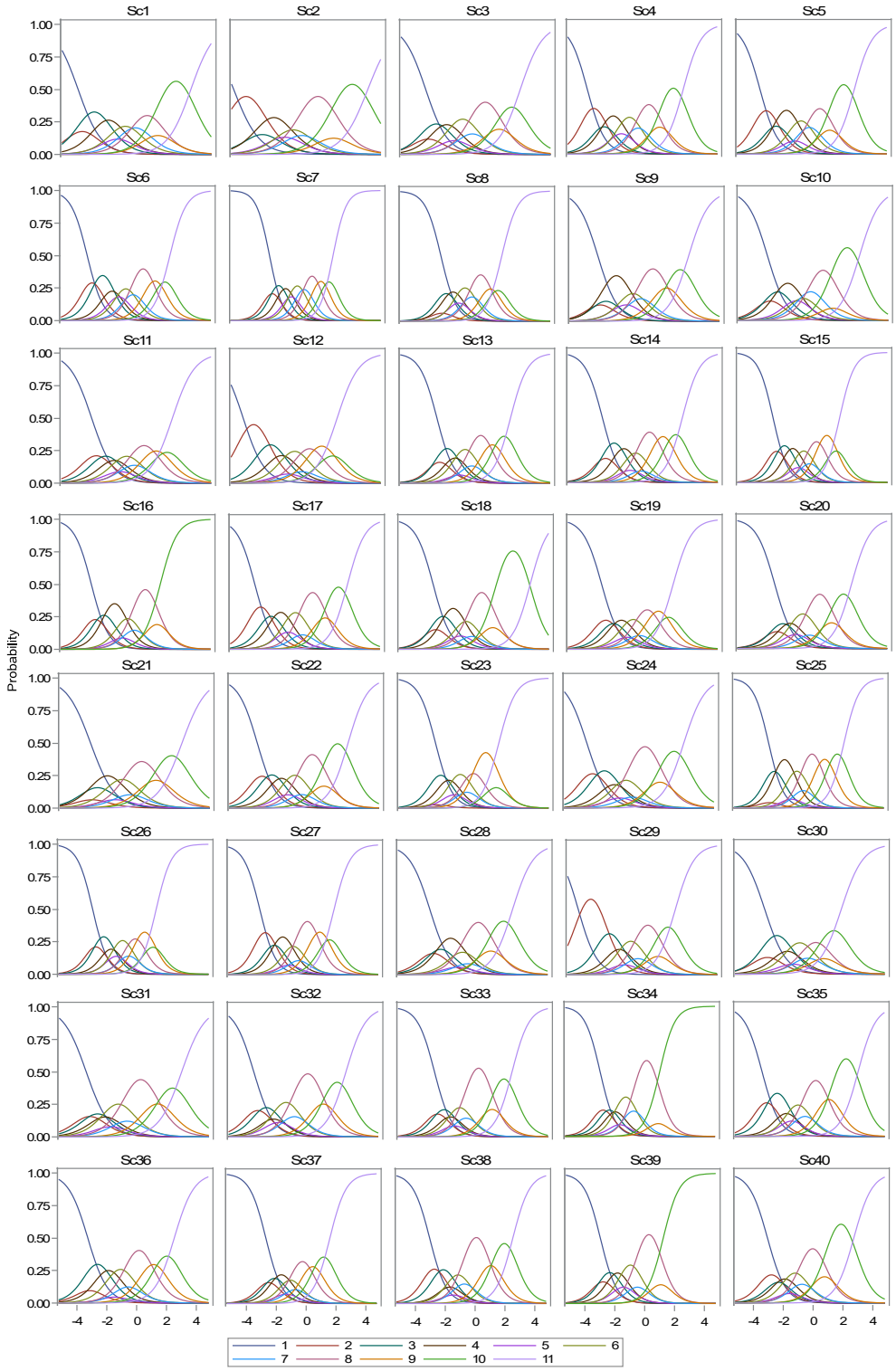
The slope parameter of each 10 items in each construct shows that all items add significant information to the survey as the parameter is higher than 1 in all the items and the P-value is lower than 0.0001. The highest slopes among the items are score 07 of the Desirable construct (Sc7) with a slope of 2.26 and score 05 of the Adaptable constructs (Sc15) with a slope of 2.02 (Table 4.11).

Table 4.11. Slope characteristics of each 10 scores in each construct

		Desirable	**Adaptable**	**Practicable**	**Serviceable**
Score 01	Slope	1.27735	1.34801	1.2305	1.29133
	Standard error	0.13801	0.14162	0.13565	0.13913
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 02	Slope	1.15341	1.38619	1.54746	1.51446
	Standard error	0.1334	0.14524	0.15641	0.15256
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 03	Slope	1.34178	1.74636	1.76714	1.7501
	Standard error	0.1419	0.16672	0.1733	0.16894
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 04	Slope	1.67293	1.7413	1.41103	1.95884
	Standard error	0.16081	0.16552	0.14584	0.19132
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 05	Slope	1.65586	2.01792	1.96767	1.69559
	Standard error	0.15997	0.18778	0.18603	0.16234
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 06	Slope	1.84149	1.75356	1.94455	1.51373
	Standard error	0.17136	0.17079	0.18211	0.1519
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 07	Slope	2.26137	1.70021	1.85347	1.8111
	Standard error	0.20895	0.16352	0.17776	0.17415
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 08	Slope	1.91252	1.69647	1.44428	1.76489
	Standard error	0.18048	0.16784	0.1482	0.16919
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 09	Slope	1.48259	1.61723	1.5749	1.84326
	Standard error	0.14898	0.15981	0.15743	0.18001
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 10	Slope	1.51572	1.61617	1.37933	1.63506
	Standard error	0.15331	0.15749	0.14429	0.16051
	P-Value	<.00001	<.00001	<.00001	<.00001

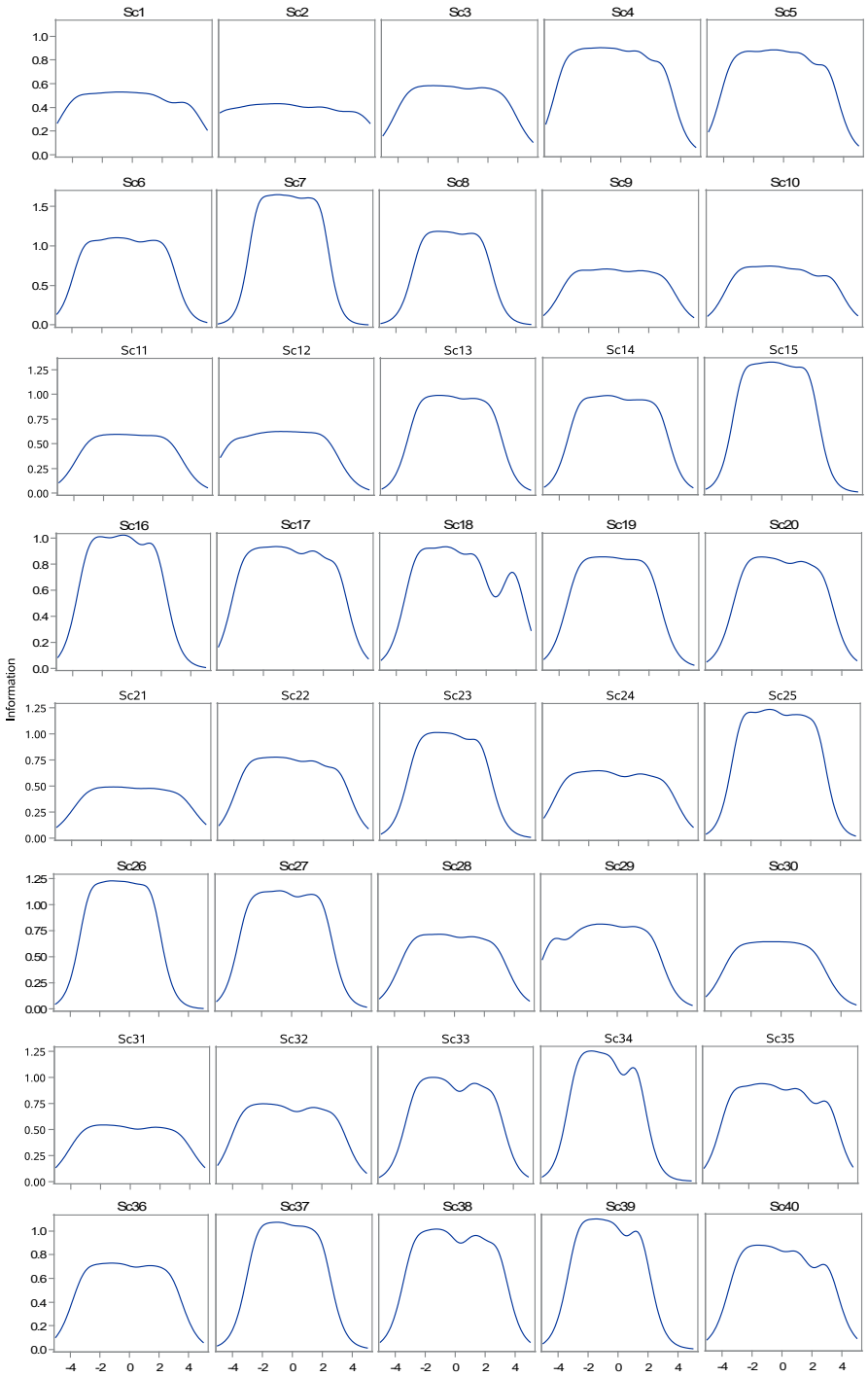
Item characteristic curves (ICC) are also shown in Figure 4.21. Lower slope function is a result of higher difficulties in items like Score 02 of the Desirable construct (Sc2, Slope: 1.15) which can be characterized by low height in extreme scores (1, 11) and higher height in middle scores (2, 5, and 10). This means that the respondent is more indecisive about these items, compared to other ones, which is a result of the participants who had no opinions on the items.

Figure 4.21. Item characteristic curves (ICC) of 40 Score (Sc) items



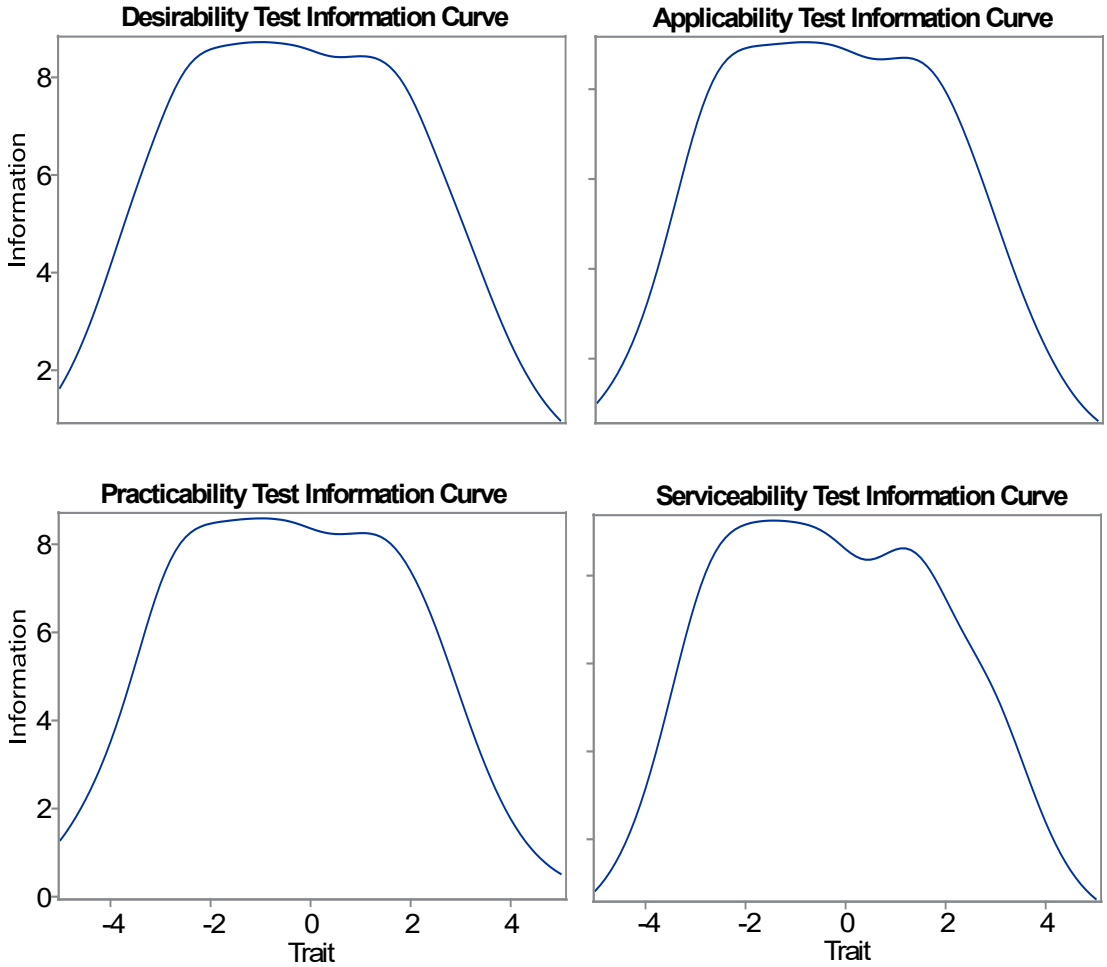
Item information curves (IIC) are more straightforward to interpret the loading of each item on each construct. Higher IIC shows higher information on a specific item and vice versa. Item 7 (Sc7) has the highest IIC with a tip of more than 1.5. which means that this item has the highest effect on the determination of desirability of the product. On the other hand, item 2 (Sc2) is almost a flat curve, which means that this item has the lowest determinant effect on the corresponding construct (Desirability). Nevertheless, this item should not be removed from the survey, as it has a slope higher than 1 (Figure 4.22).

Figure 4.22. Item information curves (IIC) of 40 Score (Sc) items



Finally, test information curves (TIC) show that all four constructs can gain the same amount of information from the defined items in each construct. This curve is the sum of information curves of the items in each factor. The shape of this curve implies between item information variation in each factor. Wide TIC implies higher variation in IIC in each factor and narrow TIC shows lower variation and higher homogeneity among IIC values. In this case, the Desirable factor is mere wider than Serviceable which is the result of the flat IIC for items Sc1 and Sc2. On the other hand, Sc31 has more curvature compared to Sc1 and Sc2 which leads to lower width of Serviceable TIC (Figure 4.23).

Figure 4.23. Test information curves of studied constructs



4.4 Survey modification

Upon completion of the Group 1 case studies, there was no suggestion that any of the critical success factors of the attributes that sit within them need to be changed. No feedback was received that particular attributes were either difficult to understand or irrelevant to end-user satisfaction. In fact, the use of short phrases rather than long sentences was welcomed.

The Qualtrics® online survey was shown to work well and greatly reduced distribution and processing time compared to manual methods. However, for some case studies, it proved necessary to complete the surveys on paper. The main reason for this was that end-users in countries outside Australia have non-English speaking backgrounds and needed help with understanding the questions. Translation via face-to-face discussions proved effective, albeit time-consuming. This was an unexpected cost to the research but was paid from funding provided by a small grant. For future activities in foreign countries, it would be better to translate the online survey. Unfortunately, this was not able to be done in the present study.

Obtaining a solid number of responses was also a challenge. A nominal target of 100 responses was set and, in several cases, exceeded, but in other cases the responses fell short. Nevertheless, enough responses were received to complete the statistical analysis, and it was likely that further responses would not have changed the findings anyway.

The main decision at the end of Group 1 data collection was that the project type of 'post occupancy evaluation' was not really a type but a context. It was clear that undertaking POE requires a different set of questions that are more aligned with office workplaces. This did not sit well with the objective of developing a generic list of attributes for all projects. Nevertheless, the survey of end-users that occupy the HSM Building still achieved the desired intention. It was therefore concluded that POE can be treated as similar to product creation. Hence, Group 2 needed only 3 case studies, not 4. This worked out well, as it proved difficult to find a large project that was owned by a single organization and that was willing to cooperate with this research study.

4.5 Group 2 case studies

Group 2 responses total 345, comprising 103 for HZMB, 104 for BEUE and 138 for GCLR. Data for HZMB and BEUE were collected by a third-party surveyor organized as part of a small research grant with the Asian Infrastructure Investment Bank and The Economist Intelligence Unit.

4.5.1 Case study calculations

The three case studies for Group 2 are summarized in Figures 4.24 to 4.26. Refer to Chapter 3 for background on each case study.

Figure 4.24. HZMB EUS model

DELIGHT (EUS)	65	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR	desirable	65	adaptable	66	practicable	67	serviceable	62

Attractiveness:

	mean	influence
Nice to look at?	3.70	
High quality?	3.08	
Profitable?	2.35	
Well-designed?	3.39	
Valuable?	4.36	
Prestigious?	3.71	
Durable?	4.28	
Popular?	3.49	
Joyful?	3.78	
Unique?	4.30	
User-defined ...	7.17	
User-defined ...	7.67	
	4.27	25.41%
	25.07	

Flexibility:

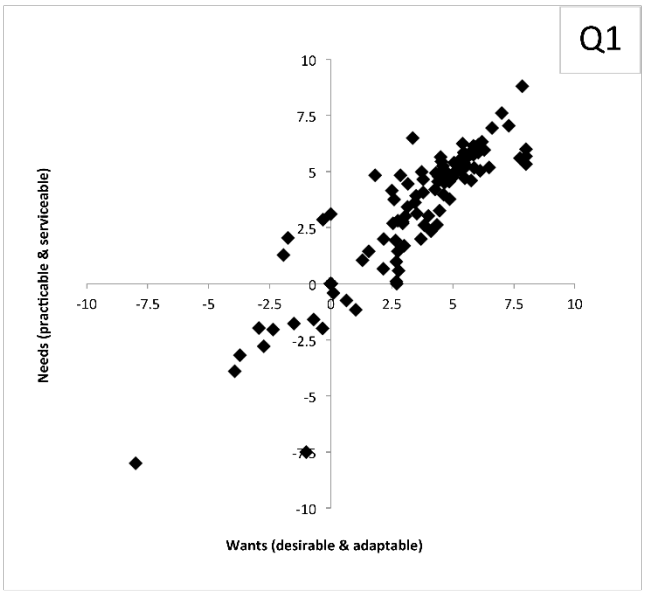
	mean
Versatile?	3.84
Easily modified?	2.52
Able to be customized?	3.46
Multi-use?	4.08
Transportable?	4.15
Better with age?	3.69
Modular?	4.67
Scalable?	4.70
Technically clever?	4.10
Timeless?	4.64
User-defined ...	7.17
User-defined ...	8.00
	4.59 27.27%
	25.40

Fit for Purpose:

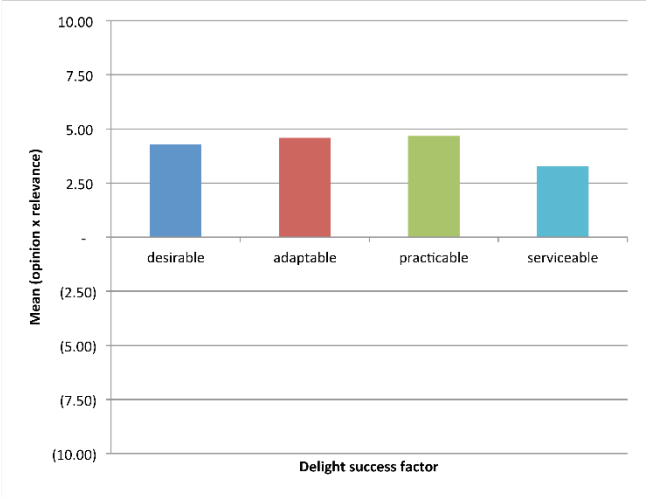
	mean
Functional?	4.53
Appropriate?	4.30
Robust?	4.31
Safe?	4.68
Healthy?	4.32
Problem-solving?	4.00
Easy to use?	4.17
Affordable?	5.11
Comfortable?	4.66
Ethical?	4.13
User-defined ...	6.00
User-defined ...	5.86
	4.67 27.78%
	25.49

Enduring:

	mean
Low maintenance?	1.32
Easily cleaned?	2.69
Recyclable?	3.59
Non-toxic?	2.66
Repairable?	4.32
Energy efficient?	3.51
Reliable?	3.82
Accessible?	3.31
Regenerative?	2.81
Habitat-safe?	2.10
User-defined ...	4.75
User-defined ...	4.57
	3.29 19.54%
	28.05 100.00%



percent Q1	82.52	%
total responses	103	



sample		N/A
return rate		0%
expected delight (LPS)		41%
actual delight (EUS)	✓	65%

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Further Information
https://bond.edu.au/cccr
(including latest updates)

Instructions
Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Disclaimer
Every attempt has been made to use unbiased evidence-based data (cells with light grey shading) in this study where possible.

i3d3 model: Copyright © 2020, Centre for Comparative Construction Research, Bond University

Figure 4.25. BEUE EUS model

DELIGHT (EUS)	88	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

SUCCESS FACTOR	desirable	88	adaptable	89	practicable	88	serviceable	88

Attractiveness:

	mean	influence
Nice to look at?	3.75	
High quality?	5.46	
Profitable?	3.51	
Well-designed?	4.55	
Valuable?	3.67	
Prestigious?	4.60	
Durable?	5.15	
Popular?	4.61	
Joyful?	4.02	
Unique?	3.48	
User-defined ...		
User-defined ...		
	4.28	24.74%
	24.96	

Flexibility:

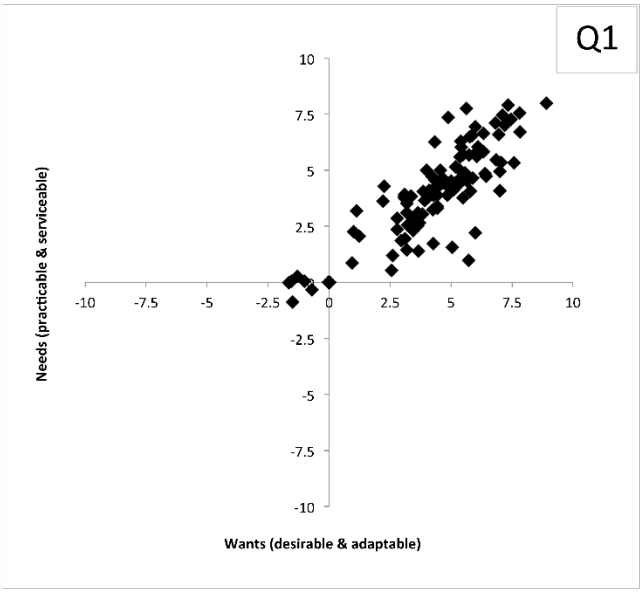
	mean
Versatile?	5.45
Easily modified?	4.96
Able to be customized?	5.11
Multi-use?	2.11
Transportable?	4.68
Better with age?	5.14
Modular?	4.18
Scalable?	4.35
Technically clever?	5.49
Timeless?	4.35
User-defined ...	
User-defined ...	
	4.58 26.50%
	25.09

Fit for Purpose:

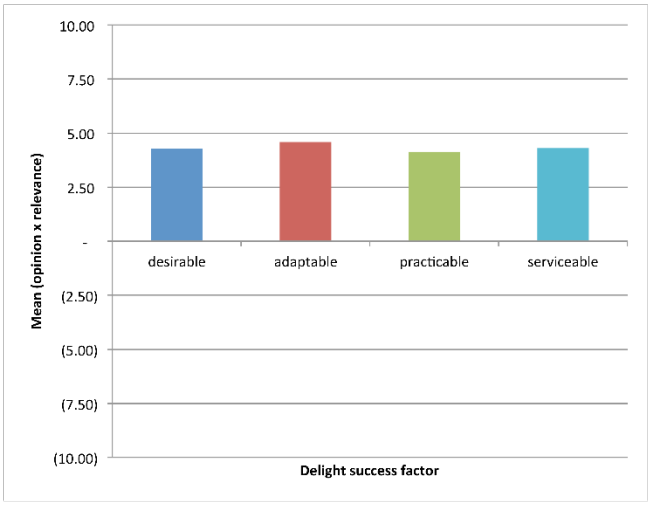
	mean
Functional?	4.29
Appropriate?	4.21
Robust?	3.67
Safe?	6.50
Healthy?	5.09
Problem-solving?	4.00
Easy to use?	4.90
Affordable?	1.95
Comfortable?	3.58
Ethical?	3.12
User-defined ...	
User-defined ...	
	4.13 23.89%
	24.94

Enduring:

	mean
Low maintenance?	0.44
Easily cleaned?	4.13
Recyclable?	4.43
Non-toxic?	5.32
Repairable?	5.39
Energy efficient?	4.77
Reliable?	3.99
Accessible?	5.25
Regenerative?	3.38
Habitat-safe?	5.94
User-defined ...	
User-defined ...	
	4.30 24.88%
	24.99 100.00%



percent Q1	94.23	%
total responses	104	



sample		N/A
return rate		0%
expected delight (LPS)		50%
actual delight (EUS)	✓	88%

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Instructions

Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Further Information

https://bond.edu.au/cccr
(including latest updates)

Disclaimer

Every attempt has been made to use unbiased evidence-based data (cells with light grey shading) in this study where possible.

i3d3 model: Copyright © 2020, Centre for Comparative Construction Research, Bond University

Figure 4.26. GCLR EUS model

DELIGHT (EUS)	35	Gold Coast Light Rail (GCLR) Stage 1 and 2

SUCCESS FACTOR	desirable	31	adaptable	25	practicable	45	serviceable	38

Attractiveness:

	mean	influence
Nice to look at?	2.84	
High quality?	3.73	
Profitable?	2.01	
Well-designed?	2.41	
Valuable?	3.20	
Prestigious?	1.76	
Durable?	3.18	
Popular?	3.22	
Joyful?	1.95	
Unique?	1.07	
User-defined ...	1.40	
User-defined ...	1.17	
	2.33	20.85%
	23.65	

Flexibility:

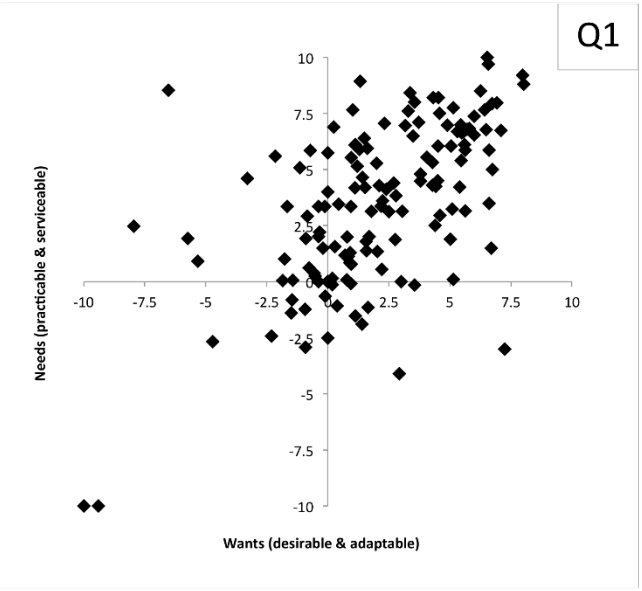
	mean
Versatile?	2.29
Easily modified?	1.37
Able to be customized?	1.48
Multi-use?	1.67
Transportable?	1.72
Better with age?	1.16
Modular?	1.30
Scalable?	2.08
Technically clever?	1.87
Timeless?	0.97
User-defined ...	
User-defined ...	
	1.59	14.25%
	21.40	

Fit for Purpose:

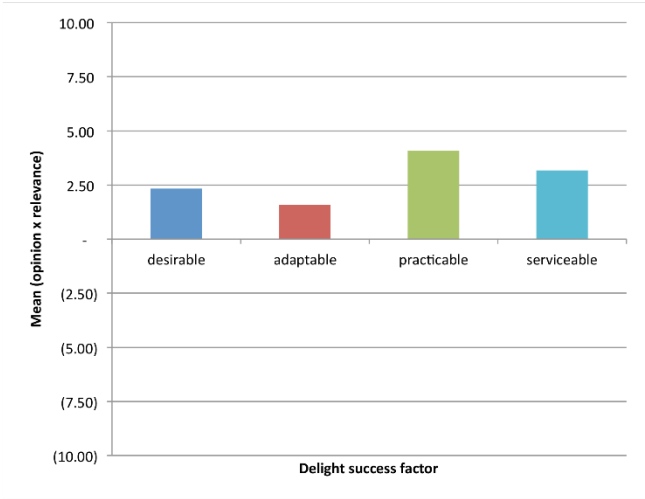
	mean
Functional?	5.46
Appropriate?	4.20
Robust?	4.01
Safe?	4.55
Healthy?	3.71
Problem-solving?	3.77
Easy to use?	4.05
Affordable?	3.33
Comfortable?	4.07
Ethical?	3.63
User-defined ...	
User-defined ...	
	4.08	36.52%
	28.76	

Enduring:

	mean
Low maintenance?	2.99
Easily cleaned?	2.73
Recyclable?	2.44
Non-toxic?	2.87
Repairable?	3.84
Energy efficient?	3.03
Reliable?	4.12
Accessible?	3.83
Regenerative?	3.00
Habitat-safe?	2.83
User-defined ...	
User-defined ...	
	3.17	28.38%
	25.10	100.00%



percent Q1	67.39 %
total responses	138



sample	413
return rate	33%
expected delight (LPS)	43%
actual delight (EUS)	35%

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Instructions

Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Further Information

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4.5.2 Statistical analysis

The analysis that follows had assistance from a colleague in learning how to use the software to produce the tables and figures that follow. This assistance is gratefully acknowledged. The finished work was checked by the colleague for accuracy, and changes were made where required to ensure that the findings are robust and dependable. Each aspect of the analysis is discussed according to the steps that were set out earlier (see Figure 4.1).

4.5.2.1 Reliability tests

Reliability test results of Cronbach's alpha in each case study revealed that in two case studies, HZMB and GCLR, the reliability is in good condition both in opinion and relevance. However, in BEUE, the test statistic is significantly low in Serviceable relevance (Table 4.12).

Table 4.12. Calculated Cronbach's alpha for Group 2 case studies

		HZMB	**BEUE**	**GCLR**	
Construct	Sample size	103	104	138	
	Number of Items	10	10	10	
Desirable	Opinion	0.948	0.826	0.844	
	Relevance	0.865	0.684	0.832	
Adaptable	Opinion	0.926	0.772	0.867	
	Relevance	0.913	0.666	0.859	
Practicable	Opinion	0.93	0.84	0.886	
	Relevance	0.919	0.672	0.882	
Serviceable	Opinion	0.936	0.725	0.828	
	Relevance	0.908	0.52	0.87	

Removal of items in BEUE could not lead to higher test statistics in Serviceable relevance. Hence, as Cronbach's alpha is low for relevance of the Serviceable construct, this case study is skipped from entering the next level of analysis.

4.5.2.2 Confirmatory factor analysis

CFA fit summaries of each case study are shown in Table 4.13. According to CFI and TLI, the model is showing a non-significant relation model (CFI < 90%), especially in BEUE. This is a desirable result in the current research, which is studying different aspects of each construct. As can be implied from the survey items, one case study can be desirable due to its popularity, but rather have different quality or profitability levels. RMSEA, however, shows differences between the case studies in terms of the significance of the CFA model. As can be seen, RMSEA of GCLR is a having a very good value of 0.077 (lower than 0.08), although its higher limit

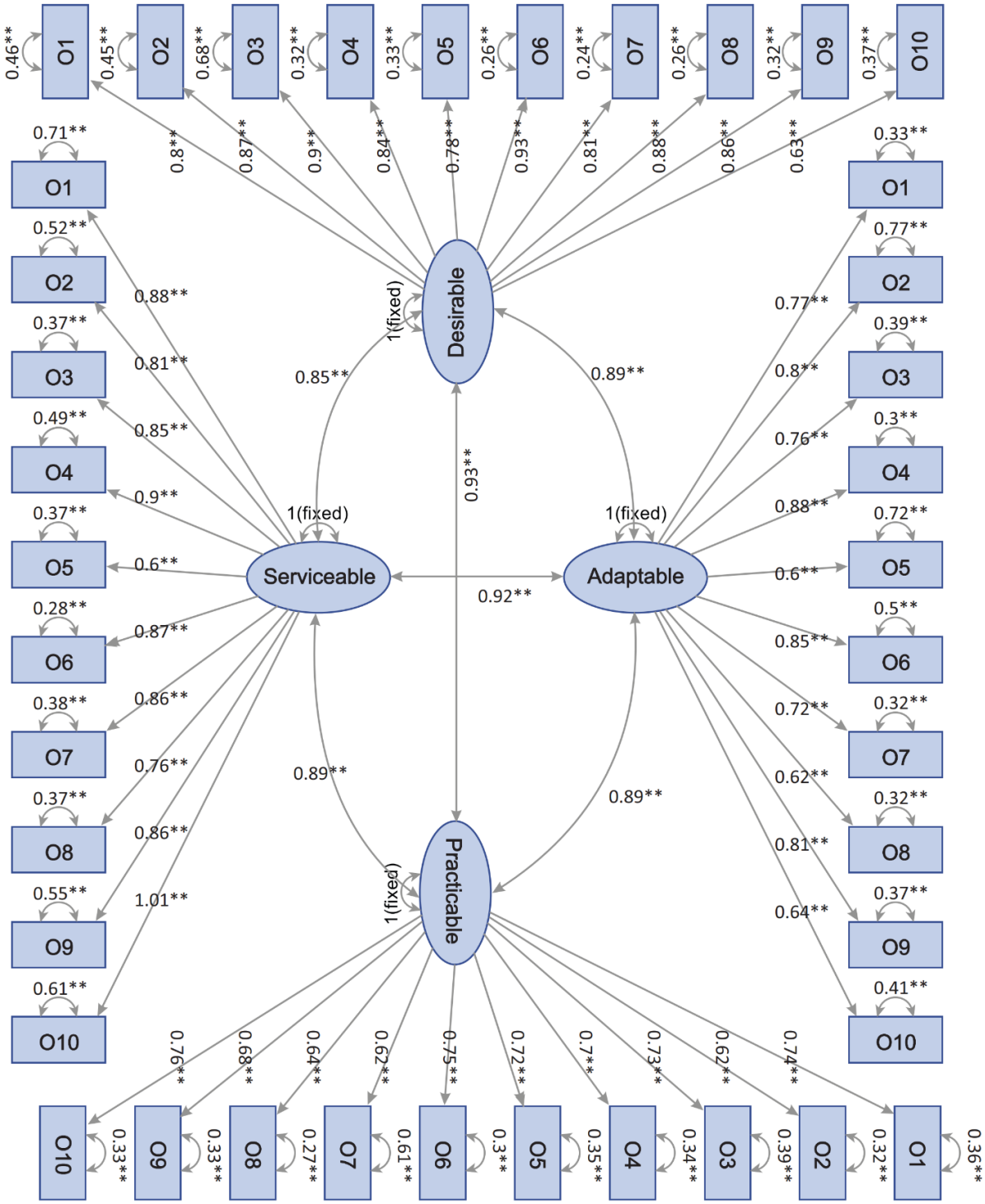
covers the 0.08 threshold. In HZMB, RMSEA was higher than the threshold, considering other test statistics, this probably is related to a low number of subjects (103).

Table 4.13. Fit parameters of the CFA models for Group 2 case studies

Fit Parameter	**HZMB**	**BEUE**	**GCLR**	
Number of Parameters	86	86	86	
Fmin	6.663	7.485	4.863	
Chi-square	1372.508	1556.851	1342.064	
DF	734	734	734	
P-value	0	0	0	
Baseline chi-square	4534.664	2820.396	3081.056	
Baseline DF	780	780	780	
Baseline P-value	0	0	0	
CFI	**0.83**	**0.597**	**0.736**	
TLI	**0.819**	**0.571**	**0.719**	
Log likelihood	-4266.79	-4040.08	-8017.06	
Unrestricted log likelihood	-3580.54	-3261.66	-7346.03	
AIC	8705.577	8252.165	16206.12	
BIC	8932.164	8479.582	16457.86	
Sample size	103	104	138	
BIC2	8660.505	8207.908	16185.79	
RMSEA	**0.092**	**0.104**	**0.077**	
RMSEA Lower bound	**0.084**	**0.097**	**0.071**	
RMSEA Upper bound	**0.099**	**0.111**	**0.084**	
RMSEA P-value	0	0	0	
SRMR	0.057	0.098	0.077	

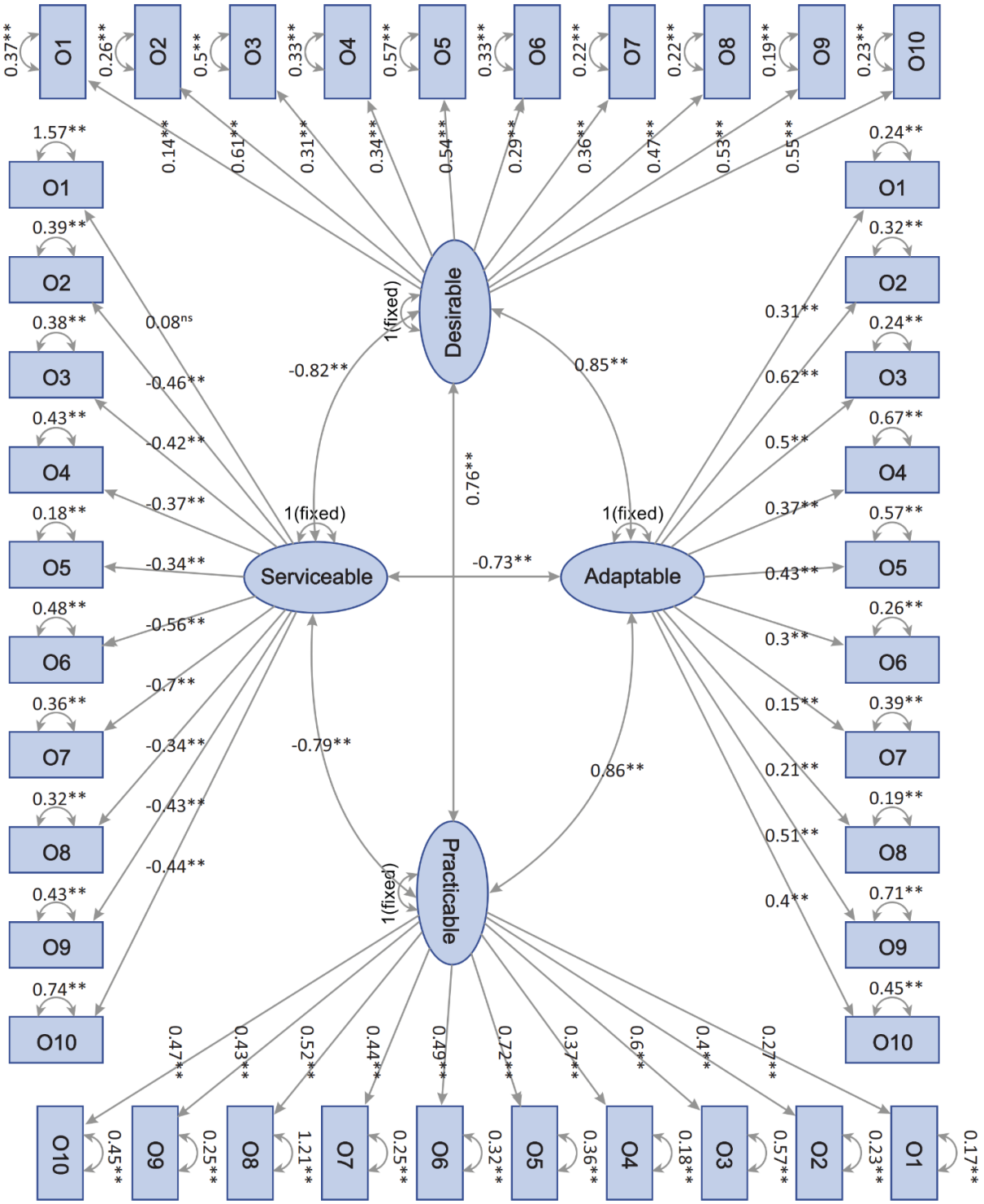
Although the fit parameters of the CFA model show the medium quality of the models, factor loadings in HZMB and GCLR are at good conditions with almost all the item loadings significance level of lower than 0.01. In BEUE, however, the factor loadings show surprising results, as the loadings are significantly negative. The covariance of studied constructs in each case study is significant at a level of P-value < 0.01. The covariance of Serviceable against the other three constructs is also negative, which is not logical. Therefore, BEUE is skipped from further analysis in the following steps (Figures 4.27 to 4.29).

Figure 4.27. Confirmatory factor analysis solution for HZMB (internal variances and factor loadings)



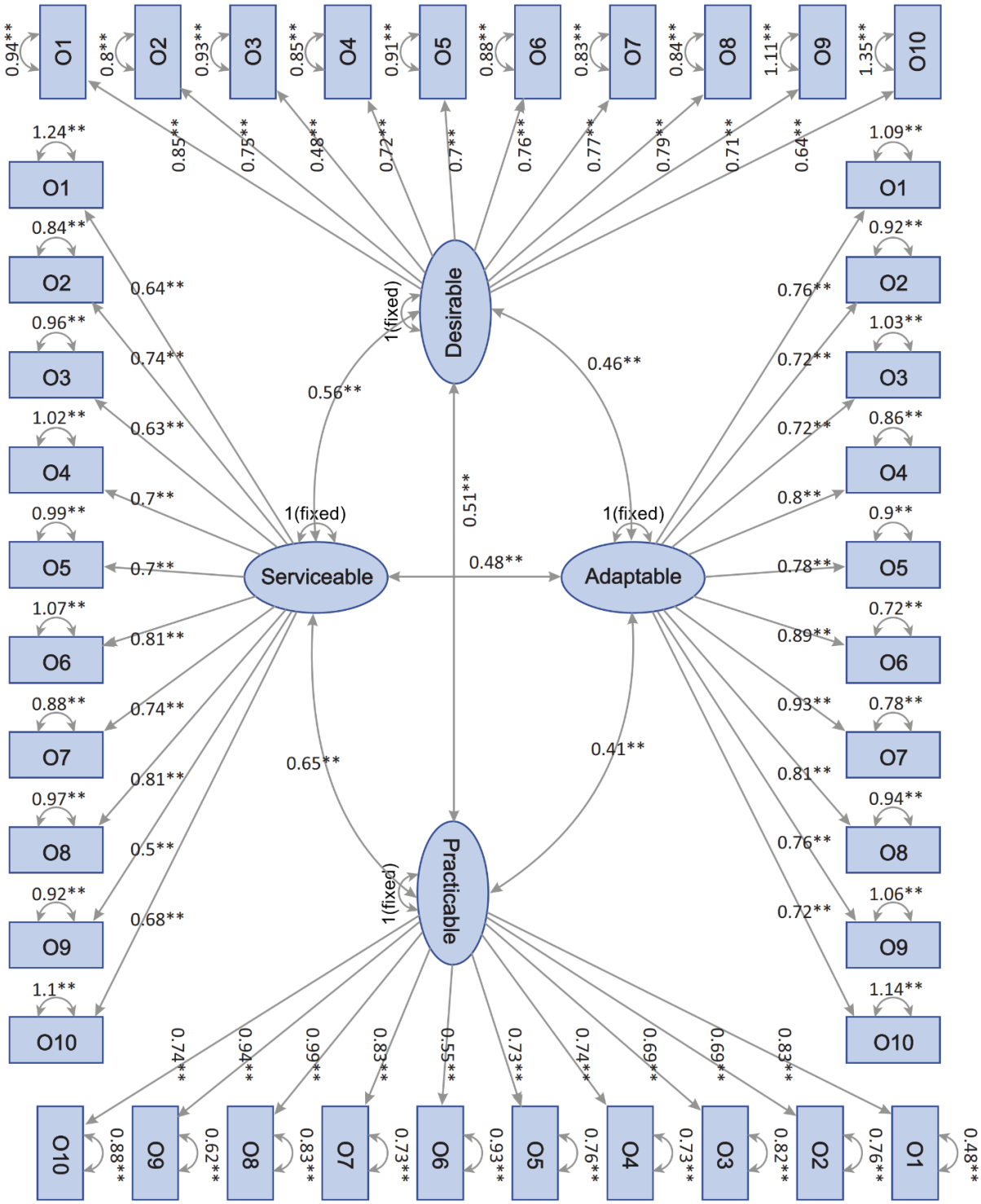
*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

Figure 4.28. Confirmatory factor analysis solution for BEUE (internal variances and factor loadings)



*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

Figure 4.29. Confirmatory factor analysis solution for GCLR (internal variances and factor loadings)



*ns: non-significant, * and ** significant at 0.05 and 0.01 levels respectively*

4.5.2.3 Correlation analysis

The Pearson's correlation coefficient (r) scale varies from +1 through 0 to -1. The complete correlation between two variables is indicated by either +1 or -1 (positive or negative correlations respectively) while a complete absence of correlation is represented by 0. However, any intermediate values may also occur, the values nearer to zero represents a weak correlation, but values of r nearer to 1 express a strong correlation (Mahdavi, 2013; Nikolić et al, 2012; Paek & Cole, 2020; Taylor, 2020).

Because both the opinion and relevance (weightage) of each item are asked from the end-users, there is a possibility of a correlation between the two. As required under the testing procedure for the next step of the analysis, opinion and relevance should be multiplied, therefore, prior removal of the correlation between opinion and relevance to reduce variance inflation to an acceptable level is required. Here, the correlation between the opinion and relevance in BEUE is checked for further investigation of the issue. Correlation analysis showed a significant relationship in 70 items in all case studies between the relevancies and opinions. Only 6 items showed a lack of correlation in BEUE, which shows that the opinion and relevance for 34 items are answered in the same manner. To remove correlations, a linear model is fitted for each item and the residuals are rescaled according to the following equation so that the range of the obtained relevance is between 1 and 5. The calculation of adjusted relevancies is using the raw relevance:

$$R'_{ijk} = \frac{Res_{R_{ijk}} + |Res_{minjk}|}{Res_{maxjk} + |Res_{minjk}|} * 4 + 1$$

where R'_{ij} is the adjusted relevance for subject i of item j in construct k, Res_{Rij} is the residual of a linear model for subject i of item j in construct k, Res_{minijk} is the minimum residual of item j in construct k, and Res_{maxijk} is the maximum residual of item j in construct k. Multiplication of the fraction part by 4 and adding the result to 1 gave a linear conversion of the scale.

Table 4.14 shows the reduction in Pearson's correlation coefficient after rescaling the relevancies and removal of the correlation. Note that bold numbers are significant coefficients at 0.05 level, *: removed correlation for this item.

Table 4.14. Correlation analysis between opinion and relevance

		Before removal				After removal			
		HZMB	BEUE	GCLR		HZMB	BEUE	GCLR	
Desirable	1	**0.36**	**0.41**	0.15		0	-0.01	0.15	
	2	-0.07	**0.21**	0.06		-0.07	0.02	0.06	
	3	**0.26**	**0.26**	0.07		-0.02	0	0.07	
	4	**0.27**	**0.44**	0.12		0	0	0.12	
	5	0.24	0.19	**0.22**		0	0.19	0.01	
	6	**0.37**	**0.64**	0.1		0	-0.02	0.1	
	7	0.11	**0.28**	**0.18**		0.11	-0.01	0	
	8	**0.34**	**0.58**	**0.24**		0.01	0.01	-0.01	
	9	**0.33**	0.18	0.11		0	0.18	0.11	
	10	**0.45**	**0.42**	**0.23**		-0.01	0.01	-0.01	
Adaptable	1	**0.32**	**0.51**	0.12		0	-0.02	0.12	
	2	0.16	0.17	-0.02		0.16	0.17	-0.02	
	3	**0.49**	**0.35**	0.01		0.01	0	0.01	
	4	**0.26**	**0.49**	0.09		0	0	0.09	
	5	0.22	**0.47**	0.08		-0.01	0	0.08	
	6	**0.35**	**0.43**	-0.05		0.02	-0.01	-0.05	
	7	**0.38**	**0.56**	0.01		-0.01	-0.02	0.01	
	8	**0.42**	**0.47**	0.07		0	0.01	0.07	
	9	0.19	**0.58**	0.09		0.19	0	0.09	
	10	**0.4**	**0.31**	0.03		-0.01	0.02	0.03	
Practicable	1	0.17	**0.55**	**0.29**		0.17	0	0.01	
	2	0.13	**0.58**	0.15		0.13	-0.02	0.15	
	3	0.06	**0.65**	0.14		0.06	-0.01	0.14	
	4	-0.03	**0.81**	**0.21**		-0.03	-0.01	-0.01	
	5	**0.28**	**0.78**	**0.22**		0	0	0.01	
	6	**0.26**	**0.67**	0.04		0	0.01	0.04	
	7	-0.01	**0.78**	0.1		-0.01	0.01	0.1	
	8	0.11	**0.64**	**0.17**		0.11	0.01	-0.01	
	9	**0.22**	0.05	**0.26**		0	0.05	-0.01	
	10	**0.31**	**0.41**	0.14		0.01	0.01	0.14	
Serviceable	1	0.1	**0.33**	**0.18**		0.1	0.01	-0.01	
	2	0.18	**0.31**	0.14		0.18	0.01	0.14	
	3	**0.24**	**0.29**	**0.21**		0	-0.01	0	
	4	-0.04	0.04	0.14		-0.04	0.04	0.14	
	5	0.11	**0.44**	**0.23**		0.11	0.01	0	
	6	0.19	**0.39**	**0.22**		0.19	0	0	
	7	0.03	0.17	**0.27**		0.03	0.17	0	
	8	0.01	**0.6**	**0.34**		0.01	0.02	0.01	
	9	**0.3**	**0.29**	**0.21**		0.3	0.01	0.01	
	10	0.1	**0.44**	**0.35**		0.1	0.02	-0.01	

4.5.2.4 Canonical discriminant analysis

In this analysis, current case studies are pooled with former ones (Sports Centre, Cinema Complex, iLearn Platform and HSM Building) to better demonstrate the differences between all case studies. BEUE is also entered at this step to evaluate its data behaviour and compared to other case studies. Results of the canonical discriminant analysis show that three CVs can explain more than 70% of variations in the 7 case studies. The first and second CVs have significant correlations of 0.6 and 0.46, respectively. The third CV has a significant correlation of 0.49 with the class variable which here are case studies of the investigation. As the raw and adjusted canonical correlations are close to each other, the software omitted the adjusted coefficient (Table 4.15). Eigenvalues in Table 4.16 also show that the first CV accounts for 38% of explained variations and the second CV accounts for 20.5% of the variation. Finally, the third CV only accounts for 18% of the variation among items. Table 4.17 shows the ANOVA test of canonical correlations.

Table 4.15. Results of correlation between canonical variables and the class variable for all case studies

	Canonical Correlation	Adjusted Canonical Correlation	Approximate Standard Error	R-Square
1	0.6353	0.6016	0.0227	0.4037
2	0.5169	0.4568	0.0279	0.2672
3	0.4929	.	0.0289	0.2430

Table 4.16. Eigenvalues of canonical correlations and model expression proportions

	Eigenvalue	Difference	Proportion	Cumulative
1	0.6770	0.3124	0.3811	0.3811
2	0.3646	0.0436	0.2053	0.5864
3	0.3211	0.1341	0.1807	0.7671

Table 4.17. ANOVA test of canonical correlations

	Likelihood Ratio	Approximate F Value	Numerator DF	Denominator DF	Pr > F
1	0.225	4.54	240	3817.9	0.0001
2	0.377	3.55	195	3194.3	0.0001
3	0.515	3.06	152	2564.7	0.0001

Canonical variable scatterplots in Figures 4.30 to 4.32 show high overlaps among all case studies and no clear border can be drawn between them. The 95% confidence limit ellipse also shows that some case studies have an overlap of more than 80% (e.g. Cinema Complex and iLearn Platform). Therefore, no significant difference among the case studies can be considered in terms of satisfaction. Here, BEUE data also show irregular behaviour as most of the data are outside of the 95% ellipse because of both high outliers and low range of the scores. The formation of a small ellipse shows that the range of scores is significantly lower compared to other case studies. Hence, all case studies can be entered into IRT analysis as one group.

Figure 4.30. Scatterplot of canonical variable 1 vs canonical variable 2

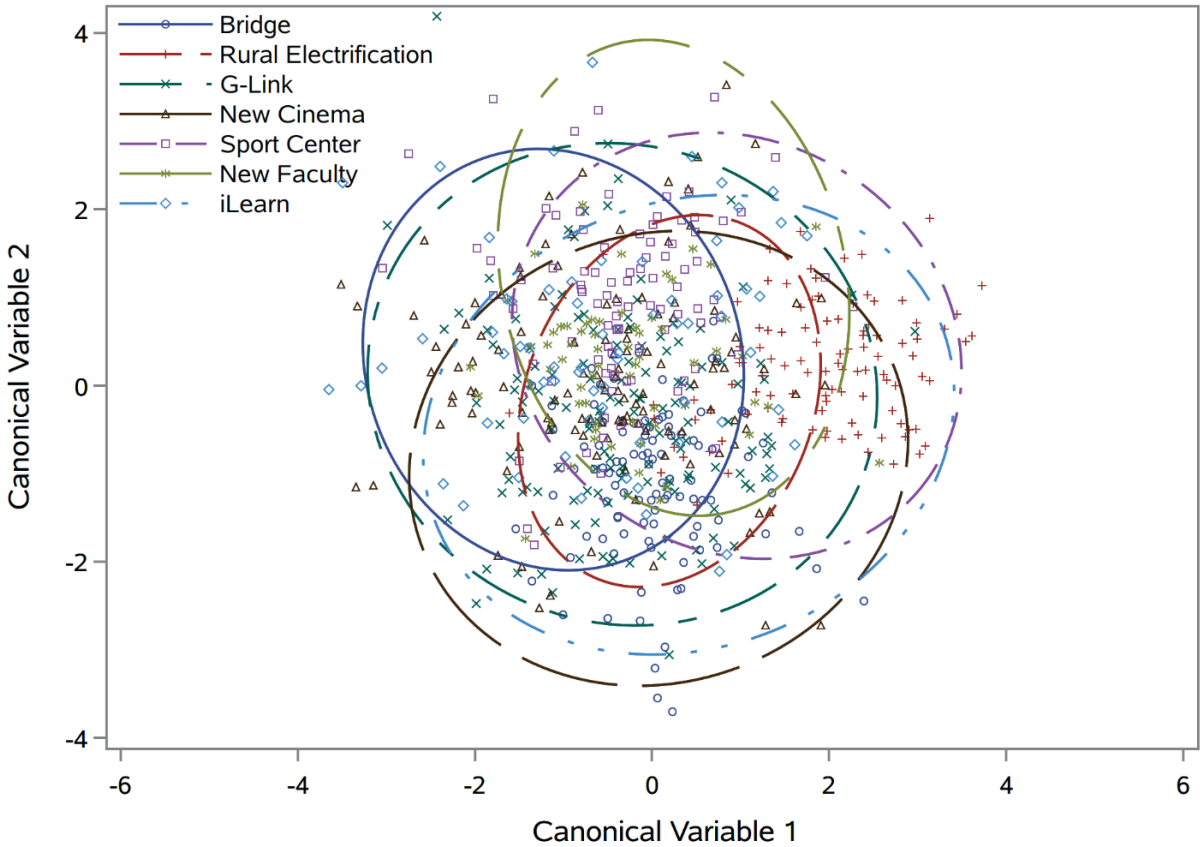


Figure 4.31. Scatterplot of canonical variable 1 vs canonical variable 3

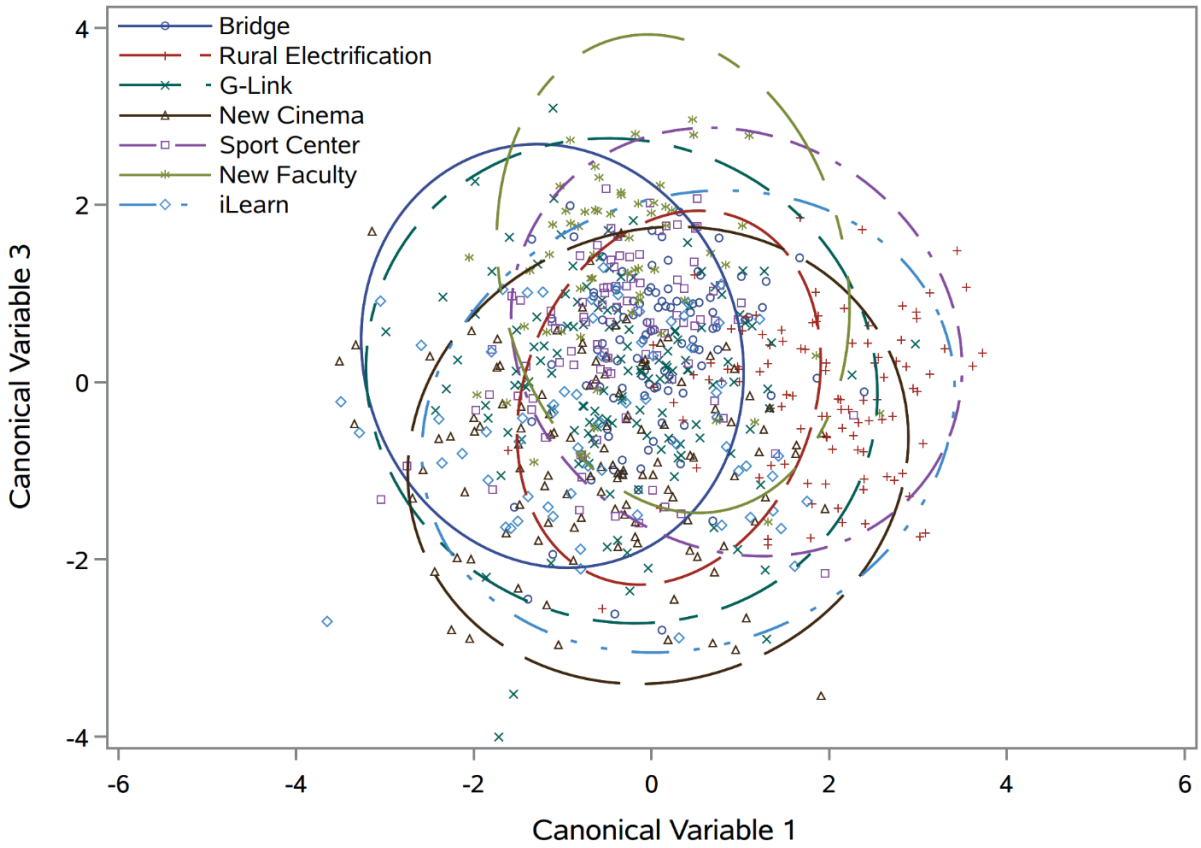
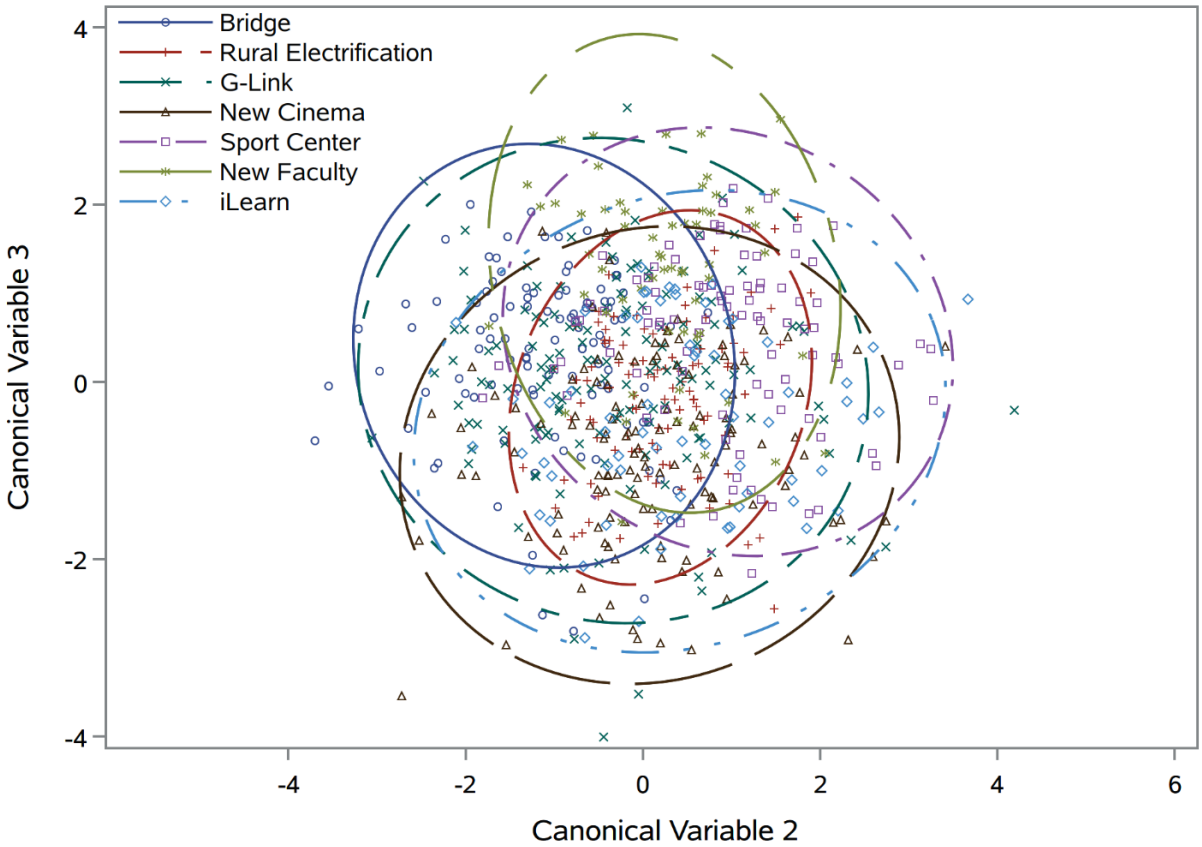


Figure 4.32. Scatterplot of canonical variable 2 vs canonical variable 3



4.5.2.5 Item response theory

In step 4, subjects were removed before entering the analysis, as they showed to be outliers. Investigation of the raw data revealed that one subject in HZMB and three subjects in GCLR registered low scores. IRT item scores were analyzed using the logit link function and graded response model with 40 items and four factors (constructs). A total of 237 subject data (102 and 135 for HZMB and GCLR, respectively) are entered into the model. Marginal Maximum Likelihood was selected as the IRT estimation method, which is a common model for questionnaire satisfaction analysis. The log-likelihood of the model was calculated as -16633 with a linear chi-square of 30674 (Table 4.18).

The polychoric correlation result in Figure 4.26 shows that the internal correlation in the first three factors is significantly high as the squares of each 10-score item show obvious borders (like former case studies). However, the Polychoric correlation in the last factor (Serviceable, Sc31 to Sc40) has faded borders which is the result of the higher difficulty of the items. Therefore, item difficulties are the lowest in Desirable and Adaptable constructs and highest in Serviceable construct. Factors score plots (Figures 4.33 to 4.39) show that both cases studies are completely mixed which shows no differences like the data, although dispersion is higher in GCLR. The scatterplots also show a positive correlation between all four factors, as they stretched along the diagonal of the scatterplot.

Table 4.18. Model fit properties and statistics after 194 iterations

Link Function	**Logit**
Response Model	Logit
Number of Items	Graded Response Model
Number of Factors	40
Number of Observations Read	4
Number of Observations Used	237
Estimation Method	237
Optimization Technique	Marginal Maximum Likelihood
Likelihood Approximation	Quasi-Newton
Number of Quadrature Points	Adaptive Gauss-Hermite Quadrature
Number of Free Parameters	5
Log-Likelihood	428
AIC	-16633
BIC	34122
LR Chi-Square	35606
LR Chi-Square DF	30674

Figure 4.23. Polychoric correlation heatmap of scores (Sc) against each other

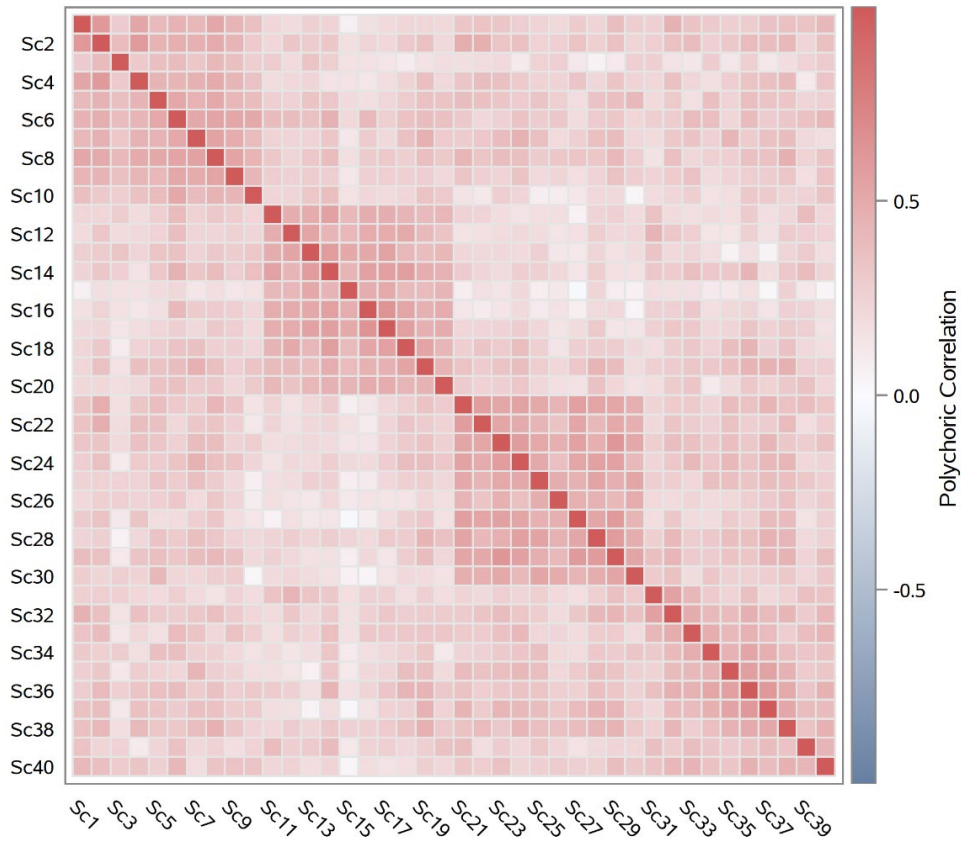


Figure 4.34. IRT scatterplot of Desirable vs Adaptable constructs

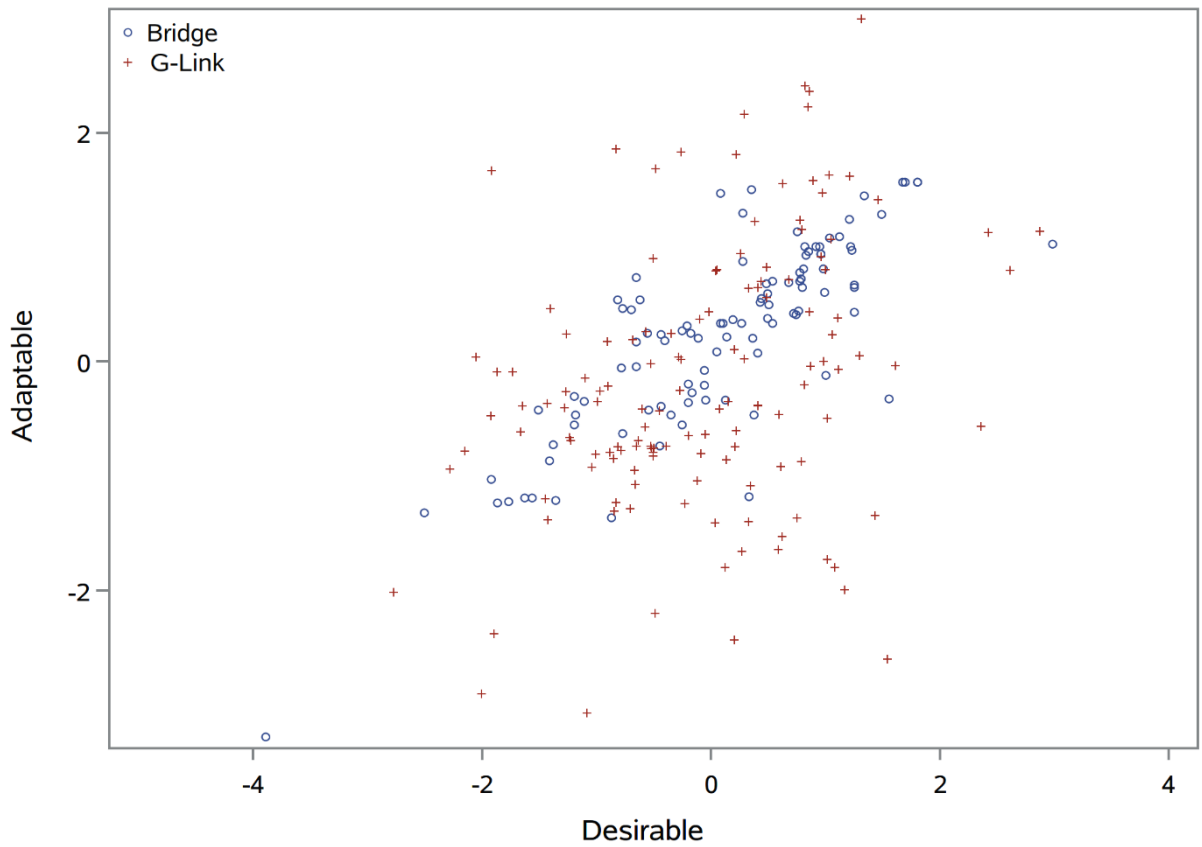


Figure 4.35. IRT scatterplot of Desirable vs Practicable constructs

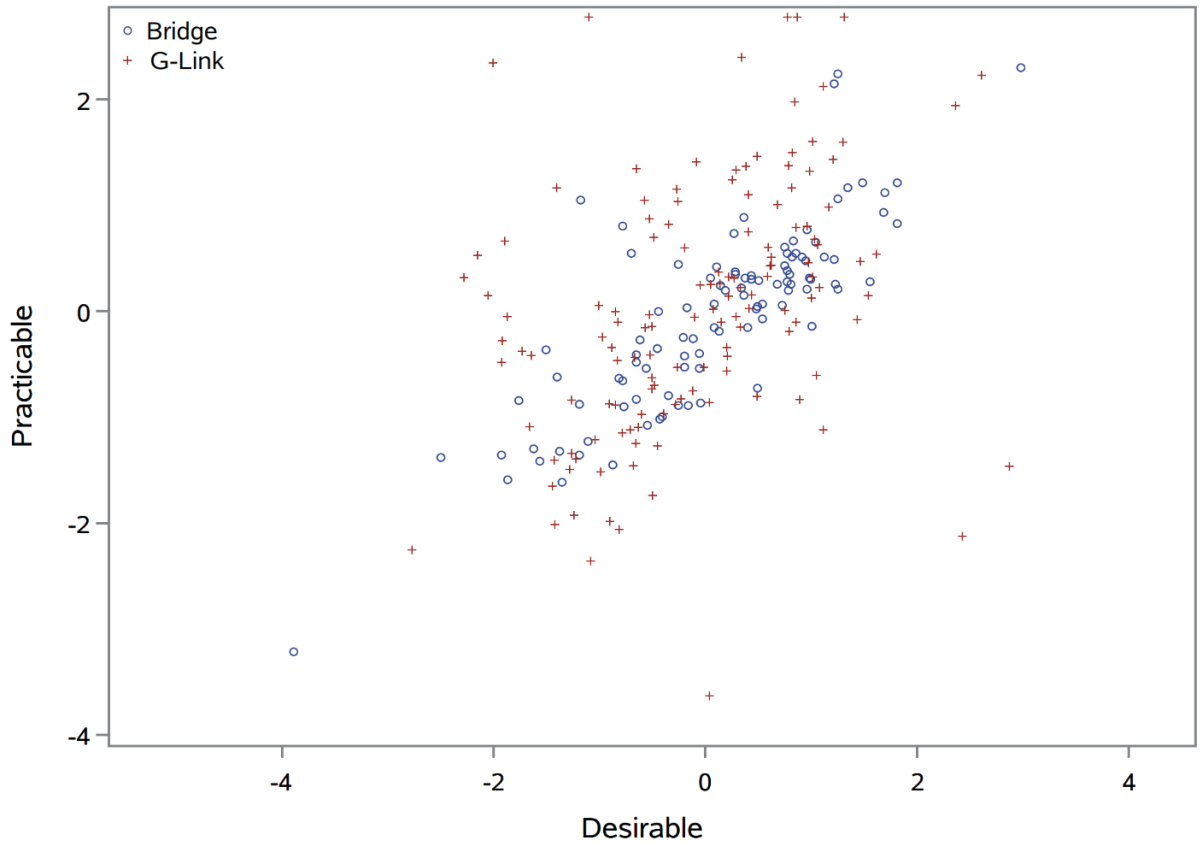


Figure 4.36. IRT scatterplot of Desirable vs Serviceable constructs

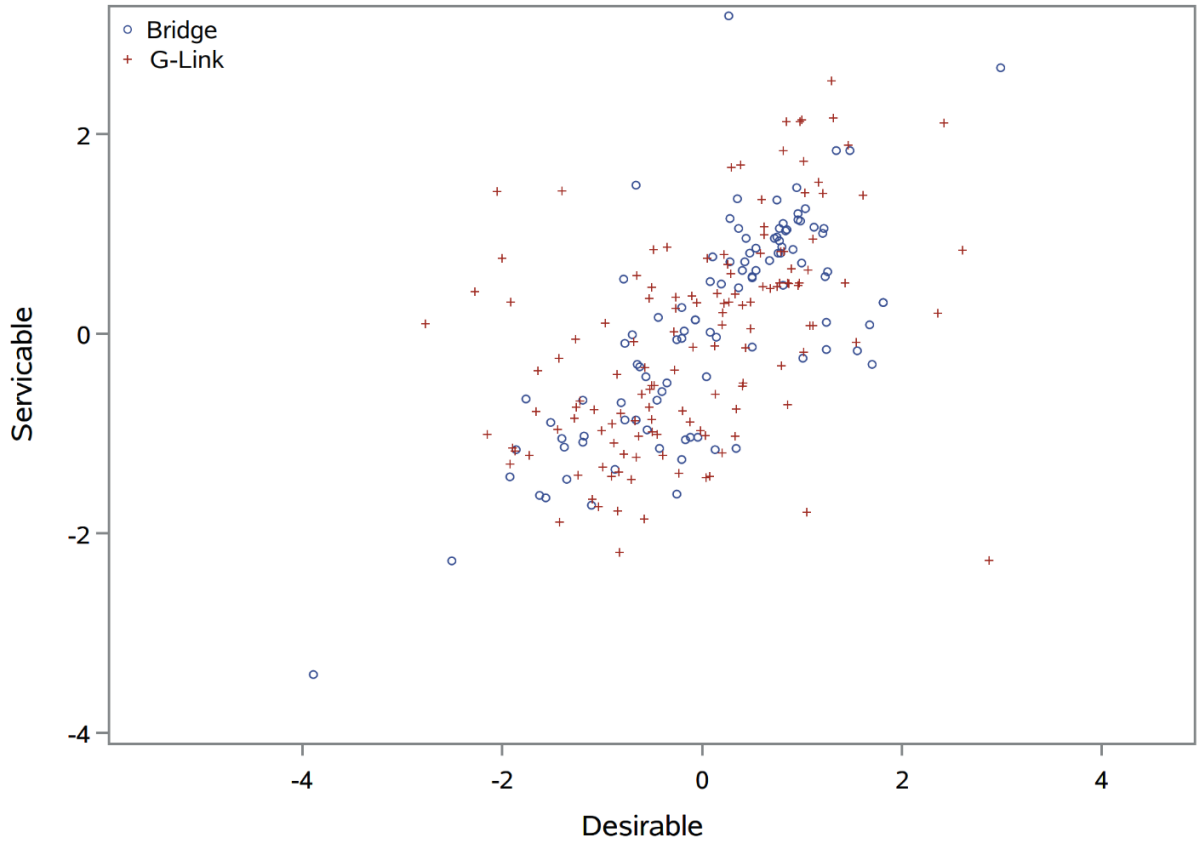


Figure 4.37. IRT scatterplot of Adaptable vs Practicable constructs

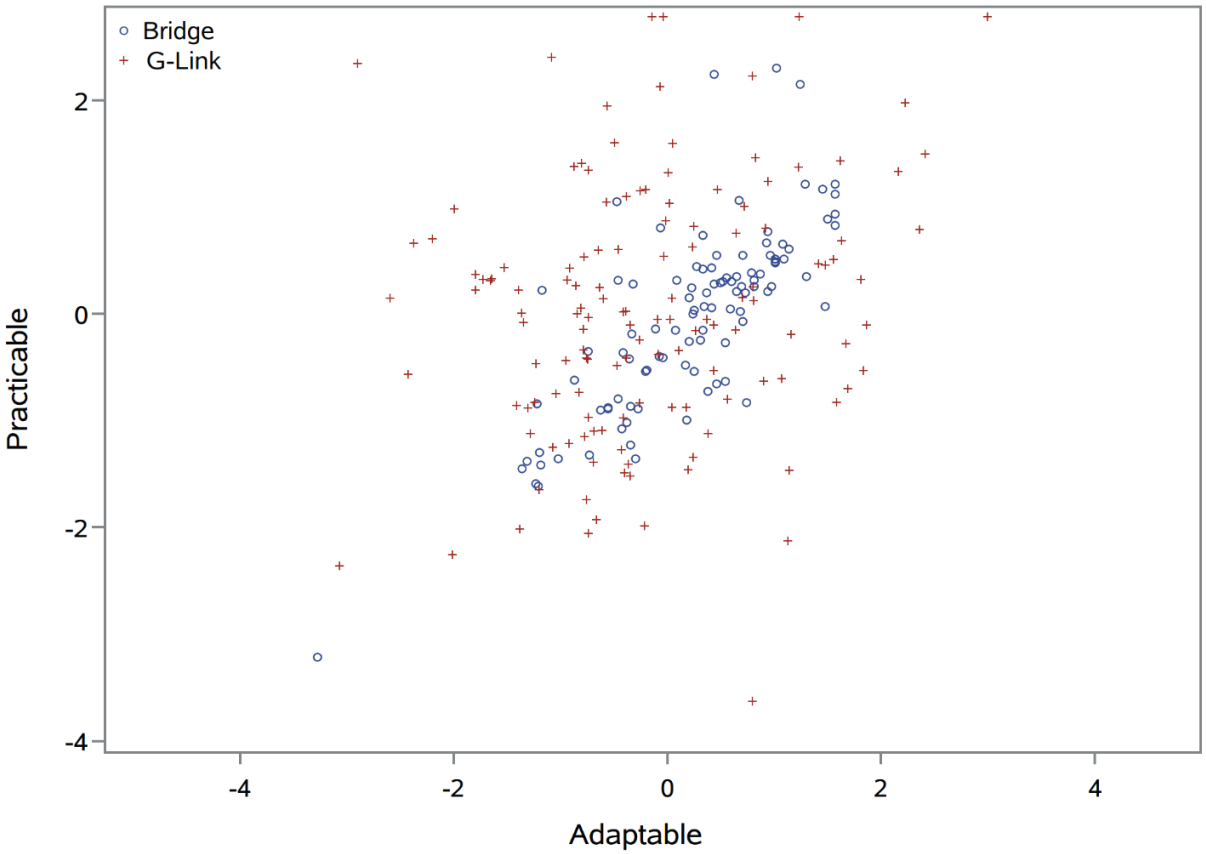


Figure 4.38. IRT scatterplot of Adaptable vs Serviceable constructs

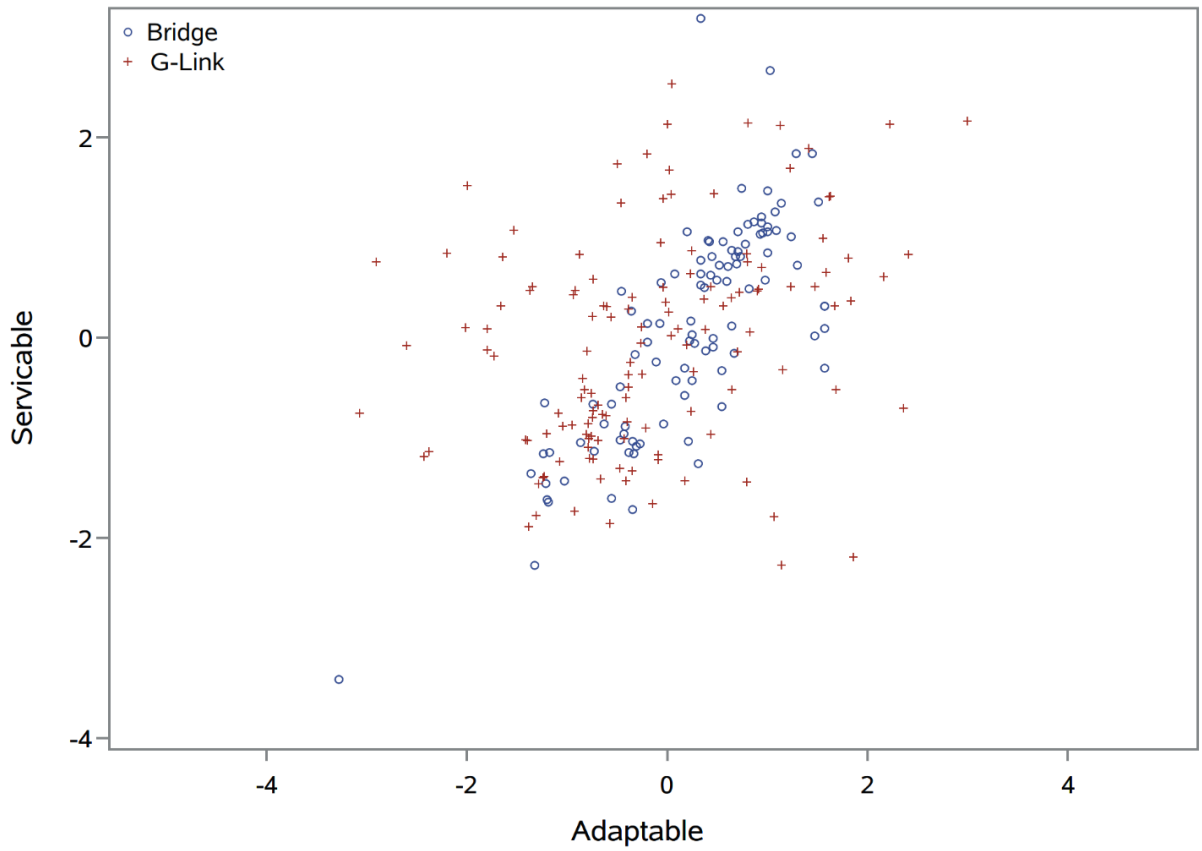
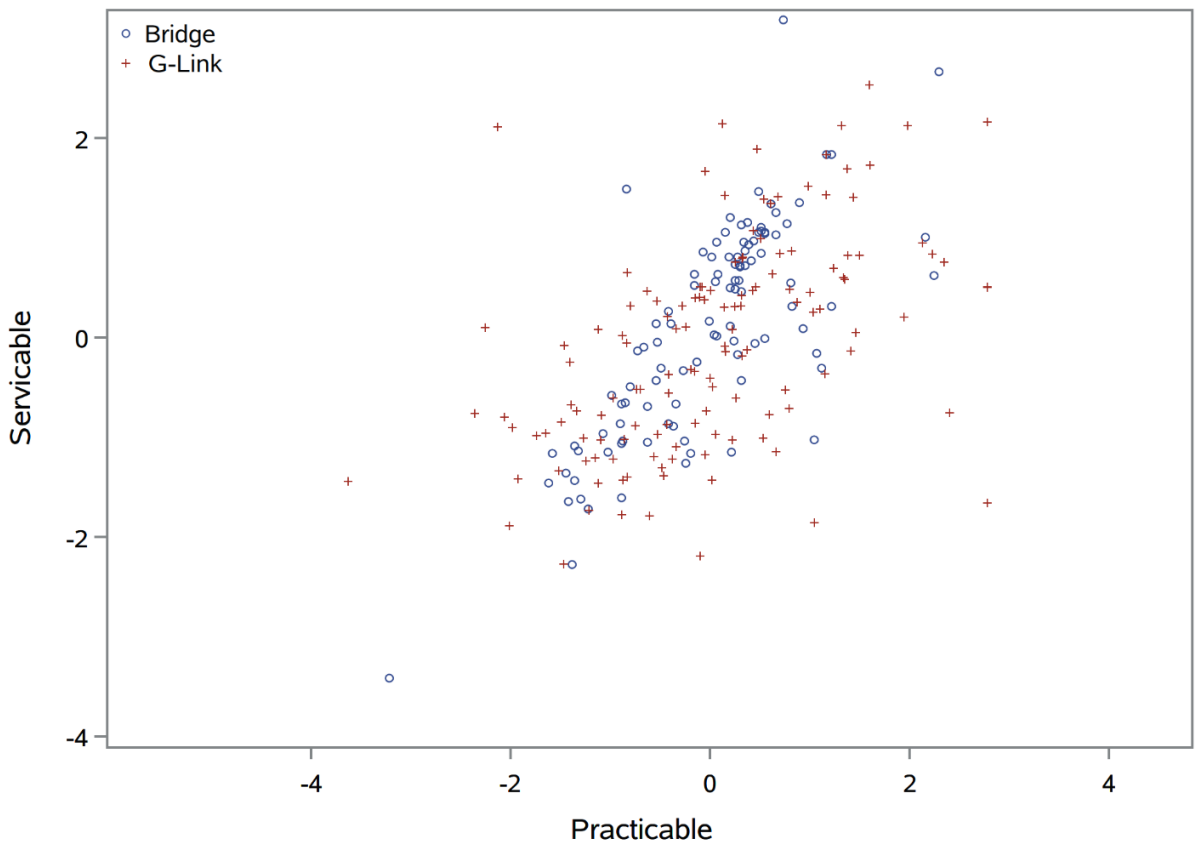


Figure 4.39. IRT scatterplot of Practicable vs Serviceable constructs



4.5.2.6 Model specification

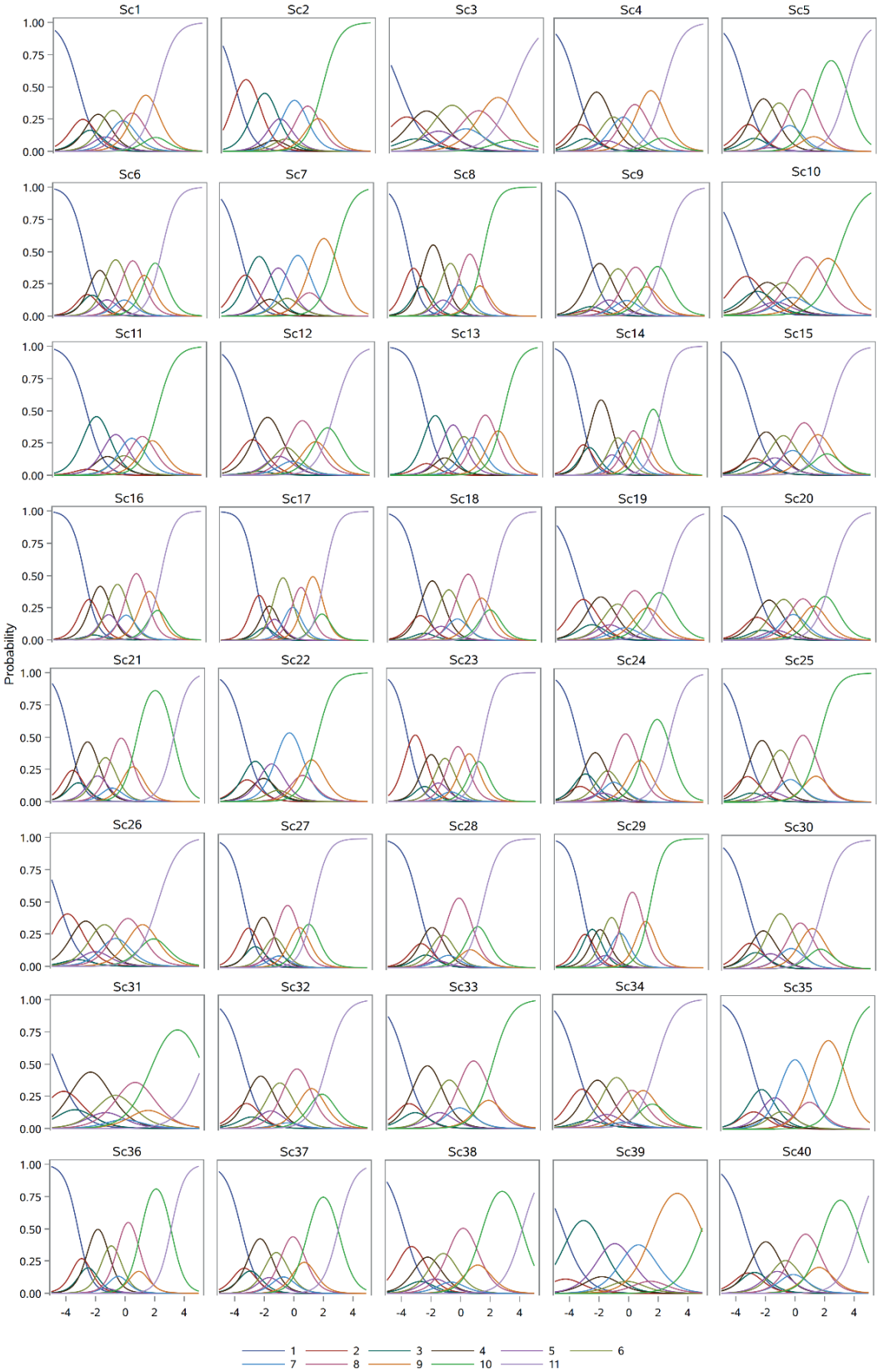
Slopes' parameter of 10 items in each construct shows that all items add significant information to the questionnaire as the parameter is higher than one in all the items and the P-value is lower than 0.0001. The highest slopes among the items belong to score 07 of the Adaptable construct (Sc17) with a slope of 2.44 followed by score 09 of the Practicable construct (Sc25) with a slope of 2.31 (Table 4.19).

Table 4.19. Slope characteristics of each 10 scores in each construct

		Desirable	Adaptable	Practicable	Serviceable
Score 01	Slope	1.70029	1.70517	2.07247	1.15817
	Standard error	0.19461	0.19164	0.23361	0.16435
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 02	Slope	1.76274	1.60049	1.78153	1.65256
	Standard error	0.2006	0.18481	0.20259	0.19707
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 03	Slope	1.17407	1.96516	2.20311	1.5804
	Standard error	0.15953	0.20872	0.2367	0.1916
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 04	Slope	1.65269	2.25067	1.88561	1.56014
	Standard error	0.18918	0.23672	0.21017	0.18672
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 05	Slope	1.68466	1.60908	1.76519	1.64218
	Standard error	0.19371	0.18217	0.20228	0.19892
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 06	Slope	2.03568	2.22219	1.46738	2.20221
	Standard error	0.22246	0.23254	0.17487	0.25081
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 07	Slope	1.7808	2.44189	2.11431	1.87704
	Standard error	0.20206	0.25411	0.22676	0.21779
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 08	Slope	2.21958	2.01499	1.91211	1.57042
	Standard error	0.24662	0.21386	0.21154	0.19153
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 09	Slope	1.71419	1.54788	2.31292	1.23526
	Standard error	0.19536	0.17963	0.24613	0.17438
	P-Value	<.00001	<.00001	<.00001	<.00001
Score 10	Slope	1.3256	1.63444	1.7089	1.53753
	Standard error	0.16918	0.18581	0.19562	0.18413
	P-Value	<.00001	<.00001	<.00001	<.00001

Item characteristic curves (ICC) are also shown in Figure 4.40. Lower slope function is a result of higher difficulties in items like Score 01 of the Serviceable construct (Sc31, Slope: 1.16) which can be characterized by low height in extreme scores (1, 11) and higher height in middle scores (4 and 10). This means that the respondent is more indecisive about these items, compared to other ones, which is a result of the participants who had no opinion on the items.

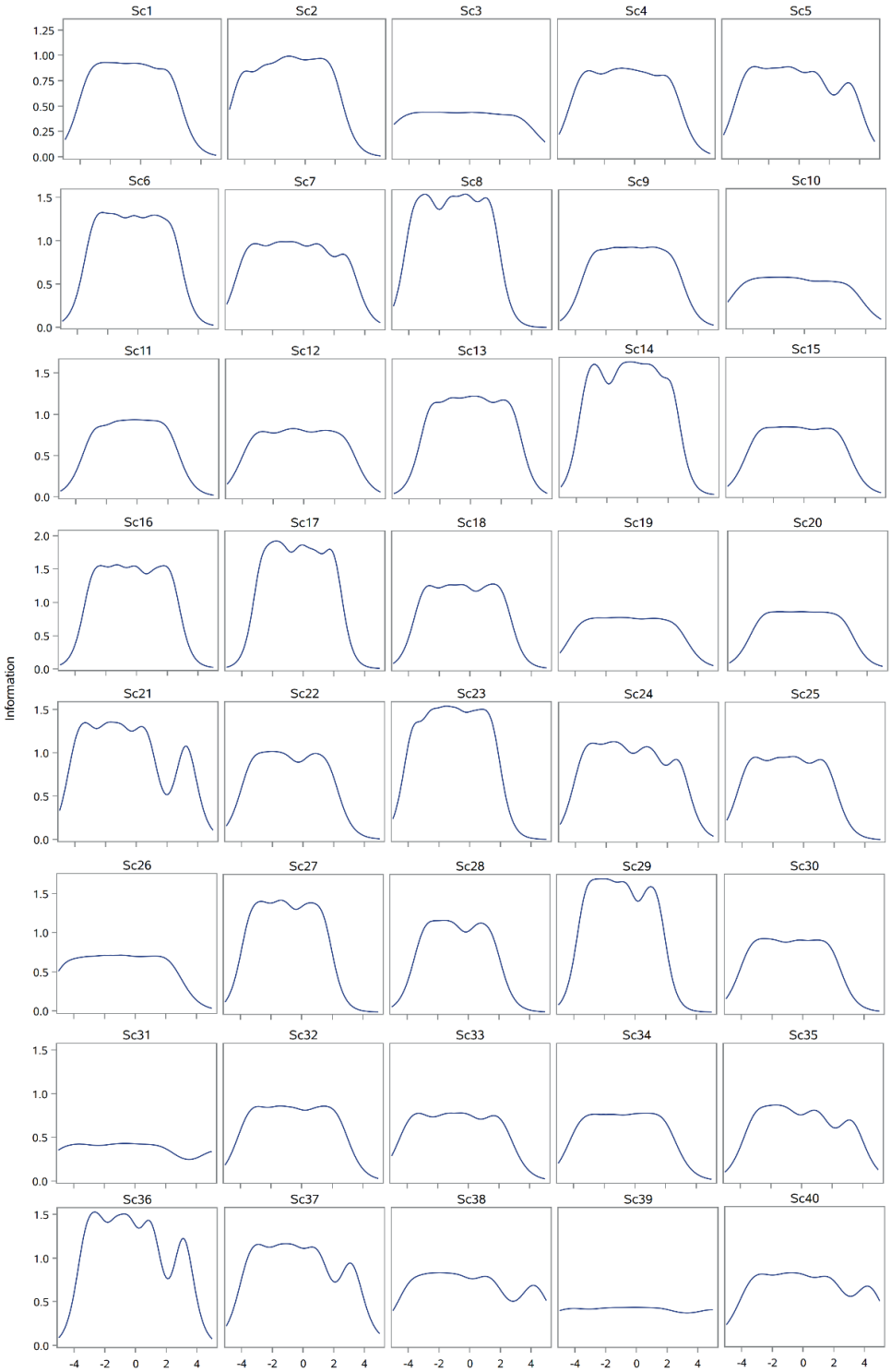
Figure 4.40. Item characteristic curves (ICC) of 40 Score (Sc) items



IIC are more straightened to interpret the loading of each item on each construct. Higher IIC shows higher information on a specific item and vice versa. Item 7 (Sc17) has the highest IIC

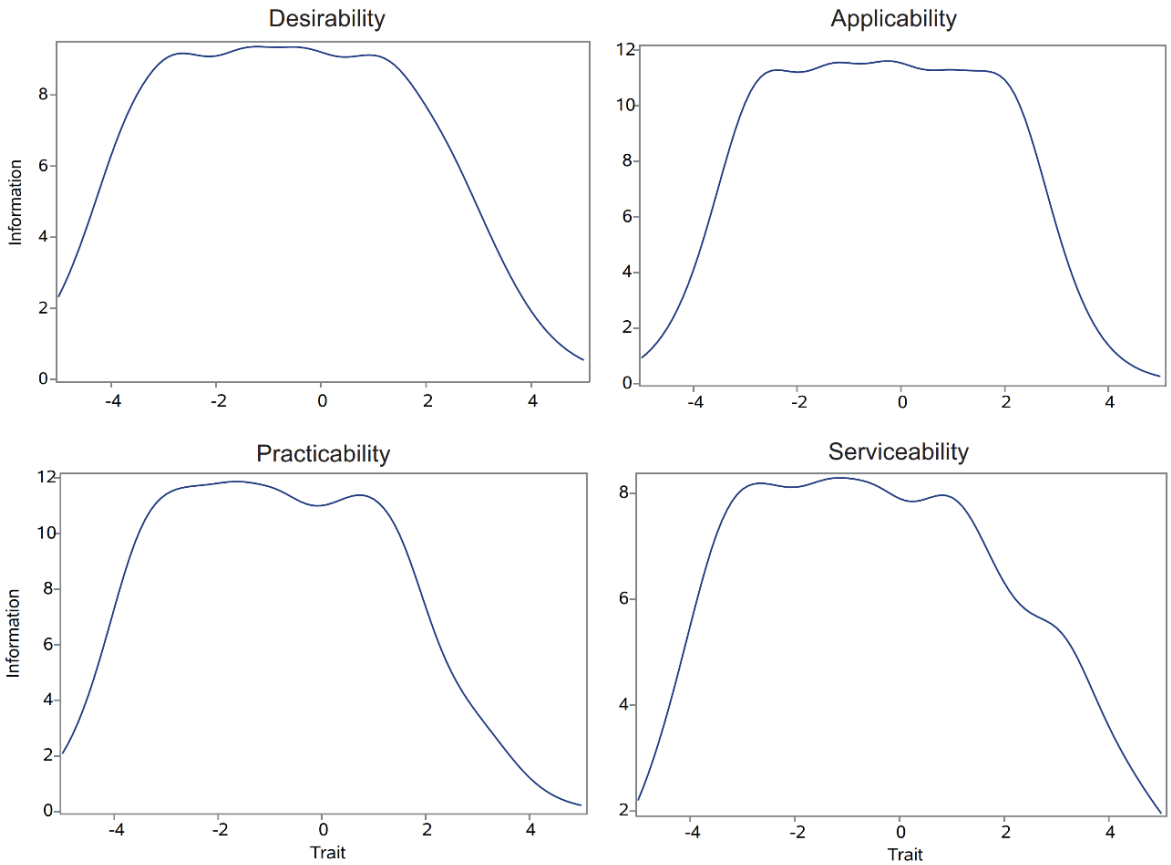
with a tip of close to two. This means that this item has the highest effect on the determination of the applicability of the product. On the other hand, item 39 (Sc32) is almost a flat curve, which means that this item has the lowest determinant effect on the corresponding construct Serviceability (Figure 4.41). Nevertheless, this item should not be removed from the questionnaire, as it has a slope higher than one (1.23).

Figure 4.41. Item information curves (IIC) of 40 Score (Sc) items



Finally, test information curves (TIC) show that two constructs (Adaptable and Practicable) can gain a high amount of information from the defined items (a score close to 12) compared to Desirable and Serviceable (9 a score close to 8). This curve is the sum of information curves of the items in each factor. The shape of this curve implies between item information variation in each factor. Wide TIC implies higher variation in IIC curves in each factor and narrow TIC shows lower variation and higher homogeneity among IIC curves. In this case, the Practicable factor is narrower than other constructs (Figure 4.42).

Figure 4.42. Test information curves of studied constructs



4.6 Primary data

The primary data collected for the case studies, expressed as end-user opinion multiplied by relevance, are summarized by attribute for each respondent (refer to: **Appendix 4**). Instances where 'no opinion' was chosen (regardless of the relevance), are highlighted as null values and ignored from the calculation of attribute means and overall satisfaction.

Data entry into the calculation template has been double-checked to ensure accuracy.

4.7 Validation

The higher values of the coefficients of Cronbach's alpha of opinion and relevance for all the seven case studies (in two groups) indicated the reliability of data collected in through the Qualtrics online survey. Thus, all the end-users demonstrated a common thought on the relevance of each item. Due to the higher values of Cronbach's alpha for all constructs (Desirable, Adaptable, Practicable and Serviceable), none of the items were removed for the next level of analysis.

In the CFA, the values of CFI and TLI showed non-significant relation (CFI < 90%). This is a desirable result for different aspects of each construct. RMSEA proved the significance of the CFA model.

Correlation analysis found a significant correlation with all the items in all case studies between the opinion and relevance. The reduction in Pearson's correlation coefficient after rescaling indicated that for some of the case studies, the Serviceable items have significant correlations between the opinion and respective relevance.

Results of the canonical discriminant analysis showed that the first and second CVs have significant correlations of 0.64 and 0.46, respectively while the third CV has a non-significant correlation of 0.39. Significantly low R-squares (lower than 0.85) show that all the case studies have significant overlapping.

IRT analysis revealed that the polychoric correlation result in the first three factors is significantly high. However, this correlation in the last factor (Serviceable) is lower in values. Therefore, item difficulties are the lowest in Desirable and Adaptable constructs and highest in the Serviceable construct.

These results confirm that the rigorous testing of the model has demonstrated that the survey instrument is valid and reliable.

4.8 Summary

Four case studies in Group 1 and three case studies in Group 2 were completed. While no modifications to the pilot survey used in the first collection were necessary, it was determined that the post occupancy specialisation be dropped as it could not provide the level of generic

assessment required. Post occupancy evaluation was folded into the other three project types as appropriate.

The collected data were tested for reliability, confirmatory factor analysis, correlation analysis, item response theory analysis and model specification, and results were tabulated, diagrammed, and interpreted. The higher the value of Cronbach's coefficient alpha, the better will be the repeatability and consistency of measuring tests (at least greater than 0.07 for strong homogeneity and adequate sampling domain). Across the case studies, the values of Cronbach's alpha are higher, therefore the data and survey measurements for the four critical success factors are reliable, both in terms of opinion and relevance.

The next chapter will discuss these results further and provide critical reflection of additional insights uncovered. The integration of EUS into a broader model of project success will be outlined and illustrated via the Group 2 case studies.

CHAPTER 5: DISCUSSION

5.1 Purpose of this chapter

The purpose of this chapter is to reflect on the results and critically evaluate the insights they offer. These insights include a discussion of generic archetypes (based on four-quadrant scatter diagrams), satisfaction attribute relevance (based on prevalence of 'no opinion' responses), and virtuous loops (based on end-user feedback to designers). EUS outcomes are compared across all seven case studies.

EUS is the final test for project success. But it needs to be viewed in the context of earlier project design and delivery. EUS is integrated into a wider model, called *i3d3*, and used to compare and rank overall project performance against other projects using a scale of -100 to +100, where zero is the threshold between success and failure. The *i3d3* model is described and examples based on the Group 2 case studies are provided to demonstrate ease of systematic adoption in practice.

Finally, the five research questions raised in Chapter 1 are comprehensively answered in the light of the research results and discussion.

5.2 Summary of results

Project success has been an unagreed concept. A universal definition has not emerged that could be broadly accepted by researchers, authors and project stakeholders (Barnes, 1988; de Wit, 1988; Pinto & Slevin, 1988; Freeman & Beale, 1992; Belassi & Tukel, 1996; Atkinson, 1999; Baccarini, 1999). The major differences in explaining this concept were mainly due to the nature of projects (size, complexity and sector), the evaluation time, local/regional, national, and international conditions/laws (affecting communities, social behaviour, climatic impacts, or politics/policies, etc.), interest and interpretation of success phenomenon by stakeholders, ever-changing and ever-increasing parameters and factors of success evaluation using different theories and models of success assessment.

As a result, many definitions and interpretations of project success have been cited in the literature (Hough & Morris, 1987; Baccarini, 1999; Greer, 1999; Lim & Mohamed, 1999; Westhuizen & Fitzgerald, 2005; Shenhar & Dvir, 2007; Kerzner, 2009; Cavarec, 2012; McLeod et al., 2012; Turner & Zolin, 2012). It has been over many decades that project performance has a different meaning to project success.

Project success is mostly assessed at the end of the implementation phase employing traditional outcome measurements (Jugdev & Muller, 2005; Musawir, 2017) like cost, time, quality, and performance, and sometimes satisfaction of stakeholders (Turner & Zolin, 2012; Mir & Pinnington, 2014). However, evaluation of post-delivery success has been emphasized more recently.

Some authors differentiated between project efficiency and project success. Project efficiency was argued to include parameters like on-time, on budget, and within the scope, while project success was more focused on business-oriented results, sustainability and customer satisfaction (Cooke-Davies, 2002; Shenhar and Dvir, 2007; Muller and Jugdev, 2012; Serrador and Turner, 2015). Therefore, taking a more holistic look at the success of an accomplished project is necessitated (Shenhar & Dvir, 2007; Mir & Pinnington, 2014). Hence, the perception of recipients of the project is different from managers and stakeholders involved during the design stage and the delivery stage of the project. Much of these ideas are now disputed (e.g. Ghanbaripour, 2020).

The various perceptions of project success by its stakeholders are highly important, in particular, the customers and end-users (Ika, 2009; Jugdev & Müller, 2005; Cavarec, 2012; Davis, 2014; Mukerjee & Devi, 2017; Wu et al., 2017). A project can only be considered successful if its outcomes (products, services, systems, and assets) are accepted by the customers and end-users during the post-delivery/operational stage. So, these stakeholders predominantly enjoy authoritative power because the products of a project can only be sustained in the market if liked, adopted and purchased by the users.

Thus, project success assessed during the post-delivery phase is the real success of any project because earlier evaluations are related only to project management success, the success can only be claimed if the outcomes (product, services, or systems) of a project are accepted by the customers and end-users (Vaezi, 2013; Williams et al., 2015; Davis, 2016; Aarseth et al., 2017; Schiebler, 2019; Wu & Wu, 2019; Ingle & Mahesh, 2020; Iriarte & Bayona, 2020).

The probable acceptance of customers and end-users depends upon the quality characteristics and innovations of products (Dvir et al., 2003; Davis, 2014; Song et al., 2018; Setyaningrum et al., 2020; Hague & Hague, 2021), which can be evaluated by measuring their satisfaction. Some selected attributes of satisfaction might be useful in the measurements of the delight of end-users (Terry et al., 2013; Rashvand & Abd Majid, 2014). The number of reported attributes is so many because these can measure variably the products, services, systems, and assets separately that are outcoming of different projects (Krikor, 2011; Machado et al., 2016; Vongsraluang & Bhatiasevi, 2017; Wu et al., 2017; Högström et al., 2016; Costa, 2020; Gao et al., 2020; Iriarte & Bayona, 2020; Lexutt, 2020). Questionnaires are the recommended tool for conducting surveys of customer satisfaction and delight (Hoonakke et al., 2010).

The major purpose of the quantitative survey was to test the reliability and effectiveness of the proposed generic model in assessing the real satisfaction and delight of customers and end-users of the 7 case studies. Thus, the evaluation was spread over various natured projects so that the broader scope of the model could be tested and proven. The data based on the opinion of customers and users in the form of replies to various questions in the survey, and the data form the proposed end-users delight measurement model, were the subject of tests like Cronbach's alpha, CFA, correlation analysis, and multidimensional IRT for checking reliability, explaining construct variance, finding a correlation between opinion and relevance, and having a comparison of groups respectively (Tavakol & Dennick, 2011; Zhou, 2019).

Validity denotes whether any concept, parameter or data have been measured/assessed rightly or not (Hair et al., 2019a & 2019b; Sekaran & Bougie, 2010; Zikmund et al., 2013). Validity determinations are important to know that interpreted results are leading to real outcomes and are free from errors. Three are three validity types of scale measurement: content validity, criterion-related validity, and construct validity (Sekaran & Bougie, 2010). Content/face validity ensures that the measure includes an adequate and representative set of items that tap the concept.

The found values of Cronbach's alpha were relatively higher and ranged from 0.5807 to 0.9125 within-group one and two, which indicated that in most of the cases, the reliability of collected data in opinions and relevancies observations were significantly better. Hence, all the participants have nearly a common thought about the outcomes of various case studies. The values of the coefficient of Cronbach's alpha were lower in the Cinema Complex case and higher in the HSM Building case.

In the second group of case studies, the values of Cronbach's Alpha were relatively higher in the two case studies HZMB and GCLR cases regarding opinions and relevancies whereas in the BEUE case the test statistic was significantly low in serviceable relevance only. Removal of items could not improve the value and lead to higher statistics. In general, the values of Cronbach's Alpha were found to be higher revealing higher reliability of model testing when compared with the standard value which is 'Acceptable > 0.7'. The viewpoint of Tavakol and Dennick (2011) that higher values of Cronbach's Alpha do not necessarily show higher reliability has not been agreed by some other authors, rather they suggested removing the extreme single values for calculating a reliable value (Cho & Kim, 2015; Salkind, 2015; Stephanie, 2021).

According to CFI and TLI values in both the groups of case studies, the end-user delight model is showing a non-significant relation (CFI < 90%), which can be regarded as a desirable result in the current studies.

The objective of CFA is to test whether the data are fitting a hypothesized measurement model or not. This hypothesized model analyses the theory and/or previous analytical research work of a social science researcher (Preedy & Watson, 2009). CFA is regarded as a powerful and flexible technique for statistical analyses which is becoming popular as a tool for researching

psychology and education. CFA enables focusing on modelling the relationship between manifesting (observed) indicators and underlying variables (Gallagher & Brown, 2013).

The values of RMSEA also showed the significance of the CFA of this model. The value of RMSEA of the Cinema Complex case had a very good value of 0.062. which is lower than 0.08, with a narrow confidence limit. Considering the number of items and subjects, RMSEA is higher than the threshold of 0.08 because of the low sample size in the other three case studies. Although the fit parameters of the CFA for this model showed medium quality, the factor loadings are in good conditions with almost all the item loadings having a significance level lower than 0.01. The HZMB and GCLR case studies display a very good CFA values of 0.077 (lower than 0.08), although its higher limit covers the 0.08 threshold.

Correlation analysis revealed a significant correlation in 80 items in all case studies of group one between the relevancies and opinions. However, correlation analysis showed a significant relationship between the relevancies and opinions in 70 items of all the three case studies of Group 2.

As stated earlier, the correlation coefficient scale varies from +1 through 0 to -1. The complete correlation between two variables is indicated by either +1 or -1, positive or negative correlations respectively while a complete absence of correlation is represented by 0. However, any intermediate values may also occur (Nikolić et al, 2012; Mahdavi, 2013; Paek & Cole, 2020; Taylor, 2020).

The marginal maximum likelihood method was employed for IRT analysis of model specification because it is a common phenomenon for questionnaire satisfaction analysis. The values of log-likelihood and linear chi-square of the model were calculated as -26757 and 49552 respectively.

The polychoric correlation result showed that the internal correlation in the first three factors is significantly high as the squares of each 10 scores item show obvious borders. However, polychoric correlation in the last factor (serviceable) has faded borders which is the result of the higher difficulty of the items. Therefore, item difficulties are the lowest in desirable and applicable constructs and highest in serviceable constructs.

The IRT modelling can produce precise, valid and relatively brief instruments for further use (Hambleton & Swaminathan, 1985; Lord, 1980; Wainer et al., 1990).

EUS scores for the case studies are shown in Table 5.1. They vary from -27 (Cinema Complex) to +88 (BEUE). Scores less than zero indicate that dissatisfied respondents outnumber those satisfied, or in other words, the number of people with a positive view that their needs and wants were satisfied is less than 50% of those surveyed. Two case studies (i.e. Cinema Complex and iLearn Platform) have negative scores for EUS. However, across all case studies, the mean EUS is +36.

Table 5.1. Summary of EUS results

Case Study	Desirable	Adaptable	Practicable	Serviceable	EUS
Sports Centre	43	39	40	52	43
Cinema Complex	-18	-33	-30	-28	-27
iLearn Platform	-26	-8	6	-8	-9
HSM Building	55	53	60	61	57
HZMB	65	66	67	62	65
BEUE	88	89	88	88	88
GCLR	31	25	45	38	35
Mean:	**34**	**33**	**39**	**38**	**36**

The ranking of the four critical success factors also shows significant variance. Needs generally outperformed wants. In most case, end-users appear satisfied with the project. The mean number of end-users surveyed is 98 (lowest = 61, highest = 138). The total number of people surveyed is 687 (Group 1 = 342, Group 2 = 345). Response rates are not relevant as the strategy in each case is to get the maximum number of surveys possible given constraints of time.

5.3 Generic archetypes

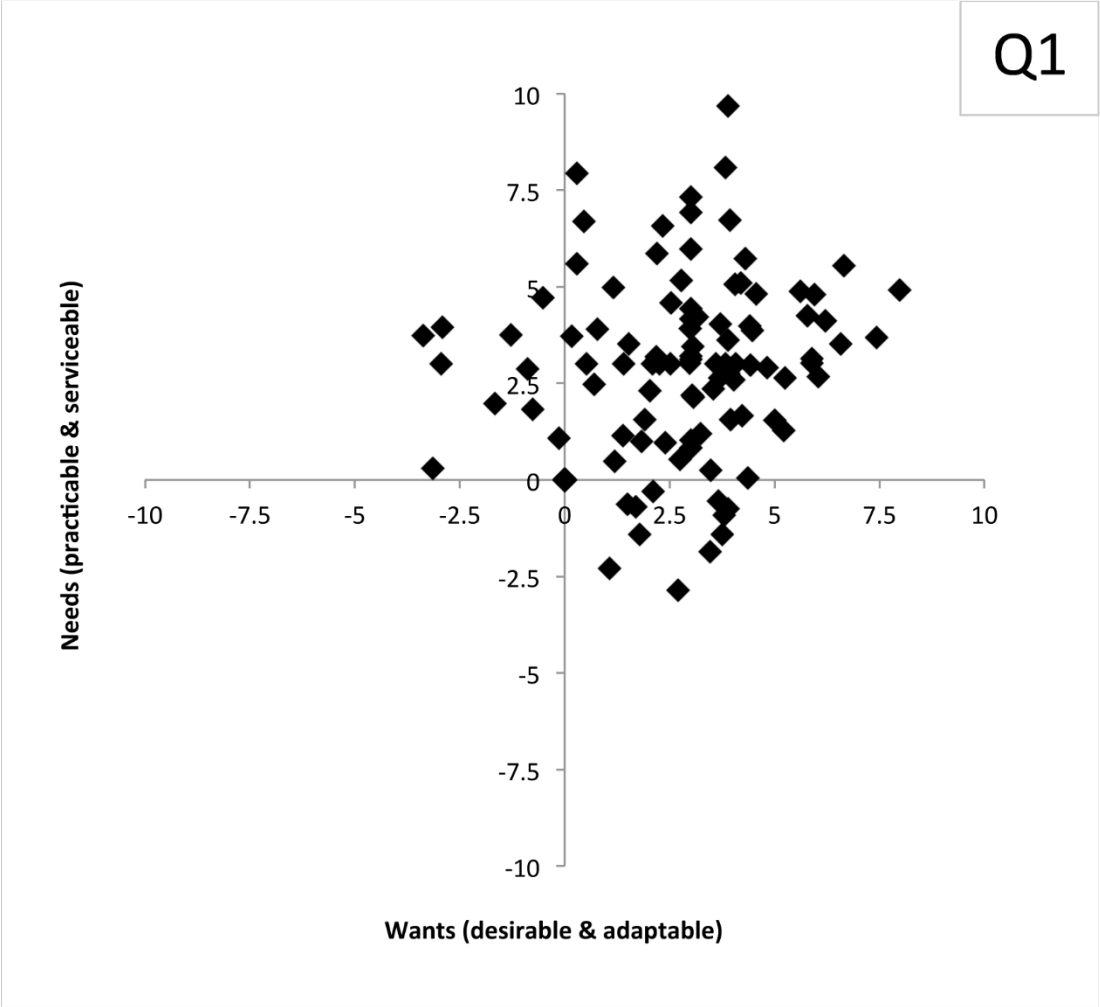
Four-quadrant diagrams comparing needs and wants depict patterns based on dispersion (wide range of responses) and linearity (balance). Some generic archetypes for these diagrams might help to understand the collective view of end-users. The relative position of the scatter plot to the Q1 quadrant is directly correlated with EUS.

Six different archetypes are discussed below. Each is simulated by random number generation given several parameters. The Microsoft Excel formula creating these patterns is listed below

each four-quadrant diagram. Every time the simulation is run, a different set of scatter points is created. However, each archetype iteration will share the same characteristics. The formula can be manipulated to create higher or lower EUS scores by modifying the boundaries of the randomization algorithm. Therefore, the calculated value of EUS for each archetype is not a defining characteristic.

Type 1 is an example of dispersion (see Figure 5.1). There is a lot of variances between needs and wants, which may suggest a level of disagreement. It could also indicate uniformed opinion. In this example, most people appear happy. EUS is based on the proportion of responses in Q1 compared to the total – it does not matter about the conviction or strength of those opinions.

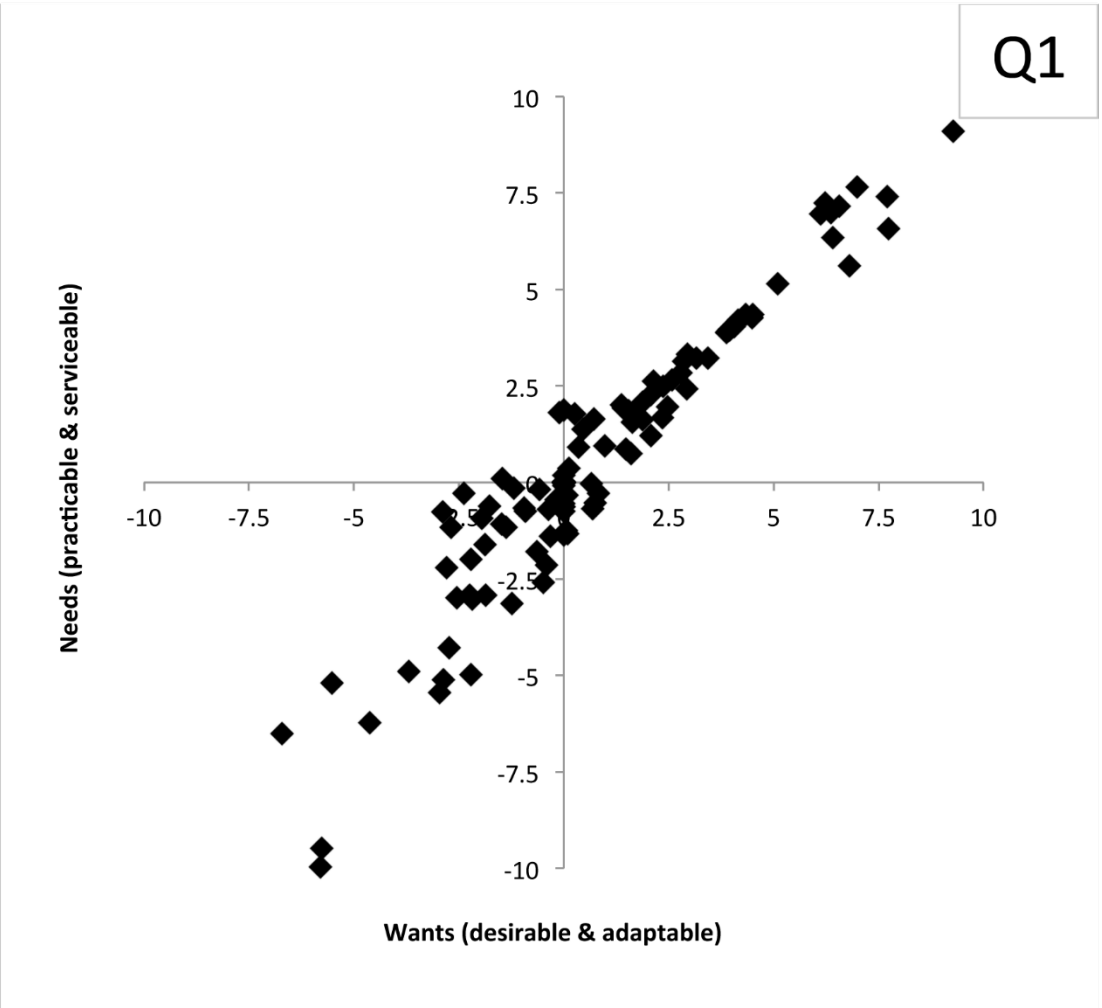
Figure 5.1. Generic archetype Type 1 (dispersion)



*Excel formula: wants=rand()*randbetween(-7,7)+3; needs=rand()*randbetween(-7,7)+3*

Type 2 is an example of positive linearity (see Figure 5.2). This is likely to be common in practice, as the difference between attributes classified as needs with those classified as wants is moderated by the number of attributes and the averaging process. Here there is strong consensus on the balance between needs and wants, but strong disagreement on whether that translates to satisfaction or dissatisfaction. There is a cluster of responses close to the origin and fewer responses at the extremes. In this case, opinion is clearly informed. However, end-users display deeply held views that suggest a diverse population.

Figure 5.2. Generic archetype Type 2 (positive linearity, balanced)

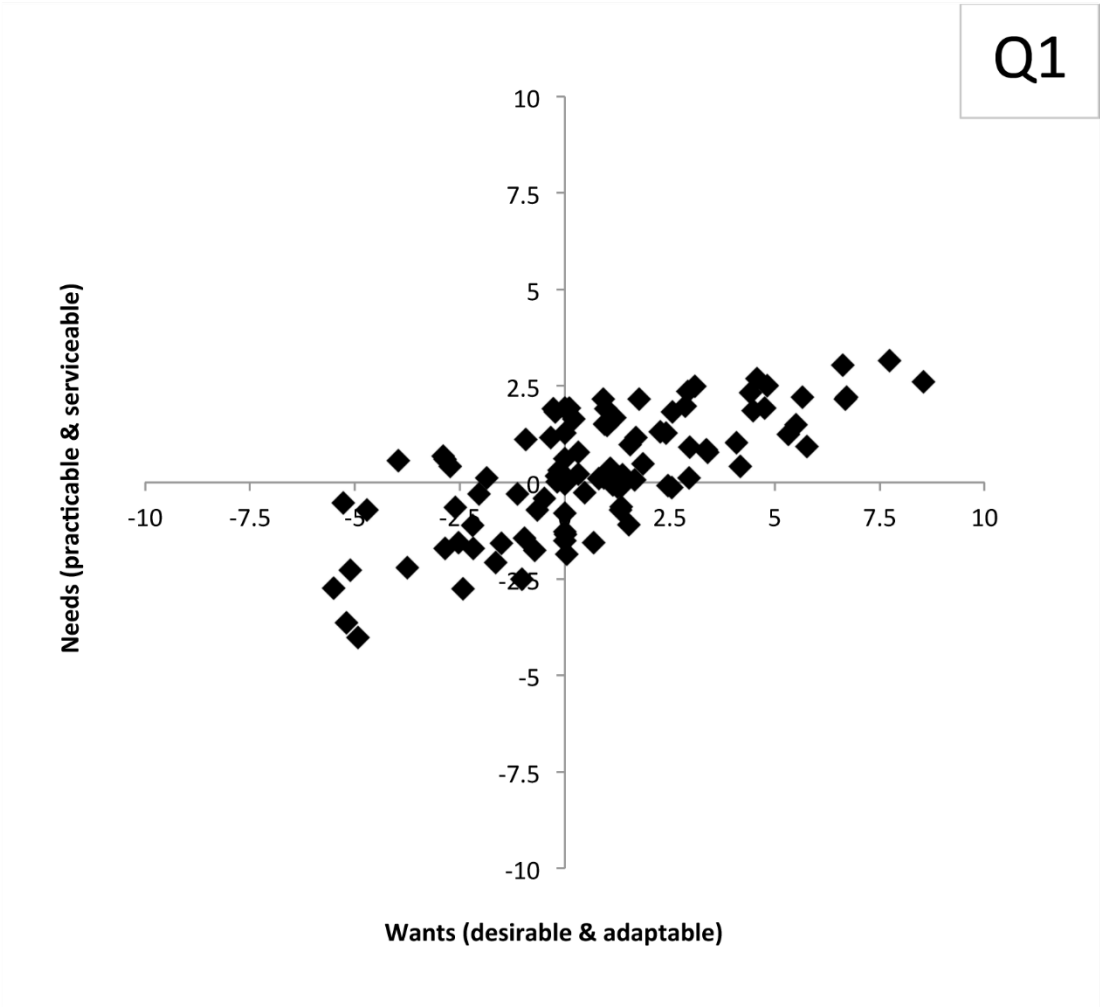


*Excel formula: wants=rand()*randbetween(-7,10); needs=(wants-4)*(1+(rand()-.5))+4*

The elongated nature of the scatter plot shown above can be easily affected by changing the randomization boundaries. In practice, it might be more likely to see less polarization of views. Rather than people being either satisfied with needs and wants or dissatisfied with both, greater dispersion might be expected.

Type 3 is an example of positive linearity, but prioritizing wants over needs (see Figure 5.3). There is strong agreement on this prioritization, but disagreement on whether that translates to satisfaction or dissatisfaction. There is once again a cluster of responses close to the origin. Wants are important to end-users even though there is volatility of opinion. Needs are less important. Nevertheless, satisfaction with wants suggests satisfaction with needs, and vice versa.

Figure 5.3. Generic archetype Type 3 (positive linearity, unbalanced wants)

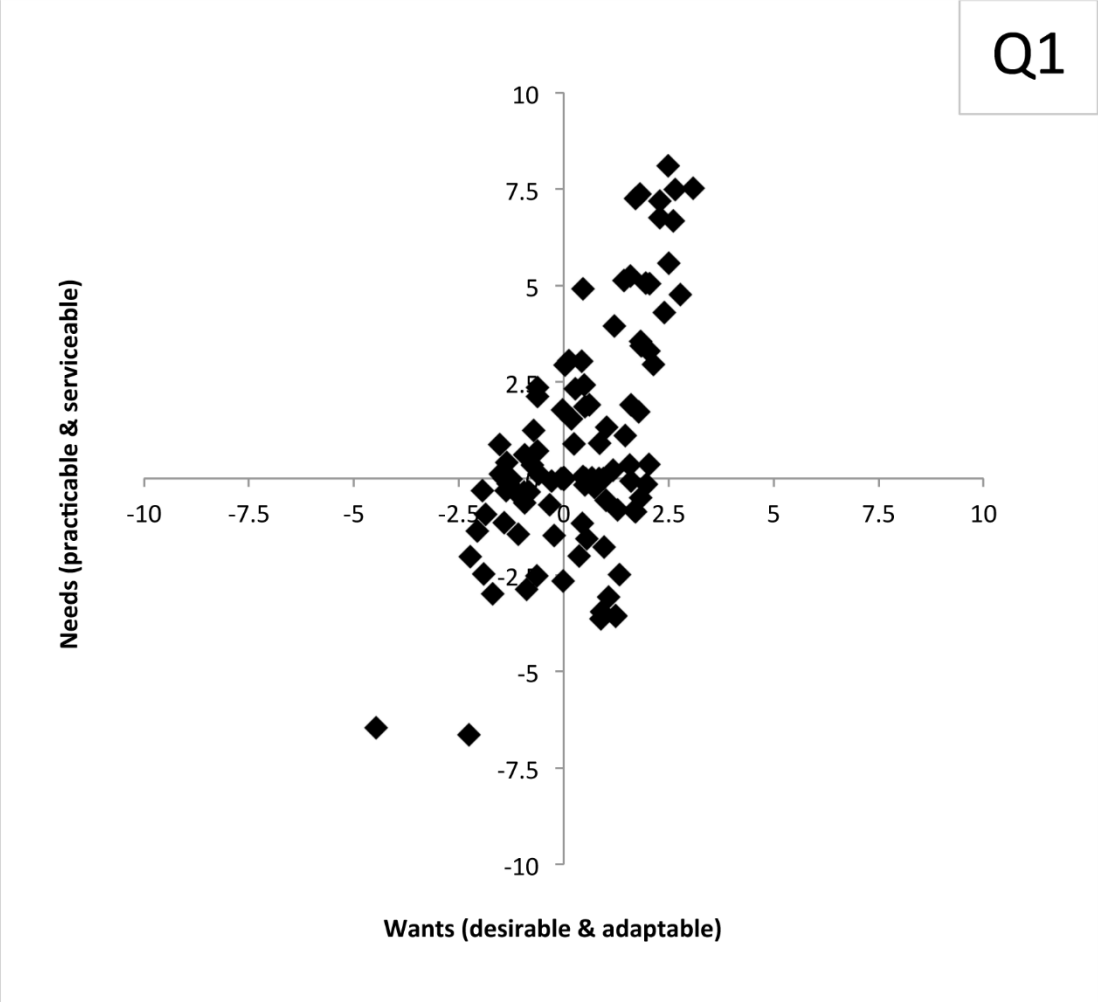


*Excel formula: wants=rand()*randbetween(-7,10); needs=(wants/3-4)*(1+(rand()-.5))+4*

Similar comments regarding elongation of the trend line discussed in relation to the Type 2 archetype apply equally here.

Type 4 is an example of positive linearity, but in this instance, prioritizing needs over wants (see Figure 5.4). There is once again strong agreement on this prioritization, but disagreement on whether that translates to satisfaction or dissatisfaction. There is still a cluster of responses close to the origin. Needs are important to end-users even though there is some volatility of opinion. Wants are seen as less important. Needs and wants are positively correlated, yet there are more dissatisfied people now.

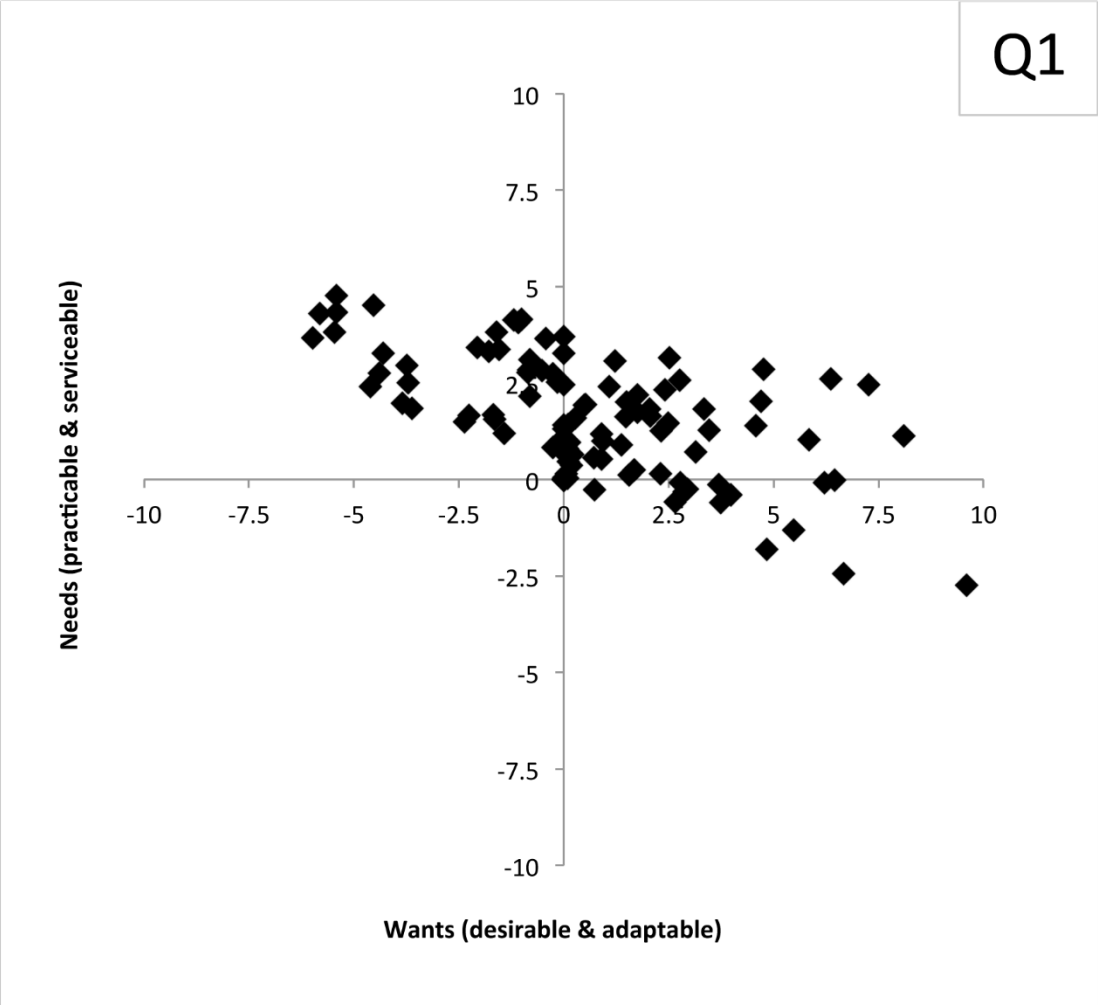
Figure 5.4. Generic archetype Type 4 (positive linearity, unbalanced needs)



Excel formula: wants=(needs/3-4)(1+(rand()-.5))+4; needs=rand()*randbetween(-7,10)*

Type 5 is an example of negative linearity, prioritizing wants over needs (see Figure 5.5). It is similar to Type 3, but the trend line is downward sloping. This is perhaps a less likely outcome. Needs are still less important than wants, but more people had their needs satisfied. No one was dissatisfied with both.

Figure 5.5. Generic archetype Type 5 (negative linearity, unbalanced wants)

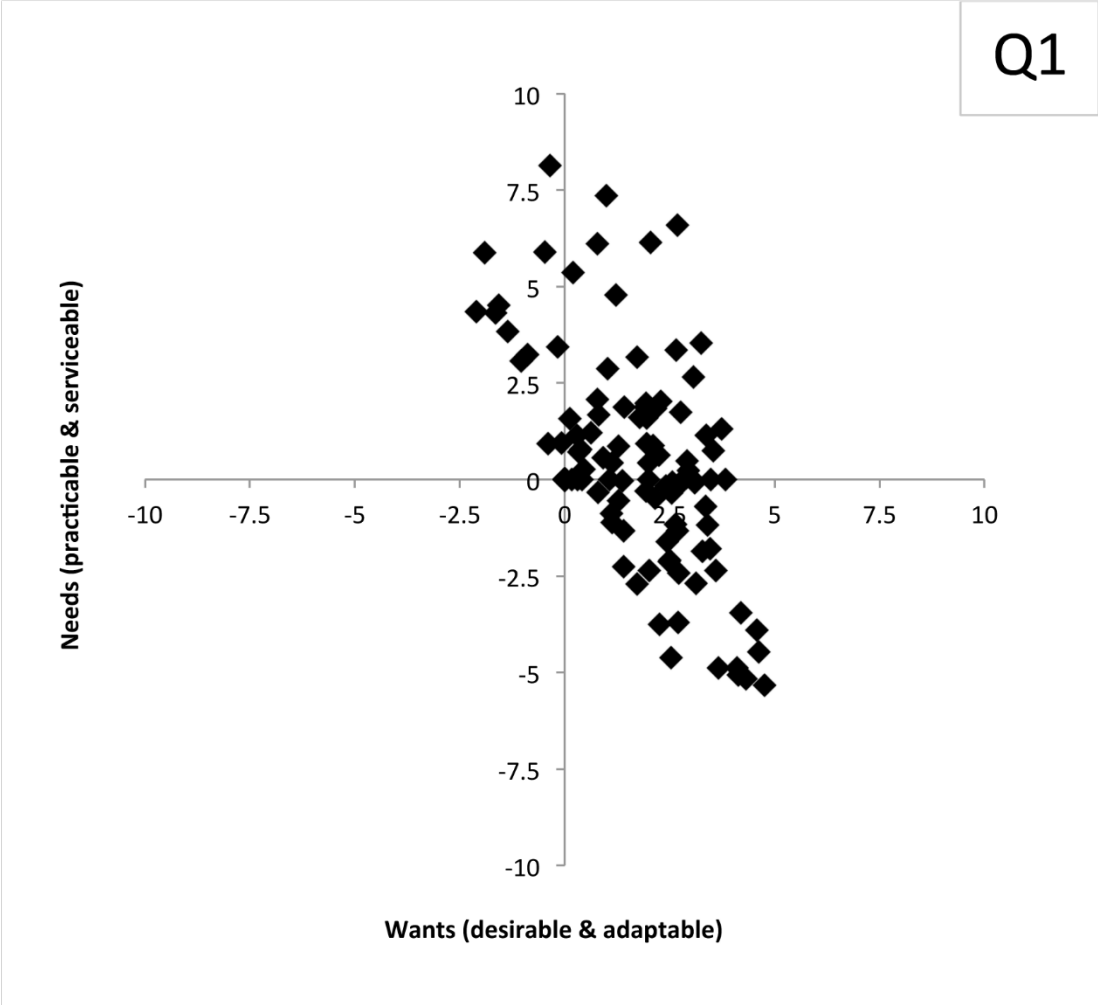


*Excel formula: wants=rand()*randbetween(-7,10); needs=(wants/-3-4)*(1+(rand()-.5))+6*

Finally, Type 6 is an example of negative linearity, prioritizing needs over wants (see Figure 5.6). It is similar to Type 4, but the trend line is once again downward sloping. This is perhaps a less likely outcome. Wants are still less important than needs, but more people had their wants satisfied. As the previous archetype, no one was dissatisfied with both.

In the seven case studies reported in Chapter 4, all show a Type 1 archetype (dispersion) except for the three international projects. The Cinema Complex appears to be generally disliked, and the range of opinion displays central tendency around the origin of the diagram that hides the dispersion effect. HZMB and BEUE show a Type 2 archetype (positive linearity, balanced) as well as strong satisfaction levels. Perhaps the fact that many end-users for these three case studies come from a non-English speaking background may have contributed to the lack of dispersion evidenced. Examination of the proportion of attributes that registered 'no opinion' might shed further light on the matter.

Figure 5.6. Generic archetype Type 5 (negative linearity, unbalanced needs)



Excel formula: wants=(needs/-3-4)(1+(rand()-.5))+6; needs=rand()*randbetween(-7,10)*

5.4 Attribute relevance

The relevance of the core attributes used in the survey can be better understood by exploring the incidence of end-users having no opinion. When this happens, those attributes have no effect on the outcome. They do not count as zero – rather null. The ratio of purposeful opinion compared to the maximum number of potential responses produces a measure of relevance. The relevance index is computed for each attribute in each case study. The results are shown in Table 5.2. User-defined questions are ignored. Values less than 75% are highlighted in orange. Only 9% of attributes have less than 75% relevance. The Cinema Complex and BEUE (both service provision projects) share most of these cases, although mostly different attributes. The attributes with more than one instance of lower relevance are profitability (3), ethical (2), non-toxic (2) and regenerative (3).

Table 5.2. Relevance index calculated by attribute and case study

Attribute	Sports Centre	Cinema Complex	iLearn Platform	HSM Building	HZMB	BEUE	GLCR
DESIRABLE							
Nice to look at?	86%	84%	76%	92%	82%	82%	88%
High quality?	89%	82%	82%	97%	87%	96%	90%
Profitable?	89%	70%	79%	93%	80%	68%	72%
Well-designed?	88%	79%	74%	95%	89%	84%	88%
Valuable?	88%	79%	81%	90%	88%	98%	80%
Prestigious?	83%	83%	88%	89%	87%	69%	75%
Durable?	90%	76%	78%	97%	84%	95%	85%
Popular?	90%	79%	79%	93%	84%	77%	81%
Joyful?	86%	84%	84%	92%	83%	88%	80%
Unique?	92%	86%	82%	93%	86%	59%	82%
ADAPTABLE							
Versatile?	86%	77%	85%	100%	86%	95%	83%
Easily modified?	92%	74%	78%	92%	89%	96%	86%
Able to be customized?	88%	74%	87%	93%	83%	92%	78%
Multi-use?	90%	77%	85%	95%	92%	60%	83%
Transportable?	90%	74%	87%	100%	89%	72%	80%
Better with age?	88%	75%	85%	100%	87%	91%	76%
Modular?	87%	76%	78%	92%	85%	65%	76%
Scalable?	89%	77%	85%	100%	88%	92%	78%
Technically clever?	92%	74%	84%	98%	86%	76%	78%
Timeless?	88%	73%	81%	95%	89%	88%	80%
PRACTICABLE							
Functional?	91%	75%	85%	93%	87%	95%	91%
Appropriate?	86%	74%	81%	100%	88%	95%	93%
Robust?	89%	79%	81%	93%	87%	96%	86%
Safe?	95%	83%	79%	90%	87%	99%	96%
Healthy?	87%	79%	79%	93%	80%	87%	83%
Problem-solving?	90%	71%	93%	97%	86%	91%	86%
Easy to use?	90%	80%	87%	97%	92%	100%	91%
Affordable?	90%	87%	84%	97%	86%	100%	93%
Comfortable?	88%	75%	85%	92%	83%	89%	90%
Ethical?	87%	71%	88%	97%	78%	73%	81%
SERVICEABLE							
Low maintenance?	88%	74%	88%	93%	87%	100%	79%
Easily cleaned?	91%	76%	84%	97%	83%	67%	81%
Recyclable?	90%	82%	85%	95%	81%	65%	77%
Non-toxic?	88%	74%	88%	97%	81%	99%	74%
Repairable?	88%	77%	87%	100%	92%	96%	89%
Energy efficient?	93%	76%	74%	97%	86%	84%	83%
Reliable?	91%	83%	93%	98%	89%	84%	83%
Accessible?	92%	79%	91%	93%	83%	77%	88%
Regenerative?	89%	71%	82%	97%	81%	69%	72%
Habitat-safe?	91%	78%	87%	98%	89%	65%	82%

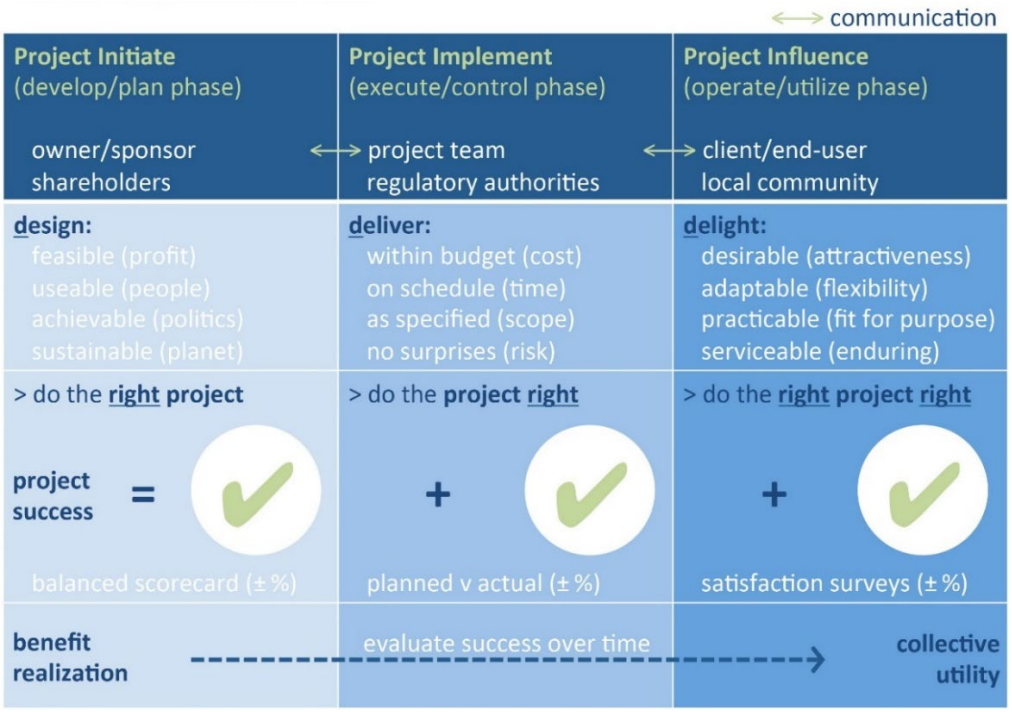
5.5 Integration with the *i3d3* model

There is much confusion about what constitutes a successful project, or a quality outcome, since often the criteria applied are not made clear at the outset and the boundaries for what is to be included in the evaluation become blurred. To overcome this problem, a new approach called *i3d3* has been developed by a group of researchers at the Centre for Comparative Construction Research at Bond University. There are generic and measurable criteria, or critical success factors, that are applicable for any project, whether this product creation, service provision, system development or any other change intervention. A single score, on a scale of -100 to +100, can be computed to identify success and to compare projects regardless of context.

5.5.1 Model overview

The *i3d3* model adopts a step-by-step procedure according to its three generic phases of *project initiate* (design), *project implement* (deliver) and *project influence* (delight). It is agnostic to project type, size, location or date. It can be applied to determine if a project is a success or a failure. It can also be used to rank projects in order of success. The procedure is enacted separately for each phase using different methods (see Figure 5.7). Ultimate success is the arithmetic mean of success scores, equally weighted, across all three phases.

Figure 5.7. The *i3d3* conceptual framework



Source: Langston et al. (2018)

5.5.2 Net benefit

Benefit(s) realization is about ensuring project objectives are fulfilled. This may take many years to eventuate. Hence, success is an on-going activity with perceptions concerning end-user delight changing over elapsed project life. It is a function of stakeholder satisfaction and is reflected in the relationships that are formed and maintained between key people over time. With that comes the acknowledgement that there is more than one stakeholder to please, that project objectives will vary between them, and that the passage of time is an important ingredient in understanding and quantifying satisfaction.

The calculation of net benefit in *i3d3* is founded on achieving mandatory performance targets, although additional criteria can be added. It is computed as the unweighted mean of the following, where each relates to a different stakeholder group:

- Feasible success score: benefit-cost ratio (BCR) > 0
- Useable success score: local project support (LPS) > 0
- Achievable success score: risk and reward (RAR) > 0
- Sustainable success score: ecological footprint (EFP) > 0
- Project delivery success score (PDS) > 0
- End-user satisfaction success score (EUS) > 0
- Humanity index > 0

The calculation of EUS is the direct contribution of the present study.

5.5.3 Humanity index

The humanity index is a construct within *i3d3* to connect project success with humanitarian contributions on a global scale. It is measured on a scale of 0 to 100. This score is not directly part of the *i3d3* ranking, but rather is an allied indicator of global citizenship. It does form part of the net benefit calculation.

The four consequences (financial, social, ethical and environmental) are mapped against the 17 Sustainable Development Goals published by the United Nations. Financial consequences relate to *Goal 8*, *Goal 9*, *Goal 11*, and *Goal 12*. Social consequences relate to *Goal 1*, *Goal 2*, *Goal 3*, and *Goal 4*. Ethical consequences relate to *Goal 5*, *Goal 10*, *Goal 13*, and *Goal 16*. Environmental consequences relate to *Goal 6*, *Goal 7*, *Goal 14*, *Goal 15*, and *Goal 17*.

5.5.4 Project initiate (design)

Project initiate is the same thing as pre-implementation or front-end planning and is largely about the design process. Success during this phase is judged from the perspective of the owner/sponsor of the project and shareholders and measured by DSS. The focus is on selection of the project and includes success factors such as whether the project's design is feasible, useable, achievable and sustainable. These design success factors are collectively assessed in sequence and test whether the project itself reflects an appropriate course of action. A balanced scorecard approach is adopted to determine success.

5.5.5 Project implement (deliver)

Project implement is about delivery. Success during this phase is judged from the perspective of the project team and regulatory authorities and measured by PDS. The focus is on materialization of the project and includes success factors such as whether the project is delivered within budget (cost), on schedule (time), as specified (scope) and with no surprises (risk). The deliver success factors are assessed holistically and test whether the project itself achieves the agreed expectations upon handover, or indeed prior to handover using interim milestones to check progress in conjunction with or in lieu of conventional earned value reporting.

5.5.6 Project influence (delight)

Project influence is the focus in the present study. Success during this phase is judged from the perspective of the client/end-user of the project and the local community and measured by EUS. The focus is on operational performance of the project and includes success factors such as whether the project is seen as desirable (attractiveness), adaptable (flexibility), practicable (fit for purpose) and serviceable (enduring). These delight success factors are assessed individually using a representative sample of stakeholders and a standard online questionnaire, and collectively tests whether the project itself is appreciated by those it was intended to serve.

5.5.7 GAPPS endorsement

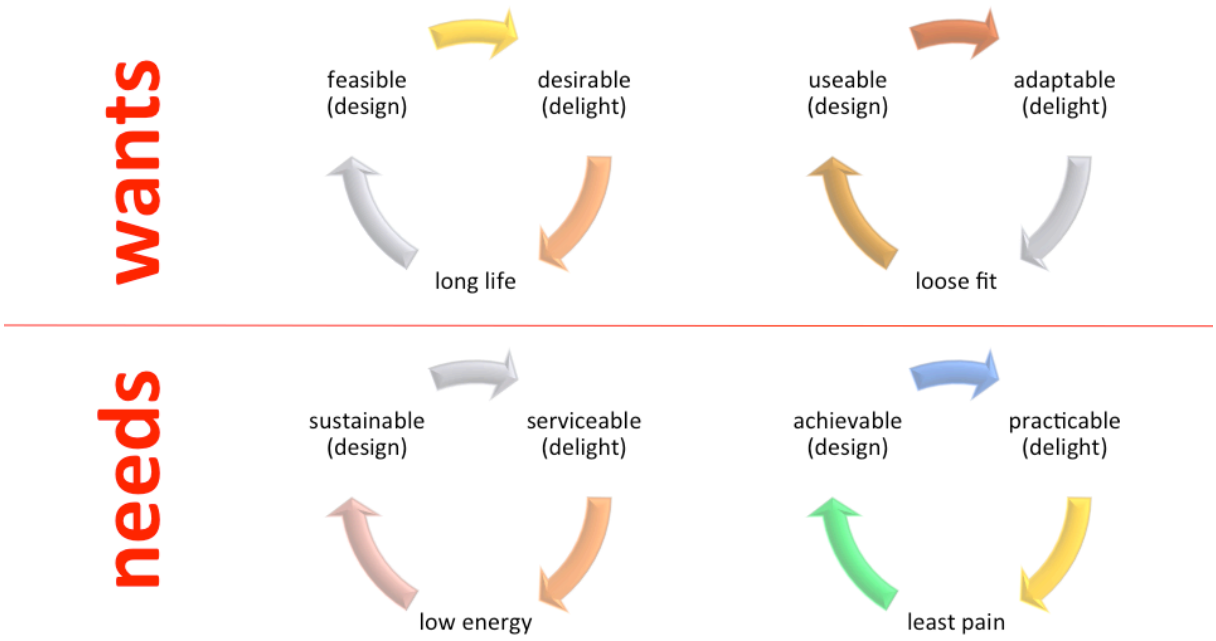
The *i3d3* model is proudly endorsed by the Global Alliance for the Project Professions (GAPPS), which is a volunteer-driven, non-profit alliance that provides a reliable source for comparison of project-based standards and qualifications. Endorsement occurred in 2021.

5.6 Virtuous loops

Meaningful two-way communication between the phases of project initiate and influence is critical to ensure that end-users are properly consulted and kept informed. This dialogue needs to be facilitated. The concepts of long life (feasible and desirable), loose fit (useable and adaptable), least pain (achievable and practicable) and low energy (sustainable and serviceable) can serve as a language that aids communication between project designers and end-users. They assist to align the objectives of the design team with the actual needs and wants of representative end-users.

Figure 5.8 indicates the mechanics of how end-user opinion can provide a positive reinforcing feedback (virtuous) loop for project designers, while also enhancing a project's success. There are four virtuous loops embedded in *i3d3*. For example, a project developed to be highly feasible during the design process is expected to also be more desirable to end-users, which would encourage them to have longer engagement with the project and hence mitigate premature obsolescence. A long life makes the project even more feasible. The same thinking also applies to help make projects more useable and adaptable, more achievable and practicable, and more sustainable and serviceable – thereby supporting an important principle of continuous improvement.

Figure 5.8. Virtuous loops



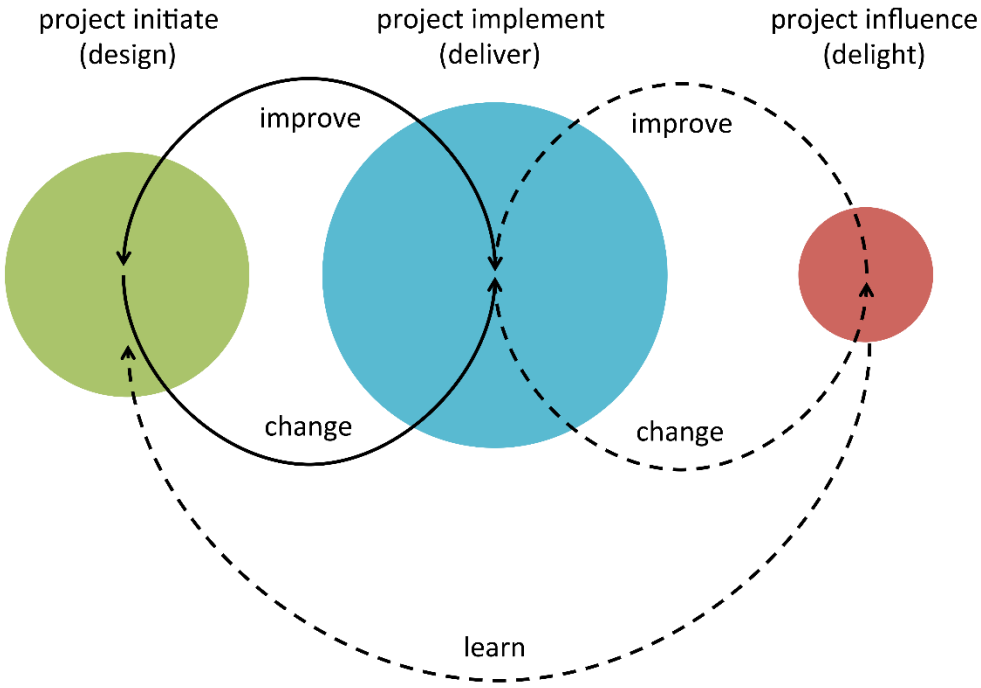
Adapted from Abu Arqoub et al. (2018)

Long life is hence aligned to financial consequences and the critical success factors of feasible and desirable. Loose fit is aligned to social consequences and the corresponding critical success factors of useable and adaptable. Similarly, least pain relates to ethical consequences and the critical success factors of achievable and practicable. Low energy relates to environmental consequences, sustainable and serviceable factors. Without these virtuous loops, learning from past actions is unlikely to occur.

5.7 Examples of *i3d3* integration

Current thinking related to project performance is often depicted by Figure 5.9. The relative size of the three circles indicates the relevance placed on project success. This explains the common preference for success to be seen through the lens of delivery, with infrequent regard to end-user satisfaction. This limits the collaboration between project implement and influence phases and underscores the inability for designers to routinely learn crucial lessons about how their projects are perceived and utilized during operation.

Figure 5.9. Current thinking

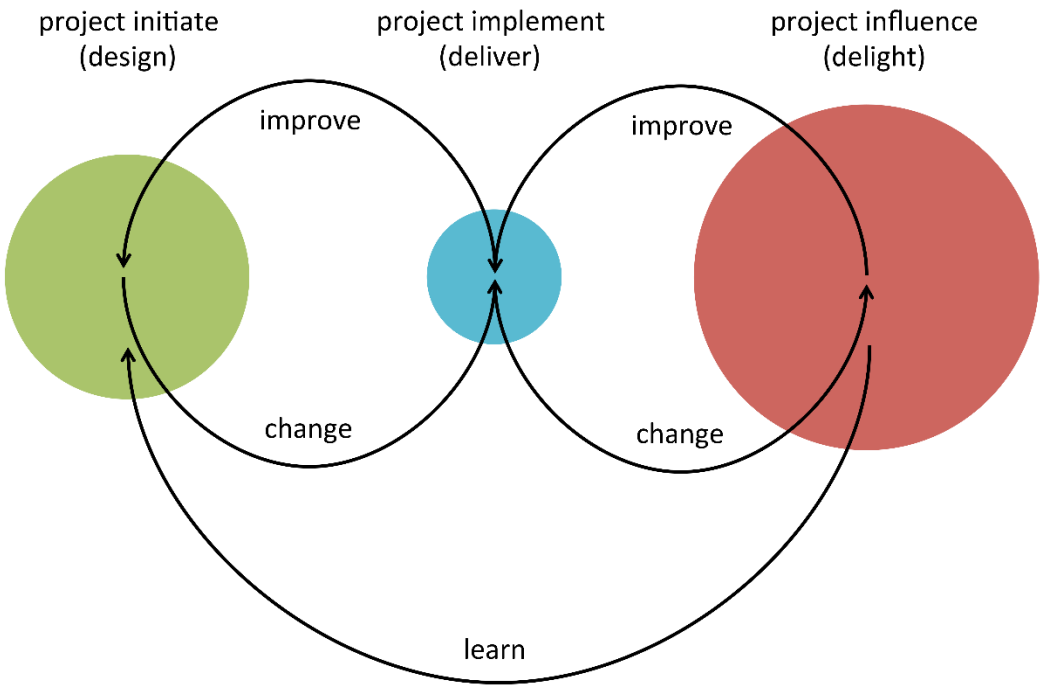


On the contrary, collaboration is normal practice between project initiate and implement phases. The reason this does not extend to the influence phase is because projects are defined as having a start and an end, and once handover is achieved, the role of the project team typically is over.

The dominance of delivery success in overall performance evaluation is the reason for projects often being seen as successful when they are implemented within budget, on schedule, as specified and with no surprises.

However, when thinking about the bigger picture and the amount of time (duration) and effort (people) embedded in each phase, the success relevance of delivery and delight is reversed. This has the effect of raising the importance of end-user satisfaction and activating both collaboration and feedback (learn) loops to earlier phases (see Figure 5.10). This is the way future practice should work.

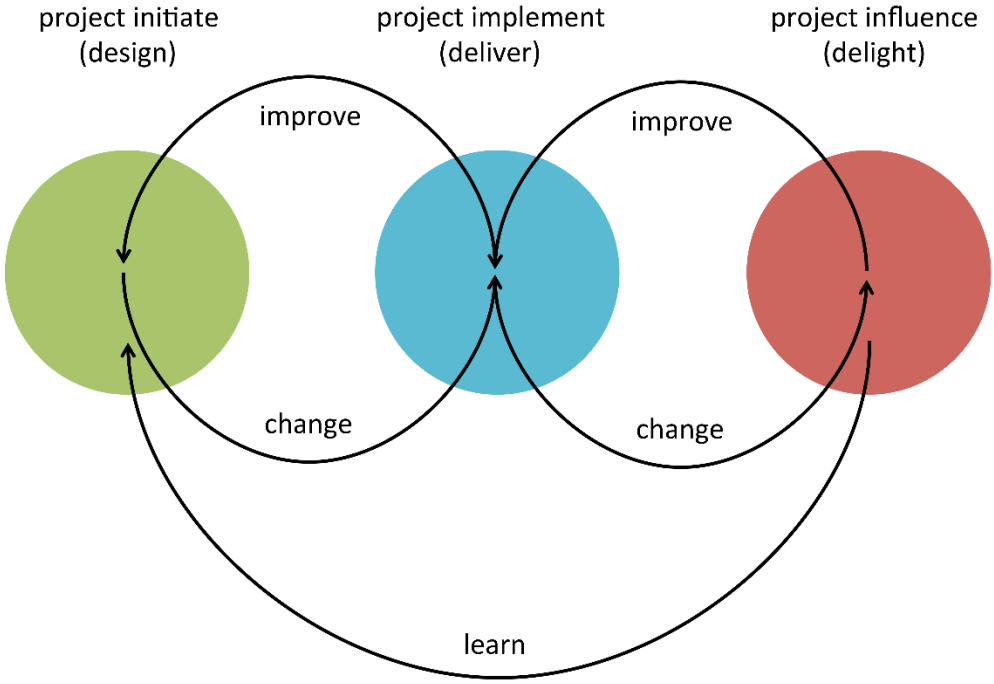
Figure 5.10. Future thinking



The importance of the design process does not change.

The *i3d3* model adopts the future thinking model. However, rather than diminish the importance of project implement and enhance the importance of influence relative to initiate, *i3d3* bestows all three phases equal standing. This is illustrated in Figure 5.11. All collaboration and feedback loops remain activated. The equal relevance of each phase to project success is why there is no differential weighting applied to the calculation for the *i3d3* ranking. The mean of DSS, PDS and EUS produces the ranking. The concept that financial, social, ethical and environmental performance also have equal relevance, leads to the corresponding conclusion that the critical success factors within them should be similarly unweighted.

Figure 5.11. *i3d3*-version of future thinking



Three examples of *i3d3* integration are provided (refer to: **Appendix 5**). They encompass the megaproject case studies from Group 2 data collection. Apart from EUS inputs, the evaluation of overall project success is undertaken by the Centre for Comparative Construction Research (CCCR) at Bond University. Both HZMB and BEUE were funded by the Asian Infrastructure Investment Bank (Beijing) in association with The Economist Intelligence Unit (Singapore). GCLR was undertaken with the cooperation of GoldLinQ Pty Ltd (Gold Coast).

Maddaloni and Davis (2018, p. 542) stated that the megaprojects are "massive investments of infrastructure, initiated by the government, which have extreme complexity, long schedules, immense lifespans and significant social impacts and attract high social-economic and political interest, and high industrial and public attention". They are also generally regarded as having a value exceeding USD 1 billion.

Table 5.3 summarizes the comparative performance achieved by HZMB, BEUE and GCLR as measured by *i3d3*.

Table 5.3. Comparison of Group 2 case studies

Rank	Project (Type)	*i3d3* Ranking*	Humanity Index	Winners
1	BEUE (service provision)	50	80	6
2	GCLR (system development)	23	20	7
3	HZMB (product creation)	22	40	5

* *The i3d3 ranking is computed as the unweighted mean of DSS, PDS and EUS. Thus, it is clear that EUS is now a seamless part of i3d3 and freely available to the public.*

Further information is available from i3d3.net (https://www.i3d3.net), Centre for Comparative Construction Research (https://bond.edu.au/cccr) and the Global Alliance for the Project Professions (https://www.pmprofessions.org/).

5.8 Summary

This chapter further interpreted the case studies and provided critical reflection on how EUS can be adopted into the broader context of measuring project success. The i3d3 model was the mechanism for integration of EUS with design and delivery. Together they cover the phases of project initiate, project implement and project influence.

The next chapter will draw the research to a close and provide answers to research questions RQ1–5 established in Chapter 1. The significant contribution to knowledge of this research will also be made clear.

CHAPTER 6: CONCLUSION

6.1 Purpose of this chapter

The purpose of this chapter is to reflect on the aim, objectives and research questions posed in Chapter 1, comment on the significance of the research contribution, outline implications for practice moving forward, clarify limitations and point to future research opportunities. It does this in the context of the literature reviewed (Chapter 2), the method deployed (Chapter 3), the results discovered (Chapter 4) and the critical reflection of practical knowledge and application (Chapter 5).

As for measuring end-user delight, success in project design and delivery is not enough. It has been shown that EUS can be evaluated using a generic survey based on desirable, adaptable, practicable and serviceable attributes and the unique assessment of opinion (-2 to +2) multiplied by relevance (+1 to +5). The proportion of respondents indicating delight in terms of 'wants' (desirable + adaptable) and 'needs' (practicable + serviceable) computes the EUS score, where a zero value is the breakeven point between satisfaction and dissatisfaction. EUS is integrated with success in design and delivery, each of equal weight, to determine overall project success.

This research is now embedded within the *i3d3* model for measuring project success, which is freely available to download and use. EUS is agnostic to project type, size, location or date. It is therefore important that delight can be assessed using a universal approach. This is shown to work equally well on small or large projects, for English-speaking and non-English speaking people in Australia or overseas, for projects recently completed or in existence for some time. Projects have been interpreted in their widest sense, comprising endeavours of product creation, service provision, and system development. The application of a standard protocol for measuring project success should not be under-estimated.

6.2 Aim, objectives and research questions (revisited)

The aim in this study was to develop a model for measuring end-user delight in an appropriate and practical format, and then empirically test this model for reliability and validity through statistical analysis of collected data.

The EUS model achieved this purpose and has been statistically tested across seven case studies divided into two groups. The results show that the balance of questions, founded on an extensive literature review of past research, is appropriate.

6.2.1 Research objectives

To achieve the above aim, six research objectives were accomplished:

1. A thorough review of the literature for measuring project success, including critical success factors and success criteria, with a particular emphasis on those that apply to post-implementation satisfaction was completed. This was supported with a SLR to help identify publications of high relevance.
2. A total of 145 attributes were found that have been used to measure end-user/customer satisfaction across a range of project types and applications. These were categorized into product creation (37), service provision (38), system development (44) and post occupancy evaluation (26).
3. A generic attribute-based approach for measuring end-user delight was conceptualized using a four-quadrant diagram that allocated the 145 attributes into four critical success factors reflecting financial, social, ethical and environmental consequences. Each of these groups were simplified into ten generic attributes (success criteria) based on short keywords that did not require technical insight/expertise.

4. A bespoke survey instrument was created to assess end-user delight across a series of case studies using a two-step process of pilot testing on small projects in each of the four project categories before undertaking larger megaprojects in three different countries. Both groups of case studies were empirically tested and validated. There was no need to change the survey design between the pilot and the final group.
5. The measurement of end-user delight has been integrated into the *i3d3* model to compute overall project success. It can assess and rank the performance of projects, as demonstrated by the Group 2 case studies included in this dissertation. EUS is given equal weight to project design and delivery performance.
6. Limitations inherent in the procedure for measuring end-user delight involve striking a balance between the scope of criteria and the time that can reasonably be sought to complete the survey. This was mitigated by adding two personal criteria to each of the critical success factors, which appears a bit unnecessary given just 2.5% of respondents took advantage of it. Further case studies are being undertaken by researchers at Bond University.

6.2.2 Research questions

There were five research questions (RQ1-5) to be answered in this study:

1. What set of generic or specific attributes enable end-user delight to be quantified as a performance metric for project success? A 'top 10' list of generic attributes is distilled from 145 that were found in the literature and allocated to each of four consequences (financial, social, ethical and environmental) that all projects can theoretically relate to. Other attributes (equivalent to 20% extra) can be added to deal with specific concerns.
2. How can end-user delight be structured and utilized as feedback to better inform future design processes? Four virtuous loops, based on the consequences above, are developed to compare end-user satisfaction with design intent. The link between them is long life, loose fit, least pain and low energy, respectively. These create potential conversations and pathways for feedback and continuous improvement.
3. For projects where end-user opinion matters, are there patterns of end-user delight that provide insight into how effective designers were in addressing their needs and wants? Generic archetypes of the four-quadrant diagram describe relationships between needs and wants. High proportions of responses in the Q1 quadrant are vital, yet patterns of dispersion and linearity show EUS strength and weakness. Six patterns were discussed.

4. What method can assess the validity and reliability of the proposed model for end-user delight? The collected data were tested for reliability, confirmatory factor analysis, correlation analysis, and item response theory analysis and results were tabulated, diagrammed, and interpreted. The higher the value of Cronbach's coefficient alpha, the better will be the repeatability and consistency of measuring tests (at least greater than 0.07 for strong homogeneity and adequate sampling domain). Across the case studies, the values of Cronbach's alpha are higher, therefore the data and survey measurements for the four critical success factors are reliable, both in terms of opinion and relevance.
5. Can the new model measure end-user delight for projects regardless of their type, size, location or date? The chosen case studies represent projects relating to product creation, service provision and system development in both small-scale and large-scale contexts. EUS can be performed at any time during project operation (influence), although it is recommended that sufficient time be provided to make informed decisions.

6.3 Significant contribution to knowledge

Most past studies address the evaluation of project management success in qualitative terms. This research, however, utilizes both quantitative and qualitative methods of assessment. The outcomes provide ordinal metrics of end-user delight that combine numerical (quantitative) and categorial (qualitative) data for the purpose of comparing and ranking the performance of different projects.

It appears that this research is the first to develop a standard protocol for measuring end-user delight that is agnostic to project type, size, location or date. There is no requirement to create bespoke criteria for every different circumstance. The same scale and method of assessment applies. Hence, this research makes a significant contribution to knowledge that underpins the ability to routinely consider end-user delight and to recognize it as a fundamental aspect of overall project success. Moreover, the developed protocol for measuring end-user delight can explain past events. It can provide a tool to understand the causes of the project's failure from an end-user perspective.

The analysis of repeatability and consistency performed on case study data strongly suggests that the EUS model is robust for a range of project types. Nevertheless, satisfaction is not the entirety of post occupancy evaluation for building projects, and hence additional investigations

are warranted to provide more targeted feedback on the quality of project design and delivery. This does not subtract from the application of EUS in assessing building construction.

6.4 Implications for practice

This research offers substantial benefit to current industry practice. EUS has become relatively easy to measure. Up to 1,000 people per project can be surveyed and their responses analyzed without manual computations. The software is freely available, including instructions and case studies. EUS is integrated into *i3d3*. Users can undertake a complete evaluation of project success, or can perform evaluations on design, deliver or delight subsets as they wish. EUS can be performed online using Qualtrics® – a template is now available from i3d3.net.

However, there are more important implications at play. Given *i3d3*'s standard protocol, projects of any type, size, location or date can be compared with each other and ranked in order of performance. This can happen at the level of an organizational portfolio, or for a geographic region, nationally or indeed globally. If this data were freely shared, such as via the i3d3.net website, a trove of performance metrics would be available for research into all aspects of project success. The following data are the most valuable:

1. Overall performance (*i3d3* ranking).
2. Financial, social, ethical and environmental consequence scores across project initiate, implement and influence phases.
3. Project initiate (design), implement (deliver) and influence (delight) scores across financial, social, ethical and environmental consequences.
4. Humanity index including UN SDGs that were eligible and justified.
5. Net benefit score.
6. Number of stakeholder groups shown to be either winners or losers.
7. The project's complexity score.

The above represent 15 numbers and up to 5 SDGs that can collectively summarize all aspects of project success. The data can be used anonymously, but ideally audited independently.

6.5 Research limitations and further research

Apart from the balance between the scope of criteria and the time that can reasonably be sought to complete the survey, there is another limitation that will likely impact on adoption in practice. Project sponsors and other stakeholders are invested in their projects. They are often happy to share their successes but prefer to hide their failures. Therefore, any progress in sharing data for performance research purposes is likely to reflect successful projects. Even anonymous databases may be mistrusted and could lead to collateral damage if confidentiality were breached. In many cases, confidentiality agreements prohibit feedback on past projects to be disclosed at all.

The ability to gain insights from widespread adoption of project performance tools is also limited by not having the context of the data, such as type of project, size, location and date.

Further research relies on the above limitations being overcome. Hence internal evaluation and performance ranking within an organizational portfolio has more likelihood to take place. Research conducted inhouse can still be written up and published by the organization to show improvement trends in key performance indicators and lessons learned from past projects that enable continuous improvement.

Further public case studies using *i3d3* can be undertaken where information is available. This implies large public projects, such as urban and civil infrastructure, prominent buildings, major events and innovative projects that attract community interest.

6.6 Summary

In Chapter 1, the problem statement for this research read:

It is not that we do not know how to measure post-implementation satisfaction (delight) – we obviously need to survey end-user opinion – it is just that we do not know how to integrate it with the wider perspective of successful pre-implementation (design) and implementation (deliver) processes. Perhaps even more importantly, we do not know whether this can be done generically across all project types or if every project is unique. Therefore, this dissertation explored these problems through an empirical case study approach, informed by previous research into project success factors and criteria, that can be tested for validity and reliability.

The above has been done. The path is now clear to adopt routine project performance reviews. The challenge is whether anyone wants to know the truth.

REFERENCES

Note: Citations requiring copyright permission have been listed at the end of this dissertation (refer: **Appendix 6**).

Aaltonen, K. (2011). Project stakeholder analysis as an environmental interpretation process. *International Journal of Project Management*, 29(2), 165-183.

Aarseth, W., Ahola, T., Aaltonen, A., Økland, A. & Andersen, B. (2017). Project sustainability strategies: a systematic literature review. *International Journal of Project Management*, 35, 1071-1083.

Abelein, U. & Paech, B. (2015). Understanding the influence of user participation and involvement on system success: a systematic mapping study. *Empirical Software Engineering*, 20, 28–81.

Abisuga, A.O., Wang, C.C. & Sunindijo, R.Y. (2020). A holistic framework with user-centred facilities performance attributes for evaluating higher education buildings. *Facilities*, 38(1/2), 132-160.

Abu Arqoub, M., Langston, C.A. & Skulmoski, G.J. (2018). Measuring end-user delight: ss success in project design and delivery enough? Paper presented at 11th International Cost Engineering Council (ICEC) World Congress & the 22nd Annual Pacific Association of Quantity Surveyors Conference, Sydney, Australia.

ACSI. (2005). *Methodology report*, March 2005, University of Michigan, Ann Arbor, MI, p. 123.

Adams, J.S. (1963). Toward and understanding of inequity. *Journal of Abnormal and Social Psychology,* 67, 422-536.

Adinyira, E., Botchway, E. & Kwofie, T.E. (2012). Determining critical project success criteria for public housing building projects (PHBPS) in Ghana. *Engineering Management Research,* 1(2), 122-132.

Aggelidis, V.P. & Chatzoglou, P.D. (2012). Hospital information systems: measuring end-user computing satisfaction (EUCS). *Journal of Biomedical Informatics,* 45, 566-579.

Ahadzie, D.K., Proverbs, D.G. & Olomolaiye, P.O. (2008). Critical success criteria for mass house building projects in developing countries. *International Journal of Project Management,* 26(6), 675-687.

Ahmad, M. (2011). *Project management: factors critical for the success of projects in oil & gas sector of Kuwait*. A project report submitted to the Department of Management Sciences, Virtual University Lahore, Pakistan.

Aigbavboa, C. & Thwala, W. (2013). A theoretical framework of users' satisfaction/ dissatisfaction theories and models. 2nd International Conference on Arts, Behavioral Sciences and Economics Issues (ICABSEI'2013) Dec. 17-18, Pattaya, Thailand.

Ajmal, K.M. & Al-Yafei, H. (2019). Exploring factors behind project scope creep – stakeholders' perspective. *International Journal of Managing Projects in Business,* 13(3), 483-504.

Akan, P. (1995). Dimensions of service quality: a study in Istanbul. *Managing Service Quality,* 5(6), 39-43.

Akinnuwesi, B.A., Uzoka, F.M., Olabiyisi, S.O., Omidiora, E.O. & Fiddi, P. (2013). An empirical analysis of end-users participation in software development projects in a developing country context. *The Electronic Journal on Information Systems in Developing Countries,* 58(6), 1-25.

Al Hammadi, N.M. (2018). A mixed methods study of key success factors for project execution in the oil and gas industry. A PhD Dissertation submitted to Grenoble Ecole De Management, France.

Aladwani, A.M. (2002). IT project uncertainty, planning, and success: an empirical investigation from Kuwait. *Information Technology & People,* 15(3), 210-226.

Albert, M., Balve, P. & Spang, K. (2017). Evaluation of project success: a structured literature review. *International Journal of Managing Projects in Business,* 10(4), 796-821.

Alias, Z., Zawawi, E.M.A., Yusof, K. & Aris, N.M. (2014). Determining critical success factors of project management practice: a conceptual framework. *Procedia - Social and Behavioral Sciences,* 153, 61-69.

Al-khawaja, A. (2015). Environmental auditing: modelling office workplace ecology. PhD Thesis, Faculty of Society & Design, Bond University, Gold Coast, Queensland.

Almalki, S. (2016). Integrating quantitative and qualitative data in mixed methods research: challenges and benefits. *Journal of Education and Learning*, 5(3), 288-296.

Almsalam, S. (2016). The effects of customer expectation and perceived service quality on customer satisfaction. *International Journal of Business and Management Invention,* 3(8), 79-84.

Alzahrani, J.I. & Emsley, M.W. (2013). The impact of contractors' attributes on construction project success: a post construction evaluation. *International Journal of Project Management,* 31(2), 313-322.

Andersen, E.S., Grude, K. & Haug, T. (2009). *Goal directed project management,* 4th ed. Kogan Page, London.

Anderson, E.W. & Sullivan, M.W. (1993). The antecedents and consequences of customer satisfaction for firms. *Marketing Science,* 12(2), 125-212.

Anderson, R. (1973). Consumer dissatisfaction: the effect of disconfirmed expectancy on perceived product performance. *Journal of Marketing Research,* 10(1), 38-44.

Andrew, P.S., Pedersen, P.M. & McEvoy, C.D. (2011). *Research methods and designs in sport management*. Human Kinetics.

Angel, S. (2019). What is the difference between a project and a product? Accenture/ Solutions IQ, Redmond, WA.

Antons, D. & Breidbach, C.F. (2017). Big data, big insights? Advancing service innovation and design with machine learning. *Journal of Service Research,* 21(1), 17-39.

APM. (2019). What is project management? APM Body of Knowledge, Association of Project Management.

Asanad, K., Zheng, J., Chan-Golston, A., Tam, E., Bhetraratana, M., Chiao-Wen, L., Zhao, M., Abdi, R., Abdi, F., Vasti, E. & Prelip, M.L. (2018). Assessing quality of care through client satisfaction at an interprofessional student-run free clinic. *Journal of Interprofessional Care,* 32(2), 203-210.

Atkinson, A. (1988). Answering the eternal question: what does the customer want? *The Cornell Hotel and Restaurant Administration Quarterly,* 29(2), 12-14.

Atkinson, R. (1999). Project management: cost, time, and quality, two best guesses and phenomenon, it is time to accept other success criteria. *International Journal of Project Management,* 17(6), 337-342.

Attarzadeh, I. & Ow, S.H. (2008). Modern project management: essential skills and techniques. *Communications of the IBIMA (International Business Information Management Association),* 2, 1-9.

Aziz, E.E. (2015). Project closing: the small process group with big impact. Paper presented at PMI® Global Congress 2015. EMEA, London, England.

Baccarini, D. (1999). The logical framework method for defining project success. *Project Management Journal,* 30(4), 25-32.

Badewi, A. (2016). The impact of project management (PM) and benefits management (BM) practices on project success: towards developing a project benefits governance framework. *International Journal of Project Management,* 34(4), 761-778.

Badi, S.M. and Pryke, S.D. (2015). Assessing the quality of collaboration towards the achievement of sustainable energy innovation in PFI school projects. *International Journal of Managing Projects in Business,* 8(3), 408-440.

Baird, G. (2014). Users' perceptions of sustainable buildings: key findings of recent studies. *Renewable Energy,* 73, 77-83.

Bajpai, N. (2011). *Business research methods.* Pearson Education, New Delhi, India.

Bannerman, P.L. (2008). Defining project success: a multilevel framework. Paper presented at PMI® Research Conference: Defining the Future of Project Management, Warsaw, Poland.

Barnes, D., Collier, J.E., Howe, V. & Hoffman, D. (2016). Multiple paths to customer delight: the impact of effort, expertise and tangibles on joy and surprise. *Journal of Service Marketing,* 30(3), 277–289.

Barnes, M. (1988). Construction project management. *International Journal of Project Management,* 6(2), 69- 79.

Barsky, J.D. & Huxley, S.J. (1992). A customer-survey tool: using the "quality sample". *Cornell Hospitality Quarterly*, 33(6), 18-25.

Barsky, J.D. (1992). Customer satisfaction in the hotel industry: meaning and measurement. *Hospitality Research Journal,* 16(1), 51-73.

Basu, R. (2014). Managing quality in projects: an empirical study. *International Journal of Project Management,* 32(1), 178-187.

Bearden, W.O. & Teel, J.E. (1983). Selected determinants of consumer satisfaction and complaint reports. *Journal of Marketing Research,* 20, 21-28.

Behe, B.K., Prince, T.A. & Tayama, H.K. (1992). Market segmentations of supermarket floral customers. *HortScience,* 27, 459-462.

Belassi, W. & Tukel, O.I. (1996). A new framework for determining critical success/failure factors in projects. *International Journal of Project Management,* 14(3), 141-152.

Beltagui, A., Darler, W. & Candi, M. (2015). Measuring the deliverable and impressible dimensions of eervice Experience. *Creativity and Innovation Management,* 3, 478-493.

Berdine, E. (2012). Reliability and validity. Available online: https://www.slideserve.com/esme/reliability-and-validity

Berman, S.L., Wicks, A.C., Kotha, S. & Jones, T.M. (1999). Does stakeholders orientation matter? The relationship between stakeholders' management models and firm financial performance. *Academy of Management Journal,* 42(5), 488-506.

Bethapudi, A. (2013). The role of ICT in tourism industry. *Journal of Applied Economics and Business,* 1(4), 67-79.

Bilgili, B. & Ünal, S. (2008). Kano model application for classifying the requirements of university students. MIBES Conference, 31-46.

Bitner, M.J. (1990). Evaluating service encounters: the effects of physical surroundings and employee responses. *Journal of Marketing*, 54(2), 69-82.

Blanton, J.E., Watson, H.J. & Moody, J. (1992). Toward a better understanding of information technology organization: a comparative case study. *MIS Quarterly,* 16(4), 531-555.

Boateng, G.O., Neilands, T.B., Frongillo, E.A. Melgar-Quiñonez, H.R. & Young, S.L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Frontiers in Public Health,* 6 (149), 1-18.

Bolton, R.N. & Drew, J.H. (1991). A multistage model of customers' assessments of service quality and value. *Journal of Consumer Research,* 17(4), 375-384.

Borjalilu, M., Zowghi, M. & Jahromi. A.E. (2011). A fuzzy hypothesis test-based model for customer satisfaction measurement. IEEE International Conference on Fuzzy Systems, Taipei, 564-571.

Bower, D.C. & Walker, D.H.T. (2007). Planning knowledge for phased rollout projects. *Project Management Journal,* 38(3), 45-60.

Bragantini, D. & Caccamese, A. (2015). Getting to stakeholders' agreement. Paper presented at PMI® Global Congress 2015—EMEA, London, England.

BRM. (2020). Research approach. Available online: https://research-methodology.net/research-methodology/research-approach/

Brown, L. (2019). 5 phases of project management life cycle you need to know. Available online: https://www.invensislearning.com/blog/5-phases-project-management-lifecycle/

Brown, S., Venkatesh, V., Kuruzovich, J. & Massey, A. (2007). Expectation confirmation: an examination of three competing models. *Organizational Behaviour and Human Decision Processes,*105, 52-66.

Bryde, D.J. (2003). Project management concepts, methods, and application. *International Journal of Operations & Production Management,* 23(7), 775-793.

Bryde, D.J. (2008). Perceptions of the impact of project sponsorship practices on project success. *International Journal of Project Management,* 26, 800-809.

Bryman, A. & Bell, E. (2015). *Business research methods*. Oxford University Press, USA.

Bughio, M., Schuetze, T. & Mahar, W.A. (2020). Comparative analysis of indoor environmental quality of architectural campus buildings' lecture halls and it's perception by building users in Karachi, Pakistan. *Sustainability*, 12, 2995, 1-29.

Burke, R. (2013). *Project management: planning and control techniques* (5th ed.). Hoboken, NJ: John Wiley & Sons.

Burns, R.P. & Burns, R., (2008). *Business research methods and statistics using SPSS*. Sage Publications.

Cardozo, R.N. (1965). An experimental study of customer effort, expectation, and satisfaction. *Journal of Marketing Research,* 12(3), 244-249.

Carlsmith, J.M. & Aronson, E. (1963). Some hedonic consequences of the confirmation and disconfirmation of expectances. *The Journal of Abnormal and Social Psychology,* 66(2), 151-156.

Carmichael, D.G. (2000). *Contracts and international project management*. Rotterdam, Netherlands: CRC Press.

Cattani, G., Ferriani, S., Frederiksen, L. & Florian, T. (2011). *Project-based organizing and strategic management.* Bingley, UK: Emerald Group Publishing Limited.

Cavarec, Y. (2012). Revisiting the definition of project success. Paper presented at PMI® Global Congress 2012, North America, Vancouver, British Columbia, Canada.

CCCR. (2019). The Application of the i3d3 Model for Measuring Project Success. Centre for Comparative Construction Research, Bond University. Available online: https://bond.edu.au/cccr

Chan, A.P.C. & Oppong, G.D. (2017). Managing the expectations of external stakeholders in construction projects. *Engineering, Construction and Architectural Management,* 24(5), 736-756.

Chang, J.C.J. & King, W.R. (2005). Measuring the performance of information systems: a functional scorecard. *Journal of Management Information Systems,* 22(1), 85-115.

Chiu, C.M., Chiu, C.S. & Chang, H.C. (2007). Examining the integrated influence of fairness and quality on learners' satisfaction and web-based learning continuance intention. *Information Systems Journal*, 17(3), 271-287.

Cho, E. & Kim, S. (2015). Cronbach's coefficient alpha: well known but poorly understood. *Organizational Research Methods,* 18(2), 207-230.

Choi, T.Y. & Chu, R. (2001). Determinants of hotel guests' satisfaction and repeat patronage in the Hong Kong hotel industry. *International Journal of Hospitality Management,* 20, 277-297.

Christenson, D. & Walker, D.H.T. (2004). Understanding the role of "vision" in project success. *Project Management Journal,* 35(3), 39-52.

Christenson, D. and Walker, D.H.T. (2008). Using vision as a critical success element in project management. *International Journal of Managing Projects in Business,* 1(4), 611-622.

Churchill Jr. G.A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research,* 16(1), 64-73.

Churchill, Jr. G.A. & Surprenant, C. (1982). An investigation into the determinants of customer satisfaction. *Journal of Marketing Research,* 19(4), 491-504.

Cicmil, S., Williams, T., Thomas, J., Hodgson, D. (2006). Rethinking project management: researching the actuality of projects. *International Journal of Project Management,* 24(8), 675-686.

Cleland, D.I. & Ireland, L.R. (2008). *Project management handbook: applying best practices across global industries*. New York, NY: McGraw-Hill Companies.

Cole, R.A. & Phelps, K. (1979). Use of canonical variate analysis in the differentiation of swede cultivars by gas-liquid chromatography of volatile hydrolysis products. *Journal of Science Food & Agriculture,* 30, 669-676.

Cooke-Davies, T.J. (2002). The real success factors of projects. *International Journal of Project Management,* 20, 185-190.

Cooke-Davies, T.J. (2007). Project success, in Morris, P.W.G. and Pinto, J.K. (eds.), The Wiley guide to project, program & portfolio management. Wiley, Hoboken, NJ, 226-249.

Cooper, R.G. & Edgett, S.J. (2003). Overcoming the crunch in resources for new product development. *Research Technology Management,* 46(3), 48-58.

Costa, C.D. (2020). The 7 factors that influence user experience. Available online: https://uxdesign.cc/the-7-factors-that-influence-user-experience-2805282616f9

Coventry, T. (2015). Requirements management - planning for success: techniques to get it right when planning requirements. Paper presented at PMI® Global Congress 2015-EMEA, London, England.

Creasy, T. & Anantatmula, V.S. (2013). From every direction: how personality traits and dimensions of project managers can conceptually affect project success. *Project Management Journal,* 44(6), 36-51.

Creswell, J. (2003). Research design: qualitative, quantitative, and mixed methods approach (2nd ed.). Thousand Oaks, CA: SAGE Publications.

Creusen, M., Hultink, E.J. & Eling, K. (2013). Choice of consumer research methods in the front end of new product development. *International Journal of Market Research,* 55(1), 80-104.

Cronin Jr. J.J. & Taylor, S.A. (1992). Measuring service quality: a re-examination and extension. *Journal of Marketing,* 56(3), 55-68.

Cronin, J. & Taylor, S. (1994). SERVPERF versus SERVQUAL: reconciling performance based and perceptions minus expectations measurement of service quality. *Journal of Marketing,* 58(1), 125-131.

Cruz-Castillo, J.G., MacKay, B.R., Lawes, G.S. & Woolley, D.J. (1992). Canonical discriminant analysis in kiwifruit rootstock research. *Acta Horticulture,* 313, 143-148.

Dahlander, L. & Gann, D.M. (2010). How open is innovation? *Research Policy,* 39(6), 699-709.

Damoah, I.S. & Akwei, C. (2017). Government project failure in Ghana: a multidimensional approach. *International Journal of Managing Projects in Business,* 10(1), 41-48.

Davis, J., Mengersen, K., Bennett, S. & Mazerolle, L. (2014). Viewing systematic reviews and meta-analysis in social research through different lenses. *SpringerPlus,* 3, 511, 1-9.

Davis, K. (2014). Different stakeholder groups and their perceptions of project success. *International Journal of Project Management,* 32, 189-201.

Davis, K. (2016). A method to measure success dimensions relating to individual stakeholder groups. *International Journal of Project Management,* 34(3), 480-493.

Davis, K. (2017). An empirical investigation into different stakeholder groups perception of project success. *International Journal of Project Management,* 35(4), 604-617.

Davis, K. (2018). Reconciling views of project success: a multiple stakeholder model. *Project Management Journal,* 49(5), 38-47.

Day, R.L. (1977). Extending the concept of consumer satisfaction, in Advances in Consumer Research Volume 04, eds. Perreault, Jr. W.D., Atlanta, GA: Association for Consumer Research, 149-154.

de Gier, H. (2018). The connected value stream model. Available online: https://www.syncforce.com/blog/content-syndication/the-connected-value-stream-model/

de Wit, A. (1988). Measurement of project success. *International Journal of Project Management,* 6(3), 164-170.

Deighton, J. (1984). The interaction of advertising and evidence. *Journal of Consumer Research,* 11(3), 763-770.

Delisle, J. (2019). Uncovering temporal underpinnings of project management standards. *International Journal of Project Management,* 37(8), 968-978.

DeLone, W.H. & McLean, E.R. (2003). Information systems success: a ten-year update. *Journal of Management Information Systems,* 19(4), 9-30.

DeLone, W.H. & McLean, E.R. (1992). Information systems success: the quest for the dependent variable. *Information Systems Research*, 3(1), 60-95.

Demirkesen, S. & Ozorhon, B. (2017). Impact of integration management on construction project management performance. *International Journal of Project Management,* 35, 1639-1654.

Derakhshan, R., Turner, R. & Mancini, M. (2019). Project governance and stakeholders: a literature review. *International Journal of Project Management,* 37, 98-116.

DeVellis, R.F. (2017). *Scale development: theory and applications* (Fourth edition.). SAGE.

Dianna, R.M. (2018). A general critical discourse analysis framework for educational research. *Journal of Advanced Academics,* 29(2), 116-142.

Dimitrios, L. (2009). Analysis of project success criteria and success factors: how to maximize success in your projects using meaningful criteria and factors. Available online: https://iknols.blogspot.com/2011/11/analysis-of-project-success-criteria.html

Dinsmore, P.C. & Davies, T.J.C. (2005). *The right projects done right: from business strategy to successful project implementation*. Hoboken, NJ: John Wiley & Sons.

Dionne, G. (2013). Risk management: history, definition, and critique. *Risk Management and Insurance Review*, *16(2),* 147-166.

Dixon-Woods, M., Bonas, S., Booth, A., Jones, D.R., Miller, T., Sutton, A.J., Shaw, R.L., Smith, J.A. & Young, B. (2006). How can systematic reviews incorporate qualitative research? A critical perspective. *Qualitative Research,* 6, 27-44.

Dixon-Woods, M., Cavers, D., Agarwal, S., Annandale, E., Arthur, A., Harvey, J., Hsu, R., Katbamna, S., Olsen, R., Smith, L., Riley, R. & Sutton, A.J. (2006). Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups. *BMC Medical Research Methodology,* 6(35).

Doll, W.J. & Torkzadeh, G. (1988). The measurement of end-user computing satisfaction. *MIS Quarterly,*12(2), 259-274.

Doloi, H.K. (2011). Understanding stakeholders' perspective of cost estimation in project management. *International Journal of Project Management,* 29(5), 622-636.

Dudovskiy, J. (2018). The ultimate guide to writing a dissertation in business studies: a step-by-step assistance. Available online: https://research-methodology.net/about-us/ebook/

Dvir, D. (2005). Transferring projects to their final users: the effect of planning and preparations for commissioning on project success. *International Journal of Project Management,* 23(4), 257-265.

Ebneyamini, S. & Moghadam, M.R.S. (2018). Toward developing a framework for conducting case study research. *International Journal of Qualitative Methods,* 17, 1-11.

Eduardo Yamasaki Sato, C. & de Freitas Chagas Jr. M. (2014). When do megaprojects start and finish? Redefining project lead time for megaproject success. *International Journal of Managing Projects in Business,* 7(4), 624-637.

Edvardsson, B., Gustafsson, A. (2000). *New service development and innovation in the new economy*. Lund, Studentlitteratur.

Egeland, B. (2011). Primary and secondary project success factors. Available online: http://pmtips.net/primary-secondary-project-success-factors/

Eichhorn, B. & Tukel, O. (2018). Business user impact on information system projects. *International Journal of Managing Projects in Business,* 11(2), 289-316.

Eigbe, A.P., Sauser, B.J. & Felder, W. (2015). Systemic analysis of the critical dimensions of project management that impact test and evaluation program outcomes. *International Journal of Project Management,* 33, 747-759.

Einhorn, F., Marnewick, C. & Meredith, J. (2019). Achieving strategic benefits from business IT projects: the critical importance of using the business case across the entire project lifetime. *International Journal of Project Management,* 37(8), 989-1002.

Ekinci, Y. & Sirakaya, E. (2004). An examination of the antecedents and consequences of customer satisfaction. In *Consumer Psychology of Tourism, Hospitality and Leisure*, Crouch, G.I., Perdue, R.R., Timmermans, H.J.P. & Uysal, M. (eds.). Cabi Publishing, Wallingford, UK, 189-202.

Engel, J.F. & Blackwood. R.D. (1982). *Consumer behaviour*. New York, Dryden Press.

Ershadi, M., Jefferies, M., Davis, P., Mojtahedi, M. (2020). Towards successful establishment of a project portfolio management system: business process management approach. *The Journal of Modern Project Management,* 8(1), 22-41.

Escrig-Tena, A.B. & Bou-Llusar, J.C. (2005). A model for evaluating organizational competencies: an application in the context of a quality management initiative. *Decision Sciences*, 36(2)*,* 221-257.

Eskerod, P., Huemann, M. & Savage, G. (2015). Project stakeholder management: past and present. *Project Management Journal*, 46(6), 6-14.

Esposito, E. (2015). Demystifying the 5 phases of project management. Available online: https://www.smartsheet.com/blog/demystifying-5-phases-project-management

Everitt, B. (1978). *Graphical techniques for multivariate data*. Heinemann, London.

Fang, J., Zhao, Z., Wen, C., Wang, R. (2017). Design and performance attributes driving mobile travel application engagement. *International Journal of Information Management,* 37, 269-283.

Festinger, L. (1957). *A Theory of Cognitive Dissonance.* Evanston, IL Row and Peterson.

Fisher, R.A. (1936). The use of multiple measurements in taxonomic problems. *Annual Eugenics,* 7, 179-188.

Fisk, R.P. & Young, C.E. (1985). Disconfirmation of equity expectations: effects on consumer satisfaction with services. *Advances in Consumer Research,* 12(1), 340-345.

Florén, H., Frishammar, J., Parida, V. & Wincent, J. (2018). Critical success factors in early new product development: a review and a conceptual model. *International Entrepreneurship and Management Journal,* 14, 411–427.

Fornell, C. (1992). A national satisfaction barometer: the Swedish experience. *Journal of Marketing,* 56(1), 6-21.

Fornell, C., Johnson, M.D., Anderson, E.W., Cha, J. & Bryant, B.F. (1996). The American Customer Satisfaction Index: nature, purpose and findings. *Journal of Marketing,* 60(4), 7-18.

Fortune, J. & White, D. (2006). Framing of project critical success factors by a systems model. *International Journal of Project Management,* 24(1), 53-65.

Fowler, A. & Walsh, M. (1999). Conflicting perceptions of success in an information systems project. *International Journal of Project Management,* 17(1), 1-10.

Frank, M., Sadeh, A. & Ashkenasi, S. (2011). The Relationship among systems engineers' capacity for engineering systems thinking, project types, and project success. *Project Management Journal,* 42(5), 31-41.

Freeman, M. & Beale, P. (1992). Measuring project success. *Project Management Journal,* 23(1), 8-17.

Freeman, R.E. (1984). *Strategic management: a stakeholder approach*. Boston: Pitman.

Frese, R. & Sauter, V. (2003). Project success and failure: what is a success, what is a failure, and how can you improve your odds for success? Available online: http://www.umsl.edu/~sauterv/analysis/6840_f03_papers/frese/

Fuentes, M., Smyth, H. & Davies, A. (2019). Co-creation of value outcomes: a client perspective on service provision in projects. *International Journal of Project Management,* 37(5), 696-715.

Galbus, A.C. (2016). Program management initiation: what to focus on in the first 90 days. Paper presented at PMI® Global Congress 2016—EMEA, Barcelona, Spain.

Gallagher M.W. & Brown T.A. (2013). Introduction to confirmatory factor analysis and structural equation modeling. In: Teo T. (eds), *Handbook of Quantitative Methods for Educational Research*. SensePublishers, Rotterdam.

Gao, F.L., Puryasana, I. & Matsuo, T. (2020). Evaluating ERP system merging success in chemical companies: system quality, information quality, and service quality. *Open Engineering,* 10(1), 282-293.

Garcia, R. & Adelakun, O.A. (2019). Conceptual framework and pilot study for examining telemedicine satisfaction research. *Journal of Medical Systems,* 43(51), online.

Gardial, S.F., Clemons, D.S., Woodruff, R.B., Schumann, D.W. & Burns, M.J. (1994). Comparing consumers' recall of prepurchase and post purchase product evaluation experiences. *Journal of Consumer Research,* 20(4), 548-560.

Garrety, K., Robertson, P.L. & Badham, R. (2004). Integrating communities of practice in technology development projects. *International Journal of Project Management,* 22(5), 351-358.

Garvin, D.A. (1983). Quality on the line. *Harvard Business Review,* 61, 65-73.

Gaus, N. (2017). Selecting research approaches and research designs: a reflective essay. *Qualitative Research Journal,* 17(2), 99-112.

Gefen, D. & Keil, M. (1998). The impact of developer responsiveness on perceptions of usefulness and ease of use: an extension of the technology acceptance model. *SIGMIS Database*, 29(2), 35-49.

Giese, J.L. & Cote, J.A. (2000). Defining consumer satisfaction. *Academy of Marketing Science Review,* 1, 1-24.

Gilbert, D. & Horsnell, S. (1998). Customer satisfaction measurement practice in United Kingdom hotels. *Journal of Hospitality & Tourism Research,* 22(4), 450-464.

Gordon, R.L. & Curlee, W. (2011). *The virtual project management office: best practices, proven methods.* Vienna, VA: Management Concepts Incorporated.

Greer, M. (1999). *Handbook of human performance technology*. San Francisco: Jossey-Bass.

Gutman, J. (1982). A means-end chain model based on consumer categorization processes. *Journal of Marketing,* 46(2), 60-72.

Haass, O. & Guzman, G. (2019). Understanding project evaluation: a review and reconceptualization. *International Journal of Managing Projects in Business,* 13(3), 573-599.

Hague, N. & Hague, P. (2021). Customer satisfaction surveys and research: how to measure customer satisfaction. Available online: https://www.b2binternational.com/publications/customer-satisfaction-survey/

Hair, J.F., Black, W.C., Babin, B.J. & Anderson, R.E. (2019a). *Multivariate data analysis* (8th ed.), London, United Kingdom: Cengage Learning.

Hair, J.F., Page, M. & Brunsveld, N. (2019b). *Essentials of business research methods* (4th ed.). New York, NY: Routledge.

Halawi, L.A., McCarthy, R.V. & Aronson, J.E. (2007). An empirical investigation of knowledge management systems' success. *Journal of Computer Information Systems,* 48(2), 121-135.

Hambleton, R.K. & Swaminathan, H. (1985). *Item response theory: principles and applications.* Boston: Kluwer-Nijhoff.

Hanawalt, E.S. & Rouse, W.B. (2010). Car wars: factors underlying the success or failure of new car programs. *System Engineering,* 13, 389-404.

Hanaysha, J., Abdullah, H.H. & Abdghani, N.H. (2016). Importance of product quality and service quality in developing brand equity. *Global Business Advancement,* 9(4), 390.

Hardy-Vallee, B. (2012). The cost of bad project management. *Business Journal.* Available online: https://news.gallup.com/businessjournal/152429/cost-bad-project-management.aspx

Harvard Business Review Staff. (2016). The four phases of project management. *Harvard Business Review.* Available online: https://hbr.org/2016/11/the-four-phases-of-project-management

Hassanain, M.A., Iftikhar, A., Al-Hammad, A.M., Alshibani, A., Ibrahim, A.M. & Abdallah, A. (2020). POE of public higher education facilities in Saudi Arabia: lessons learned from three case studies. *Property Management,* 39(2), 250-276.

Hassen, S.M., Al-Tmeemy, M., Abdul-Rahman, H. & Harun, Z. (2011). Future criteria for success of building projects in Malaysia. *International Journal of Project Management,* 29(3), 337-348.

Haverila, M.J. & Fehr, K. (2016). The impact of product superiority on customer satisfaction in project management. *International Journal of Project Management,* 34(4), 570-583.

Havila, V., Medlin, C.J. & Salmi, A. (2013). Project-ending competence in premature project closures. *International Journal of Project Management,* 31(1), 90-99.

He, Q., Wang, T., Chan, A.P.C., Li, H. & Chen, Y. (2019). Identifying the gaps in project success research: a mixed bibliographic and bibliometric analysis. *Engineering, Construction and Architectural Management,* 26(8), 1553-1573.

Heising, W. (2012). The integration of ideation and project portfolio management: a key factor for sustainable success. *International Journal of Project Management,* 30(5), 582-595.

Helson, H. (1964). *Adaptation-level theory*. New York: Harper & Row.

Henoekl, C. (2015) Influence of usability and user experience on user performance. University of Nebraska at Omaha, Ann Arbor.

Hess, T.J. & Hightower, R. (2002). Using equity theory to understand user satisfaction with ERP systems: extending and advancing the equity-implementation model. International Conference on Information Systems.

Heyvaert, M., Hannes, K. & Onghena, P. (2017). Data synthesis for integrated MMRS literature reviews. In *Using mixed methods research synthesis for literature reviews*. SAGE Publications, Inc.

Hinkin, T.R., Tracey, J.B. & Enz, C.A. (1997). Scale construction: developing reliable and valid measurement instruments. *Journal of Hospitality & Tourism Research,* 21(1), 100-120.

HMC Architects. (2020). The role of the post occupancy evaluation in architecture. Available online: https://hmcarchitects.com/news/the-role-of-the-post-occupancy-evaluation-in-architecture-2020-01-22/

Högström, C., Davoudi, S., Löfgren, M. & Johnson, M. (2016). Relevant and preferred public service: a study of user experiences and value creation in public transit. *Public Management Review,* 18(1), 65-90.

Hom, P.W., Griffeth, R.W., Palich, L.E. & Bracker, J.S. (1999). Revisiting met expectations as a reason why realistic job previews work. *Personnel Psychology,* 52(1), 97-112.

Hoonakker, P.L.T., Carayon, P. & Walker, J.M. (2010). Measurement of CPOE end-user satisfaction among ICU physicians and nurses. *Applied Clinical Informatics,* 1, 268-285.

Hough, G.H. & Morris, P.W.G. (1987). *The anatomy of major projects: a study of the reality of project management,* Wiley, Chichester and New York, NY.

Houston S.M. & Bove L.A. (2007). Execution phase. In: *Project Management for Healthcare Informatics. Health Informatics*. Springer, New York, NY.

Howard, J.D. & Sheth, J.N. (1969). *The theory of buyer behaviour,* New York, John Wiley & Sons.

Hsu, J.S., Liang, T.P., Shelly P.J., Klein, W.G. & Jiang, J.J. (2011). Promoting the integration of users and developers to achieve a collective mind through the screening of information system projects. *International Journal of Project Management,* 29(5), 514-524.

Huang, S.C.T. & Tsai, K.H. (2013). Exploring the drivers of new product success for businesses in Asia: a meta-analysis. *Asia Pacific Business Review,* 19(3), 303-319.

Huang, X., Soutar, G.N. & Brown, A. (2004). Measuring new product success: an empirical investigation of Australian SMEs. *Industrial Marketing Management,* 33, 117-123.

Huang, Y.M., Pu, Y.H., Chen, T.S. & Chiu, P.S. (2015). Development and evaluation of the mobile library service system success model: a case study of Taiwan. *The Electronic Library,* 33(6), 1174-1192.

Hyett, N., Kenny, A. & Dickson-Swift, V. (2014). Methodology or method? A critical review of qualitative case study reports. *International Journal of Qualitative Studies on Health and Well-being*, 9(1), online.

Hyvari, I. (2006). The success of projects in different organizational conditions. *Project Management Journal,* 37(4), 31-41.

Iacobucci, D., Ostrom, A. & Grayson, K. (1995). Distinguishing service quality and customer satisfaction: the voice of the consumer. *Journal of Consumer Psychology*, 4(3), 277.

Ifinedo, P. (2011). Examining the influences of external expertise and in-house computer/IT knowledge on ERP system success. *The Journal of Systems and Software,* 84, 2065-2078.

Igbaria, M. & Nachman, S.A. (1990). Correlates of user satisfaction with end-user computing: an exploratory study. *Information & Management*, 19(2), 73-82.

Ika, L.A. & Donnelly, J. (2017). Success conditions for international development capacity building projects. *International Journal of Project Management,* 35(1), 44-63.

Ika, L.A. (2009). Project success as a topic in project management journals. *Project Management Journal,* 40(4), 6-19.

Ingle, P.V. & Mahesh, G. (2020). Construction project performance areas for Indian construction projects. *International Journal of Construction Management,* online.

Invensis Inc. (2020). What is project life cycle and its main characteristics? Available online: https://www.invensislearning.com/articles/pmp/what-is-project-life-cycle-and-its-main-characteristics

Iriarte, C. & Bayona, S. (2020). IT projects success factors: a literature review. *International Journal of Information Systems and Project Management,* 8(2), 49-78.

Irving, P.G. & Meyer, J.P. (1994). Reexamination of the met-expectations hypothesis: a longitudinal analysis. *Journal of Applied Psychology,* 79(6), 937-949.

Isac, F.L. & Rusu, S. (2014). Theories of consumer's satisfaction and the operationalization of the expectation disconfirmation paradigm. *Annals - Economy Series,* 2, 82-88.

Ivanka, A.H., Suzana, M., Sanja R. (2009). Consumer satisfaction measurement in hotel industry: content analysis study. Available online: https://bib.irb.hr/datoteka/397335.PAP039.pdf

Ives, B., Olson, M.H. & Baroudi, J J. (1983). The measurement of user information satisfaction. *Communication of the ACM*, 26(10), 785-793.

Johnson, M.O., Neilands, T.B., Dilworth, S.E., Morin, S.F., Remien, R.H. & Chesney, M.A. (2007). The role of self-efficacy in HIV treatment adherence: validation of the HIV treatment adherence self-efficacy scale (HIV-ASES). *Journal of Behaviour Medicine,* 30, 359-70.

Johnson, R.B. & Onwuegbuzie, A.J. (2004). Mixed methods research: a research paradigm whose time has come. *Educational Researcher,* 33(7), 14-26.

Joshi, K. (1990). An investigation of equity as a determinant of user information satisfaction. *Decision Sciences,* 21(4), 786-807.

Joslin, R. & Müller, R. (2015). Relationships between a project management methodology and project success in different project governance contexts. *International Journal of Project Management,* 33(6), 1377-1392.

Jugdev, K., Müller, R. (2005). A retrospective look at our evolving understanding of project success. *Project Management Journal,* 36(4), 19-31.

Kano, N., Seraku, N., Takahashi, F. & Tsuji, S. (1984). Attractive quality and must-be quality. *Journal of the Japanese Society for Quality Control,* 14(2), 147-156.

Kano, N., Seraku, N., Takahashi, F. & Tsuji, S. (1996). Attractive quality and must-be quality. In *The Best on Quality*, Hromi, J.D. Ed., ASQ Quality Press: Milwaukee, WI, 165-186.

Karlson, K. (2015). *16 essential KPIs not to be ignored*. Available online: https://www.scoro.com/blog/16-essential-project-kpis/

Kendrick, T. (2015). *Identifying and managing project risk: essential tools for failure-proofing your project*. New York, NY: AMACOM.

Kerzner, H. (2011). *Project management metrics, KPIs, and dashboards*. Hoboken, NJ: John Wiley & Sons.

Kettinger, W.J. & Lee, C.C. (1994). Perceived service quality and user satisfaction with the information services function. *Decision Sciences,* 25(5/6), 737-766.

Khalifa, M. & Liu, V. (2003). Determinants of satisfaction at different adoption stages of internet-based services. *Journal of the Association for Information Systems*, 4(5), 206-232.

Khang, D.B. & Moe, T.L. (2008). Success criteria and factors for international development projects: a life-cycle-based framework. *Project Management Journal,* 39(1), 72-84.

Kline, R.B. (2010). *Principles and practice of structural equation modelling* (3rd ed.). New York, New York: Guilford Press.

Knutson, B. (1988). Frequent travellers: making them happy and bringing them back. *The Cornell Hotel and Restaurant Administration Quarterly,* 29(1), 83-87.

Kocherla, S. (2012). Evaluating managerial styles for system development life cycle stages to ensure software project success. PhD Dissertation, Walden University, College of Management and Technology, ProQuest Dissertations Publishing.

Koops, L., Bosch-Rekveldt, M., Coman, L., Hertogh, M. & Bakker, H. (2016). Identifying perspectives of public project managers on project success: comparing viewpoints of managers from five countries in North-West Europe. *International Journal of Project Management,* 34(5), 874-889.

Kositanurit, B., Ngwenyama, O. & Osei-Bryson, K. (2006) An exploration of factors that impact individual performance in an ERP environment: an analysis using multiple analytical techniques. *European Journal of Information Systems,* 15(6), 556-568.

Kotler, P. (1997). *Marketing management: analysis, planning, implementation, and control*, (9th ed.) Upper Saddle River, NJ: Prentice Hall.

Krikor, O. (2011). Steps to new product success. Available online: https://krikor.info/?p=6673

Kurt, Ö.E. (2019). Examining an e-learning system through the lens of the information systems success model: empirical evidence from Italy. *Education and Information Technologies,* 24,1173-1184.

Kwak, Y.H. (2005). A brief history of project management. In Carayannis, E.G., Kwak, Y.H. & Anbari, F.T. (Eds.), *The story of managing projects*, 1-10. Westport, CT: Greenwood Publishing Group.

Lam, P.T.I., Wong, F.W.H. & Tse, K.T.C. (2010). Effectiveness of ICT for construction information exchange among multidisciplinary project teams. *Journal of Computing in Civil Engineering*, 24(4), 365-376.

Lang, R.D. (2007). Project leadership: key elements and critical success factors for IT project managers. *Journal of Healthcare Information Management,* 21(1), 2-4.

Langston, C. & Al-khawaja, A. (2018). Workplace ecology. In *Routledge handbook of sustainable real estate*, Wilkinson, S., Dixon, T., Miller, N. and Sayce, S. (eds.), Routledge Handbooks.

Langston, C., Ghanbaripour, A.N. and Abu Arqoub, M. (2018). Measuring project success: conceptualizing a new approach applicable to all project types. The 42nd Australasian Universities Building Education Association (AUBEA) 2018 Conference: Educating Building Professional for the Future: Innovation, Technology and Sustainability, Singapore, 107-120.

Lankton, N.K. & McKnight, H.D. (2012). Examining two expectation disconfirmation theory models: assimilation and asymmetry effects. *Journal of the Association for Information Systems,* 13(2), 88-115.

LaTour, S.A. & Peat, N.C. (1980). The role of situationally produced expectations, others' experiences, and prior experience in determining customer satisfaction. *Advances in Consumer Research,* 7(1), 588-592.

Laumer, S., Maier, C. & Weitzel, T. (2017). Information quality, user satisfaction, and the manifestation of workarounds: a qualitative and quantitative study of enterprise content management system users. *European Journal of Information Systems,* 26(4), 333-360.

Leclercq, A. (2007). The perceptual evaluation of information systems using the construct of user satisfaction: case study of a large French group. *SIGMIS Database* 38(2), 27-60.

Lee, A.M. (2007). Developing effective supervisors: concepts of research supervision. *South African Journal of Higher Education,* 21(4), 680-693.

Lee, H., Lee, Y. & Yoo, D. (2000). The determinants of perceived service quality and its relationship with satisfaction. *Journal of Services Marketing,* 14(2/3), 217-231.

Lehtinen, J. & Aaltonen, K. (2020). Organizing external stakeholder engagement in inter-organizational projects: opening the black box. *International Journal of Project Management,* 38(2), 85-98.

Levy, J. (2014). *Case studies: types, designs, and logics of inference.* SAGE Publications Ltd.

Lexutt, E. (2020). Different roads to service success: a configurational analysis of financial and non-financial service performance. *Industrial Marketing Management*, 84 (2020), 105-125.

Li, P., Froese, T.M. & Brager, G. (2018). Post-occupancy evaluation: state-of-the- art analysis and state-of-the-practice review. *Building and Environment,*133, 187-202.

Liang, X., Yu, T. & Guo, L. (2017). Understanding stakeholders' influence on project success with a new SNA method: a case study of the Green Retrofit in China. *Sustainability,* 9, 1927, 1-19.

Lim, C. & Mohamed, M.Z. (1999). Criteria of project success: an exploratory re-examination. *International Journal of Project Management,* 17(4), 243-248.

Lin, W.S. & Wang, C.H. (2012). Antecedents to continued intentions of adopting e-learning system in blended learning instruction: a contingency framework based on models of information system success and task-technology fit. *Computers & Education,* 58, 88-99.

Liu, A.M.M. & Walker, A. (1998). Evaluation of project outcomes. *Construction Management & Economics,* 16(2), 209-219.

Livingston, S.A. (2018). *Test reliability: basic concepts* (Research Memorandum No. RM-18-01). Princeton, NJ: Educational Testing Service.

Lloyd-Walker, B. & Walker, D. (2011). Authentic leadership for 21st century project delivery. *International Journal of Project Management,* 29(4), 383-395.

Locatelli, G., Mikic, M., Kovacevic, M., Brookes, N. & Ivanisevic, N. (2017). The successful delivery of megaprojects: a novel research method. *Project Management Journal,* 48(5), 78-94.

Lock, D. (2007). *Project management* (9th Ed.). Burlington, VT: Gower Publishing, Ltd.

Lord, F.M., (1980). *Applications of item response theory to practical testing problems.* Hillsdale, NJ: Earlbaum.

Machado, M., Ribeiro, A. & Basto, M. (2014). An empirical assessment of customer satisfaction and quality of service: comparing SERVQUAL and SERVPERF. *Revista Gestão Industrial,* 10(2), 264-283.

Maddaloni, F.D. & Davis, K. (2018). Project manager's perception of the local communities' stakeholder in megaprojects. an empirical investigation in the UK. *International Journal of Project Management,* 36(3), 542-565.

Mahdavi, D.B. (2013). The non-misleading value of inferred correlation: an introduction to the cointelation model. *Wilmott Magazine,* 67, 50-61.

Majer, J.D., Recher, H.F. & Ganeshanandam, S. (1992). Variation in foliar nutrients in Eucalyptus trees in Eastern and western Australia. *Australian Journal of Ecology,* 17, 383-393.

Mano, H. & Oliver, R.L. (1993). Assessing the dimensionality and structure of the consumption experience: evaluation, feeling, and satisfaction. *Journal of Consumer Research,* 20(3), 451-466.

Mardia, K.V., Kent, J.T. & Bibby, J.M. (1979). *Multivariate analysis*. Academic, London.

Marr, B. (2013*). The 4 KPIs every manager must use*. Available online: https://www.linkedin.com/pulse/20130925053608-64875646-the-4-kpis-every-manager-has-to-use

Martens, M.L. & Carvalho, M.M. (2017). Key factors of sustainability in project management context: a survey exploring the project managers' perspective. *International Journal of Project Management,* 35(6), 1084-1102.

McCollough, M.A. (2000). The effect of perceived justice and attributions regarding service failure and recovery on post-recovery customer satisfaction and service quality attributes. *Journal of Hospitality & Tourism Research,* 24(4), 423-447.

McKinney, V., Kanghyun, Y. & Zahedi, F. M. (2002). The measurement of web-customer satisfaction: an expectation and disconfirmation approach. *Information Systems Research*, 13(3), 296-315.

McLeod, L., Doolin, B. & MacDonell, S.G. (2012). A perspective-based understanding of project success. *Project Management Journal,* 43(5), 68-86.

Merriam, S.B. & Tisdell, E.J. (2016). *Qualitative research: a guide to design and implementation* (4th ed.). San Francisco, CA: Jossey Bass.

Miceli, G., Ricotta, F. & Costabile, M. (2007). Customizing customization: a conceptual framework for interactive personalization. *Journal of Interactive Marketing,* 21(2), 6-25.

Millhollan, C. & Kaarst-Brown, M. (2016). Lessons for IT project manager efficacy: a review of the literature associated with project success. *Project Management Journal,* 47(5), 89-106.

Mir, F.A. & Pinnington, A.H. (2014). Exploring the value of project management: linking project management performance and project success. *International Journal of Project Management,* 32(2), 202-217.

Missonier, S. & Loufrani-Fedida, S. (2014). Stakeholder analysis and engagement in projects: from stakeholder relational perspective to stakeholder relational ontology. *International Journal of Project Management,* 32(7), 1108-1122.

Mittal, V., Ross Jr. W.T. & Baldasare, P.M. (1998). The asymmetric impact of negative and positive attribute-level performance on overall satisfaction and repurchase intentions. *Journal of Marketing,* 62(1), 33-47.

Mlecnik, E., Schütze, T., Jansen, S.J.T., de Vries, G., Visscher, H.J. & van Hal, A. (2012). End-user experiences in nearly zero-energy houses. *Energy and Buildings,* 49, 471-478.

Moher, D., Liberati, A., Tetzlaff, J. & Altman, D.G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of Internal Medicine,* 151, 264-269.

Mohsin, A. & Ryan, C. (2005). Service quality assessment of 4-staf hotels in Darwin, Northern Territory, Australia. (Buyer's Guide). *Journal of Hospitality and Tourism Management,* 12(1), 25.

Momeni, K. & Martinsuo, M. (2019). Going downstream in a project-based firm: integration of distributors in the delivery of complex systems. *International Journal of Project Management,* 37(1), 27-42.

Mukerjee, H.S. & Devi, P.U. (2017). Definitions of project success in implementation of customer relationship management (CRM) information technology (IT) solutions: perspectives of consultants from India. *South Asian Journal of Management,* 24(4), 142-157.

Müller, R. & Jugdev, K. (2012). Critical success factors in projects. *International Journal of Managing Projects Business,* 5, 757-775.

Müller, R. & Turner, R. (2007). The influence of project managers on project success criteria. *European Management Journal,* 25(4), 298-309.

Musawir, A.U., Serra, C.E.M., Zwikael, O. & Ali, I. (2017). Project governance, benefit management, and project success: towards a framework for supporting organizational strategy implementation. *International Journal of Project Management,* 35(8), 1658-1672.

Mustafa, F.A. (2017). Performance assessment of buildings via post-occupancy evaluation: a case study of the building of the architecture and software engineering departments in Salahaddin University-Erbil, Iraq. *Frontiers of Architectural Research,* 6(3), 412-429.

Myers, B.L., Kappelman, L.A. & Prybutok, V.R. (1997). A comprehensive model for assessing the quality and productivity of the information systems function: toward a theory for information systems assessment. *Information Resources Management Journal,* 10(1), 6-25.

Nadiri, H. & Hussain, K. (2005). Diagnosing the zone of tolerance for hotel services. *Managing Service Quality,* 15(3), 259-277.

Neely, A. (2005). The evolution of performance measurement research: developments in the last decade and a research agenda for the next. *International Journal of Operations & Production Management,* 25(12), 1264-1277.

Nepomuceno F., Suslick, S.B. & Walls, M. (1999). Managing technological and financial uncertainty: a decision science approach for strategic drilling decisions. *Natural Resources Research,* 8(3), 193-203.

Neuman, W.L. (2014). *Social research methods: qualitative and quantitative research approaches* (Seventh Edition). Pearson Education Limited, Harlow, Essex, UK.

Nevo, D., and Chan, Y.E. (2007). A temporal approach to expectations and desires from knowledge management systems. *Decision Support Systems*, 44(1), 298-312.

Newton, P. (2015). Project management processes: project skills. Available online: www.free-management-ebooks.com/dldebk-pdf/fme-project-processes.pdf

Nguyen, H.T. & Chaudhuri, M. (2019). Making new products go viral and succeed. *International Journal of Research in Marketing,* 36, 39-62.

Nguyen, T.P. (2014). Measuring customer satisfaction on perceived service quality-case: mobile telecommunications service of Bouygues Telecom, France. Bachelor's Thesis Degree Program in International Business, BBA, Turku University of Applied Sciences.

Nicholas, J.M. (1989). Successful project management: a force-field analysis. *Journal of Systems Management,* 40(1), 24-30.

Nikolić, D., Muresan, R.C., Feng, W. & Singer, W. (2012). Scaled correlation analysis: a better way to compute a cross-correlogram. *European Journal of Neuroscience,* 35(5), 1-21.

O'Cass, A. & Sok, P. (2014). The role of intellectual resources, product innovation capability, reputational resources, and marketing capability combinations in firm growth. *International Small Business Journal: Researching Entrepreneurship*, 32(8), 996-1018.

Ofori, D.F. (2013). Project management practices and critical success factors: a developing country perspective. *International Journal of Business and Management*, 8 (21), 14-31.

Oh, H. & Parks, S.C. (1997). Customer satisfaction and service quality: a critical review of the literature and research implications for the hospitality industry. *Hospitality Research Journal,* 20(3), 35-64.

Oliver, R.L. (1976). Hedonic reactions to the disconfirmation of product performance expectations: some moderating conditions. *Journal of Applied Psychology*, 61(2), 246-250.

Oliver, R.L. (1977). A theoretical reinterpretation of expectation and disconfirmation effects on post purchase product evaluations: experience in the field. In: *Consumer satisfaction, dissatisfaction, and complaining behaviour*, Day, R.L (ed.). Indiana University Press, 2-9.

Oliver, R.L. (1979). Product satisfaction as a function of prior expectation and subsequent disconfirmation: new evidence. In: *New dimensions of consumer satisfaction and complaining behaviour*, Day, R.L. & Hunt, H.K. (eds.). Indiana University Press, 66-71.

Oliver, R.L. (1980a). A cognitive model of the antecedents and consequences of satisfaction decisions, *Journal of Marketing Research,* XVII, 460-469.

Oliver, R.L. (1980b). Theoretical bases of consumer satisfaction research: review, critique, and future direction. In: Lamb, C. & Dunne, P. (Eds), *Theoretical developments in marketing*. Chicago: American Marketing Association, 206-210.

Oliver, R.L. (1981). Measurement and evaluation of satisfaction processes in retail settings. *Journal of Retailing*, 57(3), 25-48.

Oliver, R.L. (1993). Cognitive, affective, and attribute bases of the satisfaction response. *Journal of Consumer Research,* 20(3), 418-430.

Oliver, R.L. (1997). *Satisfaction: A behavioural perspective on the consumer*. New York: The McGraw-Hill Companies, Inc.

Oliver, R.L. (1999). Whence consumer loyalty? *The Journal of Marketing,* 63(4), 33-44.

Oliver, R.L. & Bearden, W.O. (1983). The role of involvement in satisfaction processes. *Advances in Consumer Research,* 10(1), 250-255.

Oliver, R.L. & DeSarbo, W.S. (1988). Response determinants in satisfaction judgments. *Journal of Consumer Research,*14(4), 495-507.

Oliver, R.L. & Linda, G. (1981). Effect of satisfaction and its antecedents on consumer preference and intention. In: *Advances in Consumer Research*, Monroe, K.B. (ed.). Ann Arbor, MI: Association for Consumer Research, 88-93.

Oliver, R.L. & Rust, R.T. (1997). Customer delight: foundations, findings, and managerial insight. *Journal of Retailing,* 73(3), 311-336.

Oliver, R.L. & Swan, J.E. (1989). Consumer perceptions of interpersonal equity and satisfaction in transactions: a field survey approach. *Journal of Marketing,* 53(2), 21-35.

Olshavsky, R.W. & Miller, J.A. (1972). Consumer expectations, product performance, and perceived product quality. *Journal of Marketing Research,* 9(1), 19-21.

Olson, J.C. & Dover, P.A. (1979). Disconfirmation of consumer expectations through product trial. *Journal of Applied Psychology,* 64(2), 179-189.

Oppong, G.D., Chan, A.P.C. & Dansoh, A. (2017). A review of stakeholder management performance attributes in construction projects. *International Journal of Project Management,* 35, 1037-1051.

Osborn, A. (1957). *Applied imagination: principles and procedures of creative problem-solving* (3rd Edition revised), New York, Scribner.

Oseland, N.A. (2007). British Council for Offices guide to post-occupancy evaluation. London: BCO.

Osorio, P.C.F., Quelhas, O.L.G., Zotes, L.P., Shimoda, E. & França, S. (2014). Critical success factors in project management: an exploratory study of an energy company in Brazil. *Global Journal of Management and Business Research*: *Administration and Management,* 14(10), 39-50.

Padalkar, M. & Gopinath, S. (2016). Are complexity and uncertainty distinct concepts in project management? A taxonomical examination from literature. *International Journal of Project Management,* 34(4), 688-700.

Paek, I. & Cole, K. (2020). *Using R for item response theory model applications*. First Edition. Routledge, Taylor, and Francis, London.

Palmer, J.M. & Mukherjee, T. (2006). Keynote: megaproject execution. In: proceedings of SPE Annual Technical Conference and Exhibition, September 24-27, San Antonio, Texas.

Parasuraman, A., Berry, L. & Zeitbaml, A.V.A. (1985). Conceptual model for quality service and its implications for future research. *Journal of Interactive Marketing,* 49(4), 41-50.

Parasuraman, A., Valarie, A.Z, & Leonard L.B. (1988). SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing,* 64(1), 12-40.

Parasuraman, A., Zeithamal, V.A. & Berry, L.L. (1994). Reassessment of expectations as a comparison standard in measuring service quality: implications for future research. *Journal of Marketing,* 58, 111-124.

Parasuraman, A., Zeithaml, V.A. & Malhotra, A. (2005). E-S-QUAL: A multiple item scale for assessing electronic service quality. *Journal of Service Research,* 7(3), 213-233.

Park, J.H., Kim, Y.B. & Kim, M.K. (2017). Investigating factors influencing the market success or failure of IT services in Korea. *International Journal of Information Management,* 37, 1418-1427.

Parker, C. & Mathews, B.P. (2001). Customer satisfaction: contrasting academic and consumers' interpretations. *Marketing Intelligence & Planning,* 19(1), 38-44.

Pasian, B. (2015). Extending the concept and modularization of project management maturity with adaptable, human and customer factors. *International Journal of Managing Projects in Business,* 7(2), 285-302.

Pathak, R. (2020). 5 phases of project management (PMP). Available online: https://project-management.com/project-management-phases/

Patterson, P.G., Johnson, L.W. & Spreng, R.A. (1997). Modelling the determinants of customer satisfaction for business-to-business professional services. *Journal of the Academy of Marketing Science,* 25(1), 4-17.

Pelzer, P. (2017). Usefulness of planning support systems: a conceptual framework and an empirical illustration. *Transportation Research Part A, Policy and Practice,* 104, 84-95.

Peterson, R.A. & Wilson, R.W. (1992). Measuring customer satisfaction: fact and artifact. *Journal of the Academy of Marketing Science,* 20(1), 61-71.

Petter, S. (2008). Managing user expectations on software projects: lessons from the trenches. *International Journal of Project Management,* 26(7), 700-712.

Petter, S., DeLone, W. & McLean, E. (2008). Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems,* 17, 236-263.

Phillips, J. (2003). *PMP project management professional study guide.* New York, NY: McGraw-Hill Professional.

Pinto, J.K. & Prescott, J.E. (1988). Variation in critical success factors over the stages in the project life cycle. *Journal of Management,* 14(1), 5-18.

Pinto, J.K. & Prescott, J.E. (1990). Planning and tactical factors in the project implementation process. *Journal of Management Studies,* 27(3), 305-327.

Pinto, J.K. & Slevin, D.P. (1988). Project success: definitions and measurement techniques. *Project Management Journal,* 19(1), 67-73.

Pitt, L.F., Watson, R.T. & Kavan, C.B. (1995). Service quality: a measure of information systems effectiveness. *MIS Quarterly,*19(2), 173-187.

PMI (2017a) *A guide to the project management body of knowledge: PMBOK® Guide* (Sixth Edition), Project Management Institute, Pennsylvania.

PMI (2017b). Pulse of the Profession 2017. Available online: https://www.pmi.org/learning/thought-leadership/pulse/pulse-of-the-profession-2017

PMO. (2020). *Project Initiation Phase*. Information Technology Services, University of Massachusetts, Boston.

Pollack, J., Helm, J. & Adler, D. (2018). What is the iron triangle, and how has it changed? *International Journal of Managing Projects in Business,* 11(2), 527-547.

Preedy, V.R. & Watson, R.R. (2009). *Handbook of disease burdens and quality of life measures*. New York: Springer.

Price, J.L. Mueller, C.W. (1986). *Handbook of organizational measurement*. Marshfield, MA: Pitman Publishing.

Prins, M.C., Jacobs, G. & Theron. K.I. (1990). Evaluation of carbohydrate status of apple nursery trees as a prediction of the subsequent growth in the orchard. In: XXIII International Horticulture Congress, Florence, Italy.

Purvis, R.L., Zagenczyk, T.J. & McCray, G.E. (2015). What's in it for me? Using expectancy theory and climate to explain stakeholder participation, its direction and intensity. *International Journal of Project Management,* 33(1), 3-14.

Rad, P.F. & Anantatmula, V.S. (2005). *Project planning techniques.* Vienna, VA: Management Concepts, Inc.

Radujković, M., Vukomanović, M. & Dunović, I.B. (2010). Application of key performance indicators in south-eastern European construction. *Journal of Civil Engineering and Management,* 16(4), 521-530.

Rashvand, P. & Abd Majid, M.Z. (2014). Critical criteria on client and customer satisfaction for the issue of performance measurement. *Journal of Management in Engineering,* 30(1), 1-16.

Raymond, L. & Bergeron, F. (2008). Project management information systems: an empirical study of their impact on project managers and project success. *International Journal of Project Management,* 26(2), 213-220.

Rawlinson, J.G. (1981). *Creative thinking and brainstorming*, Farnborough: Gower.

Reeve, B.B., Hays, R.D., Bjorner, J.B., Cook, K.F., Crane, P.K., Teresi, J.A., Thissen, D., Revicki, D.A., Weiss, D.J., Hambleton, R.K., Liu, H., Gershon, R., Reise, S.P., Lai, J.S. & Cella, D. (2007). *Psychometric evaluation and calibration of health-related quality of life item banks: plans for the patient-reported outcomes measurement information system (PROMIS)*. Medical Care.

Reimer A. & Kuehn R. (2005). The impact of services cape on quality perception. *European Journal of Marketing,* 39(7/8), 785-808.

Rivera, D.E., Marti, C.F., Costa, P.A., Sampaio, A. & Villar, A.S. (2019). Exploring the role of service delivery in remarkable tourism experiences. *Sustainability,* 11, 1382.

Roseke, B. (2016). Guide to the project life cycle. Available online: https://www.projectengineer.net/guide-to-the-project-life-cycle/

Roshnee, R. & Ramsaran-Fowdar. (2007). Developing a service quality questionnaire for the hotel industry in Mauritius. *Journal of Vacation Marketing,* 13(1), 21-32.

Rousson, V., Gasser, T. & Seifert, B. (2002). Assessing interrater, interrater and test–retest reliability of continuous measurements. *Statistics in Medicine,* 21, 3431-3446.

Sadeh, A., Dvir, D. & Shenhar, A. (2000). The role of contract type in the success of R&D defense projects under increasing uncertainty. *Project Management Journal,* 31(3), 14-22.

Sale, J.E., Lohfeld, L.H. & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: implications for mixed-methods research. *Quality & Quantity,* 36(1), 43-53.

Saleh, F. and Ryan, C. (1992). Client perceptions of hotels: a multi-attribute approach. *Tourism Management,* 13, 163-168.

Salkind, N.J.J. (2015). *Encyclopaedia of measurement and statistics,* 1st Edition. SAGE.

Sandelowski, M., Voils, C.I. & Barroso, J. (2006). Defining and designing mixed research synthesis studies. *Research in the Schools,* 13(1):29, 1-15.

Sanvido, V., Grobler, F., Parfitt, K., Guvenis, M. & Coyle, M. (1992). Critical success factors for construction projects. *Journal of Construction Engineering and Management,* 118(1), 94-111.

Saunders, M., Lewis, P. & Thornhill, A. (2012). *Research methods for business students,* 6th ed., Harlow, Pearson Education.

Saunders, M., Lewis, P. & Thornhill, A. (2019). *Research methods for business students*. 8th ed. Harlow, Pearson Education Limited., UK.

Savolainen, P., Ahonen, J.J., Richardson, I. (2012). Software development project success and failure from the supplier's perspective: a systematic literature review. *International Journal of Project Management,* 30(4), 458-469.

Schaefer, D.R. & Kornienko, O. (2010). Comparison processing social exchange network. *Advances in Group Processes,* 27, 185-205.

Schall, M. (2003). Best practices in the assessment of hotel-guest attitudes. *The Cornell Hotel and Restaurant Administration Quarterly*, April, 51-65.

Schiebler, T. (2019). Advancing theory of consumer satisfaction and word-of-mouth: product and service performance counts, but so do performance expectations. Inaugural-Dissertation, zur Erlangung des Doktorgrades der Philosophie an der Ludwig-Maximilians-Universität München.

Schwalbe, K. (2004). *Information technology project management* (3rd ed.). Course Technology, Boston.

Sebastian, N. (2007). *The definitive guide to project management* (2nd ed.). London, UK: Financial Times/Prentice Hall.

Seddon, P. B. (1997). A re-specification and extension of the DeLone McLean model of IS success. *Information Systems Research*, 8(3), 240-253.

Sedera, D., Gable, G. & and Chan, T. (2004). A factor and structural equation analysis of the enterprise systems success measurement model. In: AMCIS 2004 Proceedings. Available online: https://aisel.aisnet.org/amcis2004/94

Sekaran, U. & Bougie, R. (2016). *Research methods for business: a skill building approach,* John Wiley & Sons.

Sengonzi, R., Demian, P. & Emmitt, S. (2009). Opportunities for e-brainstorming in pre-design processes of healthcare projects. In M. Kagioglou, J. Barlow, A. Price, D. F. Gray, & C. Gray (Eds.), Proceedings of PhD Workshop of HaCIRIC International Conference: Improving Healthcare Infrastructures Through Innovation, 32-41.

Serra, C.E.M. & Kunc, M. (2015). Benefits realization management and its influence on project success and on the execution of business strategies. *International Journal of Project Management,* 33(1), 53-66.

Serrador, P. & Turner, R. (2015). The relationship between project success and project efficiency. *Project Management Journal,* 46(1), 30-39.

Serrador, P., and Pinto, J.K. (2015). Does Agile work? A quantitative analysis of Agile project success. *International Journal of Project Management,* 33(5), 1040-1051.

Setyaningrum, R., Subagyo, & Wijaya, A.R. (2020). A mathematical model of factors driving product success in an Indonesian market using design of experiment. *International Journal of Technology,* 11(2), 322-332.

Shao, J., Müller, R. & Turner, J.R. (2012). Measuring program success. *Project Management Journal,* 43(1), 37-49.

Sharabati, M.M.N., Sulaiman, A. & Salleh, N.K.M. (2015). End-user satisfaction and individual performance assessments in e-procurement systems. *International Journal of Computer Theory and Engineering,* 7(6), 503-509.

Shaw, N.C., DeLone, W.H. & Niederman, F. (2002). Sources of dissatisfaction in end-user support: an empirical study. *SIGMIS Database,* 33(2), 41-56.

Shenhar, A. & Holzmann, V. (2017). The three secrets of megaproject success: clear strategic vision, total alignment, and adapting to complexity. *Project Management Journal,* 48(6), 29-46.

Shenhar, A.J. & Dvir, D. (2007). *Reinventing project management: the diamond approach to successful growth and innovation*, Harvard Business School Press, Boston, MA.

Shenhar, A.J., Dvir, D., Levy, O. & Maltz, A.C. (2001). Project success: a multidimensional strategic concept. *Long Range Planning*, 34(6), 699-725.

Shenhar, A.J., Levy, O. & Dvir, D. (1997). Mapping dimensions of project success. *Project Management Journal,* 28(2), 5-13.

Slevin, D.P. & Pinto, J.K. (1986). The project implementation profile: new tool for project managers. *Project Management Journal,* September, 57-70.

Smartsheet. (2021). IT project management. Available online: https://www.smartsheet.com/content-center/best-practices/project-management/project-management-guide/project-management-IT

Song, W., Ren, S. & Yu, J. (2018). Bridging the gap between corporate social responsibility and new green product success: the role of green organizational identity. *Business Strategy and the Environment,* 28(1), 88-97.

Songer, A.D. & Molenaar, K.R. (1997). Project characteristics for successful public-sector design-build. *Journal of Construction Engineering and Management,* 123(1), 34-40.

Spreng, R.A. & Mackoy, R.D. (1996). An empirical examination of a model of perceived service quality and satisfaction. *Journal of Retailing,* 72(2), 201-214.

Spreng, R.A. & Olshavsky, R.W. (1992). A desires-as-standard model of consumer satisfaction: implications for measuring satisfaction. *Journal of Consumer Satisfaction, Dissatisfaction & Complaining Behaviour,* 5, 45-54.

Spreng, R.A. & Olshavsky, R.W. (1993). A desires congruency model of consumer satisfaction. *Journal of the Academy of Marketing Science*, 21(3), 169-177.

Spreng, R.A., MacKenzie, S.B. & Olshavsky, R.W. (1996). A re-examination of the determinants of consumer satisfaction. *Journal of Marketing,* 60(July), 15-32.

Standish Group. (2009). *CHAOS summary 2009*, Boston, MA: The Standish Group International, Inc.

Stare, A. (2010). Comprehensive management of project changes. *Economic and Business Review,* 12(3), 195-210.

Stevens, M. (2002). *Project management pathways*. Association for Project Management. Princes Risborough, England: APM Publishing.

Stephanie, G. (2021). Cronbach's alpha: simple definition, use and interpretation. Available online: https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/cronbachs-alpha-spss/

Streiner, D. (2003). Starting at the beginning: an introduction to coefficient alpha and internal consistency. *Journal of Personality Assessment,* 80, 99-103.

Suprapto, M., Bakker, H.L. & Mooi, H.G. (2015). Relational factors in owner-contractor collaboration: the mediating role of teamworking. *International Journal of Project Management,* 33(6), 1347-1363.

Swan, J.E. & Martin, W.S. (1981). Testing comparison level and predictive expectations models of satisfaction. *Advances in Consumer Research*, 8(1), 77-82.

Swan, J.E. & Trawick, I.F. (1981). Disconfirmation of expectations and satisfaction with a retail service. *Journal of Retailing,* 57(3), 49-67.

Szymanski, D.M. & Henard, D.H. (2001). Customer satisfaction: a meta-analysis of the empirical evidence. *Journal of the Academy of Marketing Science*, 29(1), 16-35.

Tam, C., da Costa Moura, E.J., Oliveira, T. & Varajão, J. (2020). The factors influencing the success of on-going agile software development projects. *International Journal of Project Management,* 38(3), 165-176.

Tashakkori, A. & Teddlie, C. eds. (2003). *Handbook of mixed methods in social & behavioural research.* Thousand Oaks, CA: SAGE Publications.

Tavakol, M. & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education,* 2, 53-55.

Taylor, C. (2020). Calculating the correlation coefficient. Available online: https://www.thoughtco.com/how-to-calculate-the-correlation-coefficient-3126228

Terry, H.Y., Li, S., Ng, T. & Skitmore, M. (2013). Evaluating stakeholder satisfaction during public participation in major infrastructure and construction projects: a fuzzy approach. *Automation in Construction*, 29, 123-135.

Thibaut, J.W. & Kelley, H.H. (1959). *The social psychology of groups*. New York: Wiley.

Ting, H.C. & Chen, C.N. (2002). The asymmetrical and non-linear effects of store quality attributes on customer satisfaction. *Total Quality Management,* 13(4), 547-569.

Toor, S. & Ogunlana, S.O. (2008). Critical COMs of success in large-scale construction projects: evidence from Thailand construction industry. *International Journal of Project Management,* 26(4), 420-430.

Torbica, Z.M. & Stroh, R.C. (2001). Customer satisfaction in home building. *Journal of Construction Engineering and Management,* 127(1), 82-86.

Torres, E. N. (2014). Deconstructing service quality and customer satisfaction: challenges and directions for future research. *Journal of Hospitality Marketing Management,* 23(May), 652-677.

Tse, D.K. & Wilton, P.C. (1988). Models of consumer satisfaction formation: an extension. *Journal of Marketing Research,* XXV(May), 204-212.

Turner, J.R. (2009). *The handbook of project-based management: leading strategic change in organizations* (3rd Ed.). London, UK: McGraw-Hill.

Turner, J.R. & Müller, R. (2005). Project manager's leadership style as a success factor on projects: a review. *Project Management Journal,* 36(2), 49-61.

Turner, R. & Zolin, R. (2012). Multiple perspectives by multiple stakeholders over multiple time frame. *Project Management Journal,* 43(5), 87-99.

Um, T., Kim, T. & Chung, N. (2020). How does an intelligence chatbot affect customers compared with self-service technology for sustainable services? *Sustainability,* 12, 5119, 1-21.

Vaezi, R. (2013). User satisfaction with information systems: a comprehensive model of attribute satisfaction. PhD Dissertation, Faculty of the C.T. Bauer College of Business, University of Houston.

van der Westhuizen, D. & Fitzgerald, E.P. (2005). Defining and measuring project success. In: European Conference on IS Management, Leadership and Governance, University of Reading, 7-8 July.

van Maanen, J., Sørensen, J.B. & Michell, T.R. (2007). The interplay between theory and method. *Academy of Management Review,* 32(4), 1145-1154.

van Offenbeek, M.A.G. & Vos, J.F.J. (2016). An integrative framework for managing project issues across stakeholder groups. *International Journal of Project Management*, 34(1), 44-57.

Vavra, T.G. (1999). *Improving your measurement of customer satisfaction: a guide to creating, conducting, analyzing, and reporting customer satisfaction measurement programs*. American Society for Quality.

Vongsraluang, N. & Bhatiasevi, V. (2017). The determinants of social commerce system success for SMEs in Thailand. *Information Development,* 33(1) 80-96.

Voss, M. (2012). Impact of customer integration on project portfolio management and its success: developing a conceptual framework. *International Journal of Project Management,* 30(5), 567-581.

Vuorinen, L. & Martinsuo, M. (2019). Value-oriented stakeholder influence on infrastructure projects. *International Journal of Project Management*, 37(5), 750-766.

Wainer, H., Dorans, N.J., Flaugher, R., Bert, F.G. & Robert, J.M. (1990). *Computerized adaptive testing: a primer*. Hillsdale NJ: Lawrence Earlbaum Associates.

Walster, E., Walster, G.W. & Bersheid, E. (1978). *Equity: theory and research*. Boston: Allyn & Bacon.

Wang, C.Y. (2010). Service quality, perceived value, corporate image, and customer loyalty in the context of varying levels of switching costs. *Psychology & Marketing,* 27, 252-262.

Wang, E.T.G., Chang, J.Y.T., Jiang, J.Y.J. & Klein, G. (2011). User advocacy and information system project performance. *International Journal of Project Management,* 29(2), 146-154.

Wang, Y., Lu, X. & Tan, Y. (2018). Impact of product attributes on customer satisfaction: an analysis of online reviews for washing machines. *Electronic Commerce Research and Applications,* 29, 1-11.

Wang, Y.S., Tseng, T.H., Wang, W.T., Shih, Y.W. & Chan, P.Y. (2019). Developing and validating a mobile catering app success model. *International Journal of Hospitality Management,* 77, 19-30.

Wateridge, J. (1998). How can IS/IT projects be measured for success? *International Journal of Project Management,* 16(1), 59-63.

Weaver, D. & Brickman, P. (1974). Expectancy, feedback, and disconfirmation as independent factors in outcome satisfaction. *Journal of Personality and Social Psychology,* 30(3), 420-428.

Weir, J.P. (2005). Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *Journal of Strength Conditioning Research,* 19, 231-240.

Westbrook, R.A. (1987). Product/consumption-based affective responses and post-purchase processes. *Journal of Marketing Research*, 24(3), 258-270.

Westbrook, R.A. & Oliver, R.L. (1991). The dimensionality of consumption emotion patterns and consumer satisfaction. *Journal of Consumer Research,* 18(1), 84-91.

Westbrook, R.A. & Reilly, M.D. (1983). Value-percept disparity: an alternative to the disconfirmation of expectations theory of consumer satisfaction. In: *Advances in consumer research (volume 10)*, eds. Bagozzi, R.P. & Tybout, A.M. (eds.). Ann Abor, MI: Association for Consumer Research, 256-261.

Westerveld, E. (2003). The project excellence model: linking success criteria and critical success factors. *International Journal of Project Management,* 21(6), 411-418.

Westland, J. (2007). *The project management life cycle: a complete step-by-step methodology for initiating, planning, executing, and closing a project successfully*. London, UK: Kogan Page Publishers.

Westland, J. (2018). History of project management. Available online: https://www.projectmanager.com/blog/history-project-management

Whittemore, R. & Knafl, K. (2005). The integrative review: updated methodology. *Journal of Advanced Nursing,* 52(5), 546-553.

Williams, C. (2007). Research methods. *Journal of Business & Economic Research,* 5(3), 65-72.

Williams, M. (2008*). The principles of project management.* Available online: https://www.sitepoint.com/principles-project-management/

Williams, P., Ashill, N. J., Naumann, E. & Jackson, E. (2015). Relationship quality and satisfaction: customer-perceived success factors for on-time projects. *International Journal of Project Management,* 33, 1836-1850.

Williams, T. (2016). Identifying success factors in construction projects: a case study. *Project Management Journal,* 4(1), 97-112.

Winter, M., Smith, C., Morris, P. & Cicmil, S. (2006). Directions for future research in project management: the main findings of a UK government-funded research network. *International Journal of Project Management,* 24(8), 638-649.

Wirtz, J. & Mattila, A. (2001). Exploring the role of alternative perceived performance measures and needs-congruency in the consumer satisfaction process. *Journal of Consumer Psychology,* 11(3), 181-192.

Wixom, B.H. & Todd, P.A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research*, 16(1), 85-102.

Woodside, A.G.; Frey, L.L. & Daly, R.T. (1989). Linking service quality, customer satisfaction, and behavior. *Journal of Health Care Marketing,* 9(4), 5-17.

Wright, J.N. (1997). Time and budget: the twin imperatives of a project sponsor. *International Journal of Project Management,* 15(3), 181-186.

Wu, G., Liu, C., Zhao, X. & Zuo, J. (2017). Investigating the relationship between communication-conflict interaction and project success among construction project teams. *International Journal of Project Management,* 35(8), 1466-1482.

Wu, J. & Wu, Z. (2019). ISO certification and new product success in an emerging market. *Asian Business Management,* 18, 51-71.

Wysocki, R.K. (2009). *Effective project management: traditional, adaptive, extreme* (5th Ed.). Indianapolis, IN: John Wiley Publishing, Inc.

Xue, X., Shen, Q. & Ren, Z. (2010). Critical review of collaborative working in construction projects: business environment and human behaviors. *Journal of Management in Engineering,* 26(4), 196-208.

Xueming, L. & Bhattacharya, C.B. (2006). Corporate social responsibility, customer satisfaction, and market value. *Journal of Marketing,* 70, 1-18.

Yalegama, S., Chileshe, N. & Ma, T. (2016). Critical success factors for community-driven development projects: a Sri Lankan community perspective. *International Journal of Project Management,* 34(4), 643-659.

Yang, K., Li, X., Kim, H. & Kim, Y.H. (2015). Social shopping website quality attributes increasing consumer participation, positive eWOM, and co-shopping: the reciprocating role of participation. *Elsevier Journal of Retailing and Consumer Services*, 24, 1-9.

Yang, L.R. (2012). Implementation of project strategy to improve new product development performance. *International Journal of Project Management,* 30(7), 760-770.

Yi, Y. (1990). A critical review of consumer satisfaction. In: *Review of marketing*. Zeithaml, V.A. (ed.). Chicago: American Marketing Association, 68-123.

Yin, R.K. (2018). *Case study research and applications: design and methods* (6th Ed.). Thousand Oaks, CA: SAGE Publications.

Yoo, D.K. & Park, J.A. (2007). Perceived service quality-analyzing relationships among employees, customers, and financial performance. *International Journal of Quality & Reliability Management,* 21(9), 908-926.

Yu, A.G., Flett, P.D. & Bowers, J.A. (2005). Developing a value-centered proposal for assessing project success. *International Journal of Project Management,* 23(6), 428-436.

Yuan, H. (2017). Achieving sustainability in railway projects: major stakeholder concerns. *Project Management Journal*, 48(5), 115-132.

Yüksel, A. & Yüksel, F. (2008). *Customer satisfaction: conceptual issues consumer satisfaction theories: a critical review*. Sheffield Hallam University.

Zarewa, G.A. (2019). Barriers to effective stakeholder management in the delivery of multifarious infrastructure projects (MIPs). *Journal of Engineering, Project, and Production Management,* 9(2), 85-96.

Zarina, A., Zawawi, E.M.A., Yusof, K. & Aris, N.M. (2014). Determining critical success factors of project management practice: a conceptual framework. *Procedia - Social and Behavioral Sciences,* 153(16), 61-69.

Zeithaml, V.A., Berry, L.L., Parasuraman A. (1993). The nature and determinants of customer expectations of service. *Journal of the Academy of Marketing Science,* 21(1), 1-12.

Zhang J. & Wu, W.P. (2017). Leveraging internal resources and external business networks for new product success: a dynamic capabilities perspective. *Industrial Marketing Management,* 61, 170-181.

Zhang, Z., Cao, T., Shu, J. & Liu, H. (2020). Identifying key factors affecting college students' adoption of the e-learning system in mandatory blended learning environments. *Interactive Learning Environments*, February (online).

Zhao, Y., Xu, X. & Wang, M. (2018). Predicting overall customer satisfaction: big data evidence from hotel online textual reviews. *International Journal of Hospitality Management,* 76, 111-121.

Zhou, Y. (2019). A mixed methods model of scale development and validation analysis. *Measurement (Mahwah, N.J.),* 17(1), 38-47.

Zidane, Y.J.T., Johansen, A. & Ekambaram, A. (2015). Project evaluation holistic framework: application on megaproject case. *Procedia Computer Science,* 64, 409-416.

Zikmund, W.G., Babin, B.J., Carr, J.C. & Griffin, M. (2013). *Business research methods*. Cengage Learning.

Zoovu. (2017). 15 key factors influencing customer satisfaction. Available online: https://zoovu.com/blog/customer-satisfaction-factors/

Žukauskas, P., Vveinhardt, J. & Andriukaitienė, R. (2018). *Philosophy and paradigm of scientific research*. IntechOpen.

APPENDICES

Appendix 1: Systematic literature review and integrative literature review

This appendix sets out the process of searching previous literature to obtain a list of publications suitable to critique. Stage one involves a systematic literature review (SLR) and stage two involves an integrative literature review (ILR).

The SLR is defined as synthesizing past research findings in a systematic, transparent and reproducible way on any selected topic, and is considered the gold standard among various types of reviews (Davis et al., 2014). It was conducted by searching the three Q1 journals specifically relevant to the discipline of project management: namely, the *International Journal of Project Management*, the *Project Management Journal* and the *International Journal of Managing Projects in Business*. Journals were searched in chronological order starting from 1990 until 2020 inclusive. The ScienceDirect database was used to perform the search.

First, the titles and the abstract of the resulted papers were scanned, and the most relevant were chosen for the reading of the full text. The results then were saved. For synthesizing the

literature review findings, Heyvaert et al. (2017) was used as the primary methodological reference. In this method, the qualitative data are quantitated (and vice versa) for the synthesis of qualitative and quantitative data (Sandelowski et al., 2006). Vote count, frequencies and percentage were calculated by grouping similar articles.

The SLR helped to identify the gaps, deficiencies and missing specified definitions of the concepts of project success, including critical success factors, from the perception of project recipients (i.e. project stakeholders, end-users, customers, clients, and the local community).

The ILR permits employing different methods for a better understanding of a specific theme. An integrative review is closely related to the semi-structured review approach or critical review approach**.** In comparison to the semi-structured review, ILR usually has a different purpose, intending to assess, critique and synthesize the literature on a selected research topic enabling new theoretical frameworks and perspectives to emerge (Whittemore & Knafl, 2005). The satisfaction of the project recipients is the most dominant aspect of this stage of the study. Of course, literature in marketing, information systems studies and product success studies has been visited to appropriately review end-user satisfaction. This stage was accomplished by searching the Web of Science database.

The Web of Science database was selected for the ILR because it has been reported as a comprehensive database for finding scholarly work (Dahlander & Gann, 2010). Its Social-Science-Citation-Index provides access to peer-reviewed journals, thereby ensuring academic quality. Finally, unlike other databases, the search results in the Web of Science are not constrained as institutional (university) journal subscriptions. Therefore, other scholars can replicate the study results reported by an earlier researcher (Antons & Breidbach, 2017) to ensure fast and reliable searching and increasing the value of citation through an in-depth analysis. This database is indexing and abstracting a about 10,000 of the world's leading journals. The Web of Science was searched for peer-reviewed journals from 2010-2020 only.

The following terms were used in covering the study fields and preparing a comprehensive list of the attributes that drive customer satisfaction with the project, whether it was product creation, service provision, system development, or post occupancy evaluation.

1. *Project and customer satisfaction:* the term combined "customer satisfaction" and "projects" and has been chosen to cover the literature that deals with these concepts, and

as elaborated in published journals other than those selected in the first phase of the literature review.

2. *Project and client satisfaction:* the term combined "client satisfaction" and "projects" and has been chosen to cover the literature that deals with these concepts in published journals other than the selected in the first phase of the literature review.
3. *Stakeholder satisfaction:* the term used to discover all the attributes that drive stakeholder satisfaction, regardless of the industry or field.
4. *End-user satisfaction:* the term used to discover all the attributes that drive the end-user satisfaction, regardless of the industry and fields of study.
5. *Product success:* the attributes of product creation related to end-user satisfaction.
6. *Service success:* the attributes of service provision related to end-user satisfaction.
7. *System success:* the attributes of system development related to end-user satisfaction.
8. *Post occupancy evaluation:* the attributes that relate to the satisfaction of occupants of a building after they have occupied the space for a full year.

This process helped to reveal the attributes associated with the satisfaction and delight of end-users. The identified items/attributes were integrated into the questionnaire development, an instrument for data collection in the quantitative part of this study.

For synthesizing the findings of the ILR, Dixon-Woods, Bonas et al. (2006) and Dixon-Woods, Cavers, et al. (2006) were used as the primary methodological references, which aim towards theory generation and a critically informed integration of evidence from qualitative, quantitative and mixed method studies. "The outcome of the critical interpretive synthesis takes the form of a coherent theoretical framework comprising a network of constructs and the relationships between them, and links synthetic constructs" (i.e. new constructs generated through synthesis) and existing constructs (Dixon-Woods, Cavers et al., 2006, p. 10).

Most research for this study has been published in the *International Journal of Project Management*, where 2,005 papers appeared from a wide-ranging search, but only 116 had some relevance and just 58 were selected as having high relevance to the present study.

A broad search of the *Project Management Journal* yielded 423 articles (least number within the three selected journals), out of which 52 indicated some relevance while only 14 were selected to include in the SLR due to their high relevance.

The *International Journal of Managing Projects in Business* published 453 articles found during a broad search, but only 24 of these possessed some relevance and just 7 could be identified as high relevance.

All 79 high relevance papers were examined thoroughly, and their major themes were enlisted from their dominating subject content, which was classified and passed through frequency distribution. There were nine major themes identified. The number of papers in each theme along with respective calculated percentages is given below:

- *Theme One:* Basis for defining project success and associated controversies (7 papers, 9.5%)
- *Theme Two:* Various stakeholder groups of projects and how they are managed effectively (5 papers, 6%)
- *Theme Three:* Project critical success factors and success criteria for measurement (20 papers, 25.5%)
- *Theme Four:* Definitions of project success related to stakeholders involved during design (11 papers, 14%)
- *Theme Five:* Definitions of project success arising during project execution (11 papers, 14%)
- *Theme Six:* End-user perceptions of project success in the post-delivery phase (11 papers, 14%)
- *Theme Seven:* Causes of low success or failure of projects and strategies to avoid (5 papers, 6%)
- *Theme Eight:* Measurement/evaluation models for the quantification of project success (5 papers, 6%)
- *Theme Nine:* Deficiencies and gaps that have been identified from past research findings (4 papers, 5%)

Full texts of high-relevance papers were collected for further reading, including analyzing and synthesizing the subject matter under different headings. The collected literature was classified into major themes using frequency distribution. Findings have been elaborated and discussed in the body of this dissertation with logic and critique supported by the secondary literature.

Findings from the above search strategies are presented in Table A.1 and then explored further in Tables A.2 to 10 under nine major themes. These tables summarize the SLR process to locate relevance papers.

Table A.1. Information of journals included in the SLR

Journal	Database/ publisher	Duration	Nature of content of the journal	Articles related to project success and its factors	Articles having some relevance to the present study	Number of articles incorporated in the present manuscript due to high relevance
Project Management Journal	SAGE Publishing, Project Management Institute (PMI)	1998-2020	Research, techniques, theories, and applications in project management	423	52	14
International Journal of Project Management	Elsevier in association with the APM and IPMA	2001-2020	Project management and organization studies	2,005	116	58
International Journal of Managing Projects in Business	Emerald Insight Publishing, UK	2008-2020	Management Science/ Management Studies	453	24	7

Table A.2. Major theme one: basis of defining project success/disagreements (7 papers, 9.5%)

Article-No. under the theme	Authors of the articles	Year of publication	Title of the article	Name of journal, book or Thesis and volume, issue, & DOI/Website	The essence of the paper and the major conclusion
1	Fowler & Walsh	1999	Conflicting perceptions of success in an information systems project	*International Journal of Project Management, 17*(1), 1-10. https://doi.org/10.1016/S0263-7863(97)00063-X	The perceptions of success amongst different stakeholders vary according to their interests because considerable perception differences were found between senior managers, system developers, and end-users including project managers.
2	Jugdev & Müller	2005	A retrospective look at our evolving understanding of project success	*Project Management Journal,* 36(4), 19-31. https://doi.org/10.1177/875697280503600403	The meanings of success broadly vary to different people at different times, and under various contexts. The definition of project success has been changing during the last 40 years due to changing critical success factors but remained restricted to the project implementation phase.
3	McLeod, Doolin & MacDonell	2012	A perspective-based understanding of project success	*Project Management Journal, 43*(5), 68-86. https://doi.org/10.1002/pmj.21290	Using poor success criteria (incomplete, unrealistic, and conflicting) that may be interpreted differently by stakeholders and efforts to please everybody are the major problems in defining project success unanimously.

4	Serrador & Turner	2015	The relationship between project success and project efficiency	*Project Management Journal,* 46(1), 30-39. https://doi.org/10.1002/pmj.21468	Project efficiency (meeting time, scope, and budget goals) is correlated to, but not Project success itself.
5	Millhollan & Kaarst-Brown	2016	Lessons for IT project manager efficacy: a review of the literature associated with project success	*Project Management Journal,* 47(5), 89-106. https://doi.org/10.1177/875697281604700507	The conflicts in defining and evaluating project success are due to focusing only on three perspectives: project outcomes, project management processes, and the project manager's influence while stakeholders have different perceptions.
6	Yuan	2017	Achieving sustainability in railway projects: major stakeholder concerns	*Project Management Journal, 48*(5), 115-132. https://doi.org/10.1177/875697281704800508	The sustainability (economic, environmental, and social) of projects is lesser when there are major differences (Confrontations and disputes) among stakeholders regarding targets of projects.
7	Delisle	2019	Uncovering temporal underpinnings of project management standards	*International Journal of Project Management, 37*(8), 968-978. https://doi.org/10.1016/j.ijproman.2019.09.005	Time management and deadlines should be put at the forefront during project management.

Table A.3. Major theme two: various stakeholders of projects (5 papers, 6%)

Article-No. under the theme	**Authors of the articles**	**Year of publication**	**Title of the article**	**Name of journal, book or Thesis, and volume, issue, & DOI/Website**	**The essence of the paper and the major conclusion**
1	Purvis, Zagenczyk & McCray	2015	What's in it for me? Using expectancy theory and climate to explain stakeholder participation, its direction, and intensity	*International Journal of Project Management, 33*(1), 3-14. https://doi.org/10.1016/j.ijproman.2014.03.003	Expectancy theory was employed to explain the motivation of stakeholders to participate in a project which indicated that psychological, climate, and assessments shape their motivation.
2	van Offenbeek & Vos	2016	An integrative framework for managing project issues across stakeholder groups	*International Journal of Project Management, 34*(1), 44-57. https://doi.org/10.1016/j.ijproman.2015.09.006	The stakeholders and project issues are associated, but the project stakeholder management literature is deficient in analysing the linkages between stakeholders and the issues they bring.
3	Maddaloni & Davis	2018	Project manager's perception of the local communities' stakeholders in megaprojects. An empirical investig-ation in the UK	*International Journal of Project Management, 36*(3), 542-565. https://doi.org/10.1016/j.ijproman.2017.11.003	Addressing the benefits of secondary stakeholder groups (users, customers, & communities) has led to delays, cost overruns, and significant damage to the organization.
4	Vuorinen & Martinsuo	2019	Value-oriented stakeholder influence on infrastructure projects.	*International Journal of Project Management, 37*(5), 750-766. https://doi.org/10.1016/j.ijproman.2018.10.003	Managing and fulfilling stakeholder expectations and focusing on the viewpoint of the firm rather than that of the project stakeholders alone. Thus, a combination should be addressed.

5	Lehtinen & Aaltonen	2020	Organizing external stakeholder engagement in inter-organizational projects: opening the black box	*International Journal of Project Management, 38*(2), 85-98. https://doi.org/10.1016/j.ijproman.2019.12.001	External stakeholder engagement is crucial for delivering inter-organizational projects. The management should adopt governance, values, and dynamism to engage them.

Table A.4. Major theme three: project success factors/criteria (20 papers, 25.5%)

Article-No. under the theme	Authors of the articles	Year of publication	Title of the article	Name of journal, book or Thesis, and volume, issue, & DOI/Website	The essence of the paper and the major conclusion
1	Christenson & Walker	2004	Understanding the role of "vision" in project success	*Project Management Journal, 35*(3), 39-52. https://doi.org/10.1177/875697280403500306	A significant driver of project management success is effective and intelligent leadership, communication, and inspiring vision of targets and how to achieve these.
2	Khang & Moe	2008	Success criteria and factors for international development projects: a life-cycle-based framework	*Project Management Journal, 39*(1), 72-84. https://doi.org/10.1002/pmj.20034	An international successful project has a good reputation, a clear impact on the targeted beneficiaries, has built institutional capacity within the country, has a good chance of being extended due to its success, and projects' outcomes are likely to be sustained.
3	Ahadzie, Proverbs & Olomolaiye	2008	Critical success criteria for mass house building projects in developing countries	*International Journal of Project Management, 26*(6), 675-687. https://doi.org/10.1016/j.ijproman.2007.09.006	There are four underlying clusters of project success factors named in order of their significance as environmental impact, customer satisfaction, quality, and cost and time.
4	Toor & Ogunlana	2008	Beyond the 'iron triangle': stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects	*International Journal of Project Management, 28*(3), 228-236. https://doi.org/10.1016/j.ijproman.2009.05.005	The traditional measures of the iron triangle (on-time, under-budget, and according to specifications) are no more applicable to measuring performance on large public sector development projects because performance indicators such as safety, efficient use of resources, effectiveness, the satisfaction of stakeholders, and reduced conflicts and disputes are becoming more important.
5	Hassan, Al-Tmeemy, Abdul-Rahman & Harun.	2011	Future criteria for success of building projects in Malaysia	*International Journal of Project Management, 29*(3), 337-348. https://doi.org/10.1016/j.ijproman.2010.03.003	A categorization scheme for success criteria for building projects includes the categories of project management success, product success, and market success.
6	Doloi	2011	Understanding stakeholders' perspective of cost estimation in project management	*International Journal of Project Management, 29*(5), 622-636. https://doi.org/10.1016/j.ijproman.2010.06.001	Cost overrun is a chronic problem in most completed projects whereas statutory compliance and environmental issues are perceived to be critical in influencing cost performance in projects.

7	Savolainen, Ahonen & Richardson	2012	Software development project success and failure from the supplier's perspective: A systematic literature review	*International Journal of Project Management, 30*(4), 458-469. https://doi.org/10.1016/j.ijproman.2011.07.002	Three success criteria of project success and project management (PM) success were identified from the supplier's perspective which are customer satisfaction, short-term business benefits, and long-term business benefits.
8	Turner & Zolin	2012	Forecasting success on large projects: developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames	*Project Management Journal,* 43(5), 87-99. https://doi.org/10.1002/pmj.21289	Many stakeholders work together in large projects who are having different, rather sometimes conflicting objectives. The outputs may operate for many years, or even decades while perceptions of stakeholders can change with time. Therefore, project managers must consider performance indicators that go beyond the traditional triple constraints (time, cost, and quality).
9	Yang	2012	Implementation of project strategy to improve new product development performance.	*International Journal of Project Management, 30*(7), 760-770. https://doi.org/10.1016/j.ijproman.2011.11.005	The poor project strategy is one of the major causes of project failure.
10	Alzahrani & Emsley	2013	The impact of contractors' attributes on construction project success: a post-construction evaluation	*International Journal of Project Management, 31*(2), 313-322. https://doi.org/10.1016/j.ijproman.2012.06.006	The role of the contractors in project success is significant. Contractors' factors for the success of construction projects are (i) safety and quality (ii) past performance (iii) environment (iv) management and technical aspects (v) resource (vi) organization (vii) experience (viii) size/type of pervious projects and (ix) finance.
11	Pasian	2015	Extending the concept and modularization of project management maturity with adaptable, human, and customer factors	*International Journal of Managing Projects in Business, 7*(2), 285-302. https://doi.org/10.1108/IJMPB-01-2014-0006	The non-process factors like human factors (trust, attitude, motivation, and attitude), along with increased customer involvement and a more adaptable organizational environment, are important as well to achieve project success.
12	Eigbe, Sauser & Felder	2015	Systemic analysis of the critical dimensions of project management that impact test and evaluation program outcomes.	*International Journal of Project Management, 33*(4), 747-759. https://doi.org/10.1016/j.ijproman.2014.09.008	Adopting standard project management practices will enhance the capability of organizations to achieve program success and customer satisfaction.
13	Williams	2016	Identifying success factors in construction projects: a case study	*Project Management Journal, 4*(1), 97-112. https://doi.org/10.1012/pmj.21558	The project's success depends upon chains consisting of multiple factors rather than simple success factors. The multi-dimensionality of success is related to complex interactions of factors contributing to project performance synergistically.

14	Koops, Bosch-Rekveldt, Coman, Hartogh &Bakker	2016	Identifying perspectives of public project managers on project success: comparing viewpoints of managers from five countries in North-West Europe	*International Journal of Project Management, 34*(5), 874-889. ISSN 0263-7863, https://doi.org/10.1016/j.ijproman.2016.03.007	The managers of public and private projects largely contribute to the success of big infrastructure projects. However, project managers might be the product-driven manager, the parent-oriented manager, and the manager with a stakeholder focus, in addition to the conventional project manager, they can all drive the projects to success if are aware and collaborate properly.
15	Yalegama, Chileshe & Ma	2016	Critical success factors for community-driven development projects: a Sri Lankan community perspective	*International Journal of Project Management, 34*(4), 643-659. https://doi.org/10.1016/j.ijproman.2016.02.006	Three critical success factors: enabling community environment, measurable project management outcomes by village organization, and community project management engagement were identified in community development projects.
16	Damoah & Akwei	2017	Government project failure in Ghana: a multidimensional approach	*International Journal of Managing Projects in Business, 10*(1), 41-48. https://doi.org/10.1108/IJMPB-02-2016-0017	Out of the six assessment criteria, the worst failure criterion in the Ghana government sector is meeting the schedule, which is followed by cost, requirements, stakeholder satisfaction, national development, and contribution to the sector where projects are implemented, respectively.
17	Musawir, Serra, Zwikael & Ali	2017	Project governance, benefits management, and project success: towards a framework for supporting organizational strategy implementation.	*International Journal of Project Management, 35*(8), 1658-1672. https://doi.org/10.1016/j.ijproman.2017.07.007	Effective project governance enhances project success and enables the realization of strategic objectives of projects.
18	Wu, Liu, Zhao & Zuo	2017	Investigating the relationship between communication-conflict interaction and project success among construction project teams	*International Journal of Project Management, 35*(8), 1466-1482. https://doi.org/10.1016/j.ijproman.2017.08.006	Communication (tasks and processes) directly affects project success; effectiveness is positively related while conflicts have a negative relationship.
19	Ajmal & Al-Yafei	2019	Exploring factors behind project scope creep: stakeholders' perspective	*International Journal of Managing Projects in Business, 13*(3), 483-504. https://doi.org/10.1108/IJMPB-10-2018-0228	Communication is among the major causes of project scope creep, as reported by all project stakeholder groups in this study.
20	Tam, da Costa Moura, Oliveira & Varajão	2020	The factors influencing the success of ongoing agile software development projects	*International Journal of Project Management, 38*(3), 165-176. https://doi.org/10.1016/j.ijproman.2020.02.001	The success of ongoing agile software development projects, when measured in terms of cost, time, and customer satisfaction, depends on team capability and customer involvement.

Table A.5. Major theme four: definitions of project success from stakeholder perceptions (11 papers, 14%)

Article-No. under the theme	Authors of the articles	Year of publication	Title of the article	Name of journal, book or Thesis, and volume, issue, & DOI/Website	The essence of the paper and the major conclusion
1	Belassi & Tukel	1996	A new framework for determining critical success/failure factors in projects	*International Journal of Project Management, 14*(3), 141–152. https://doi.org/10.1016/0263-7863(95)00064-X	The satisfaction of stakeholders and the health and safety impacts the project and should be part of the measurements of success.
2	Wright	1997	Time and budget: the twin imperatives of a project sponsor	*International Journal of Project Management, 15*(3), 181-186. https://doi.org/10.1016/S0263-7863(96)00059-2	Without acceptance and the cooperation of stakeholders, it will be unlikely to complete the project near the time or close to budget.
3	Garrety, Robertson & Badham	2004	Integrating communities of practice in technology development projects.	*International Journal of Project Management, 22*(5), 351-358. https://doi.org/10.1016/j.ijproman.2003.08.003	Integration of communities and users in the developing technology can ensure that the outcomes are comprehensible to all groups who are satisfied by meeting their interests.
4	Bryde	2008	Perceptions of the impact of project sponsorship practices on project success	*International Journal of Project Management, 26*(8), 800-809. https://doi.org/10.1016/j.ijproman.2007.12.001	The project sponsorship is a multi-dimensional construct and is a project Critical Success Factor.
5	Hsu, Liang, Shelly, Klein & Jiang	2011	Promoting the integration of users and developers to achieve a collective mind through the screening of information system projects	*International Journal of Project Management, 29*(5), 514-524. https://doi.org/10.1016/j.ijproman.2010.06.006	The active and fruitful participation of users in the development projects of information systems (IS) is a crucial factor in achieving success.
6	Davis	2014	Different stakeholder groups and their perceptions of project success	*International Journal of Project Management, 32*(2), 189-201. ISSN 0263-7863, https://doi.org/10.1016/j.ijproman.2013.02.006	The thematic analysis of project success literature since the 1970s indicated a lack of agreement in perceptions of project success factors between three groups (senior management, project core team, and project recipient stakeholder groups). Thus, there is a need for empirical research into perceptions of project success.
7	Mir & Pinnington	2014	Exploring the value of project management: linking project management performance and project success	*International Journal of Project Management*, *32*(2), 202-217	Cost, time, quality, performance, and satisfaction of stakeholders are included in the definition of project success.

8	Schepper, Dooms & Haezendonck	2014	Stakeholder dynamics and responsibilities in public-private partnerships: a mixed experience	*International Journal of Project Management 32*(7):1210–1222. https://doi.org/10.1016/j.ijproman.2014.01.006	Stakeholder management is one of the main success factors in Public-Private Partnerships (PPPs) while it is more complex to manage and balancing between stakeholder claims. The sharing and division of responsibilities between stakeholders are still to be searched.
9	Yang, Chen & Wang	2015	Assessing the effect of requirement definition and management on performance outcomes: role of interpersonal conflict, product advantage, and project type	*International Journal of Project Management, 33*(1), 67-80. https://doi.org/10.1016/j.ijproman.2014.02.012	The number of groups moderates the relationship between requirements, quality & stability, and project performance.
10	Ika & Donnelly	2017	Success conditions for international development capacity-building projects	*International Journal of Project Management, 35*(1), 44-63. https://doi.org/10.1016/j.ijproman.2016.10.005	Ika, & Donnelly (2017) A high level of multi-stakeholder commitment, collaboration, alignment, and adaptation are necessary for projects to succeed.
11	Derakhshan, Turner & Mancini	2019	Project governance and stakeholders: a literature review	*International Journal of Project Management, 37*(1), 98-116. https://doi.org/10.1016/j.ijproman.2018.10.007	The roles, relationships, and positions of internal and external stakeholders inside and outside of the organization's structure have not been fixed in literature and vary from project to project.

Table A.6. Major theme five: definitions of project success during the project execution phase (11 papers, 14%)

Article-No. under the theme	**Authors of the articles**	**Year of publication**	**Title of the article**	**Name of journal, book or Thesis, and volume, issue, & DOI/Website**	**The essence of the paper and the major conclusion**
1	Pinto & Prescott	1988	Variation in critical success factors over the stages in the project life cycle	*Journal of Management, 14*(1), 5-18.	Project success is defined as the completion of the project on schedule and within the allocated costs.
2	Freeman & Beale	1992	Measuring project success	*Project Management Journal, 23*(1), 8–17.	The quality parameters must be added to the definition of project success.
3	Atkinson	1999	Project management: cost, time, and quality, two best guesses and phenomenon, it is time to accept other success criteria	*International Journal of Project Management, 17*(6), 337-342	The addition of other criteria into the Iron Triangle, such as stakeholder benefits was urged. A new framework to consider success criteria including time, cost, quality, and satisfaction of stakeholders was proposed.
4	Dvir, Raz & Shenhar	2003	An empirical analysis of the relationship between project planning and project success	*International Journal of Project Management, 21*(2), 89-95. https://doi.org/10.1016/S0263-7863(02)00012-1	Project success is insensitive to the level of management processes and procedures but is positively correlated with the investment in requirements and development of technical specifications.

5	Agarwal & Rathod	2006	Defining 'success' for software projects: An exploratory revelation	*International Journal of Project Management, 24*(4), 358-370. https://doi.org/10.1016/j.ijproman.2005.11.009	There are clear differences in the perception of the meaning of 'success in the minds of various stakeholders: external stakeholders mean the target cost and time while internal stakeholders agree on the attainment of scope.
6	Winter, Smith, Morris & Cicmil	2006	Focusing on business projects as an area for future research: an exploratory discussion of four different perspectives	*International Journal of Project Management, 24*(8), 699-709. https://doi.org/10.1016/j.ijproman.2006.08.005	Successful business projects require implementing business strategy, improving organizational effectiveness, and managing the realization of stakeholder benefits.
7	Lloyd-Walker & Walker	2011	Authentic leadership for 21st-century project delivery	International Journal of Project Management, 29(4), 383-395. https://doi.org/10.1016/j.ijproman.2011.02.004	Project leadership must adapt to meet changing needs of this 21st century if it is to remain relevant.
8	Voss	2012	Impact of customer integration on project portfolio management and its success: developing a conceptual framework	*International Journal of Project Management, 30*(5), 567-581. https://doi.org/10.1016/j.ijproman.2012.01.017	Customers' demand is a higher value which is considered a key success factor in the future for project success.
9	Heising	2012	The integration of ideation and project portfolio management: a key factor for sustainable success	*International Journal of Project Management, 30*(5), 582-595. https://doi.org/10.1016/j.ijproman.2012.01.014	For implementing successful projects, opportunities are discovered, ideas are created, and the foundation for planning good projects, and corporate success is laid.
10	Davis	2016	A method to measure success dimensions relating to individual stakeholder groups	*International Journal of Project Management 34*(3), 480-493. https://doi.org/10.1016/j.ijproman.2015.12.009	Three new success dimensions are linked directly to the perception of project success: benefit to the stakeholder group, client/customer-specific issues, and time/cost/quality.
11	Badewi	2016	The impact of project management (PM) and benefits management (BM) practices on project success: Towards developing a project benefits governance framework	*International Journal of Project Management, 34*(4), 761-778. https://doi.org/10.1016/j.ijproman.2015.05.005	Benefits management (BM) and project management (PM) are two interrelated approaches to the success of projects. However, project success is enhanced significantly when PM and BM practices are combined.

Table A.7. Major theme six: end-user perceptions of project success during post-delivery phase (11 papers, 14%)

Article-No. under the theme	Authors of the articles	Year of publication	Title of the article	Name of journal, book or Thesis, and volume, issue, & DOI/Website	The essence of the paper and the major conclusion
1	de Wit	1988	Measurement of project success	*International Journal of Project Management, 6*(3), 164-170. https://doi.org/10.1016/0263-7863(88)90043-9	During the evaluation of project success, the objectives of all stakeholders, including end-users, throughout the project life cycle must be considered at all levels of management hierarchy.
2	Dvir	2005	Transferring projects to their final users: the effect of planning and preparations for commissioning on project success	*International Journal of Project Management, 23*(4), 257-265. https://doi.org/10.1016/j.ijproman.2004.12.003	The four aspects (development of operational & maintenance requirements, customer participation in the development process, developer preparations for turning over the project to its final users, and final user preparations for operational use) are considered when a project is planned and prepared to transfer to final users while project efficiency, customer benefits and overall success are conducted at delivery.
3	Yu, Flett & Bowers	2005	Developing a value-centered proposal for assessing project success	*International Journal of Project Management, 23*(6), 428-436. https://doi.org/10.1016/j.ijproman.2005.01.008	A product-based project success definition was proposed and a comparison of two concepts, Net Project Execution Cost and the Net Product Operation Value has been recommended for reaching the same project success or failure verdict by various stakeholders, which may help to remove issues emerging from the use of different success criteria.
4	Wang, Chang, Jiang & Klein	2011	User advocacy and information system project performance	*International Journal of Project Management*, *29*(2), 146-154. https://doi.org/10.1016/j.ijproman.2010.02.011	Although user participation in projects pays back and it is usually considered to help to shape the requirements of the system. However, information system project managers should go beyond to promote a role of advocacy for the users represented in the project team.
5	Havila, Medlin & Salmi	2013	Project-ending competence in premature project closures.	*International Journal of Project Management, 31(1), 90-99.* https://doi.org/10.1016/j.ijproman.2012.05.001	Project management literature tended to focus on the early phases of a project such as planning, scheduling, budgeting, resourcing, and motivating. Only a small fraction of the discussion is devoted to closure and delivery.
6	Basu	2014	Managing quality in projects: An empirical study	*International Journal of Project Management, 32*(1), 178-187. https://doi.org/10.1016/j.ijproman.2013.02.003	The defined project quality may have three dimensions: Design Quality, Process Quality, and Organization Quality while quality ensures adaptation of project success.

7	Haverhill	2016	The impact of product superiority on customer satisfaction in project management	*International Journal of Project Management, 34*(4), 570-583. https://doi.org/10.1016/j.ijproman.2016.02.007	Product superiority is a precursor for customer satisfaction but has a lower impact on customer satisfaction than better project management. Therefore, higher service provision dominates the product-oriented nature of the project delivery system.
8	Martens & Carvalho	2017	Key factors of sustainability in project management context: A survey exploring the project managers' perspective	*International Journal of Project Management, 35*(6), 1084-1102. https://doi.org/10.1016/j.ijproman.2016.04.004	The sustainability of projects depends upon Sustainable Innovation Business Model, Stakeholders Management, Economic and Competitive Advantage, and Environmental Policies and Resources Saving.
9	Oppong, Chan & Dansoh	2017	A review of stakeholder management performance attributes in construction projects	*International Journal of Project Management, 35*(6), 1037-1051. https://doi.org/10.1016/j.ijproman.2017.04.015	The project success can be measured by objectively and subjectively evaluating the level of stakeholder and organizational satisfaction on delivery
10	Einhorn, Marnewick & Meredith	2019	Achieving strategic benefits from business IT projects: the critical importance of using the business case across the entire project lifetime.	*International Journal of Project Management, 37*(8), 989-1002. https://doi.org/10.1016/j.ijproman.2019.09.001	The business case usage diminishes significantly after project approval, which gives potentially negative consequences to success because project processes should continue throughout the life cycle.
11	Momeni & Martinsuo	2019	Integrating services into solution offerings in the sales work of project-based firms	*International Journal of Project Management, 37*(8), 956-967. https://doi.org/10.1016/j.ijproman.2019.09.004	Effective sales are a prerequisite for the successful delivery of projects. Project Marketing and sales are the key activities for the delivery for which integration of sales and services is required.

Table A.8. Major theme seven: causes of low success or failure of projects (5 papers, 6%)

Article-No. under the theme	**Authors of the articles**	**Year of publication**	**Title of the article**	**Name of journal, book or Thesis, and volume, issue, & DOI/Website**	**The essence of the paper and the major conclusion**
1	Frank, Sadeh & Ashkenasi	2011	The relationship among systems engineers' capacity for engineering systems thinking, project types, and project success	*Project Management Journal, 42*(5), 31-41. https://doi.org/10.1002/pmj.20252	Two-thirds of projects fail because of more focus on processes that should be on people.. A statistically significant correlation between capacity for engineering systems thinking and project success exists. The project's novelty, complexity, and technological uncertainty may affect this correlation.
2	Badi & Pryke	2015	Assessing the quality of collaboration towards the achievement of sustainable energy innovation in PFI school projects	*International Journal of Managing Projects in Business, 8*(3), 408-440. https://doi.org/10.1108/1JMPB-09-2014-0060	The restricted internal relationships within the company, ineffective communication with public sector clients and users as well as the misalignment of public sector-private sector sustainability objectives are the major causes of low success.

3	Shenhar & Holzmann	2017	The three secrets of megaproject success: clear strategic vision, total alignment, and adapting to complexity	*Project Management Journal, 48*(6), 29-46. https://doi.org/10.1177/8756972817048006 04	Most of the important megaprojects met failure due to misunderstanding of expectations, extensive overruns, or both. The megaprojects are successful due to three major elements: a clear vision of strategies, total alignment, and coping with complexity.
4	Locatelli, Mikic, Kovacevic, Brookes & Ivanisevic	2017	The successful delivery of megaprojects: a novel research method.	*Project Management Journal, 48*(5), 78-94. https://doi.org/10.1177/8756972817048005 06	More often, megaprojects are associated with poor delivery performance and poor benefits realization which can be managed by employing Fisher's exact test and machine learning techniques. These help to identify the correlation between megaprojects' characteristics and performance and understanding of their causation.
5	Fuentes, Smyth & Davies	2019	Co-creation of value outcomes: a client perspective on service provision in projects	*International Journal of Project Management, 37*(5), 696-715. DOI: https://doi.org/10.1016/j.ijproman.2019.01.003	The medium- and long-term projects constantly fail to provide valuable outcomes because these mostly appear in the latter stages of a project, yet, they have a link back to the project definition phase.

Table A.9. Major theme eight: measurement/evaluation of project success models (5 papers, 6%)

Article-No. under the theme	**Authors of the articles**	**Year of publication**	**Title of the article**	**Name of journal, book or Thesis, and volume, issue, & DOI/Website**	**The essence of the paper and the major conclusion**
1	Petter	2008	Managing user expectations on software projects: lessons from the trenches	*International Journal of Project Management, 26*(7), 700-712. https://doi.org/10.1016/j.ijproman.2008.05.014	Inappropriate expectations of users can affect the success of projects but that can be managed by user involvement, leadership, and trust.
2	Raymond & Bergeron	2008	Project management information systems: an empirical study of their impact on project managers and project success	*International Journal of Project Management, 26*(2), 213-220. https://doi.org/10.1016/j.ijproman.2007.06.002	Project management information systems (PMIS) is a useful model/software which contributes project managers in successful project management, improvements in effectiveness and efficiency in managerial tasks, better project planning, scheduling, monitoring, and control that all consequent to success.
3	Shao, Müller & Turner	2012	Measuring program success.	*Project Management Journal, 43*(1), 37-49. https://doi.org/10.1002/pmj.20286	The program and project success can be measured using four dimensions, delivery capability, organizational capability, marketing capability, and innovative capability.

4	Missonier & Loufrani-Fedida	2014	Stakeholder analysis and engagement in projects: from stakeholder relational perspective to stakeholder relational ontology	*International Journal of Project Management, 32*(7), 1108-1122. https://doi.org/10.1016/j.ijproman.2014.02.010	They proposed Actor-Network Theory (ANT) to analyze stakeholders' engagement in a project which depends on the nature of the project, roles, and relations between stakeholders.
5	Davis	2017	An empirical investigation into different stakeholder groups perception of project success	*International Journal of Project Management, 35*(4), 604-617. ISSN 0263-7863, https://doi.org/10.1016/j.ijproman.2017.02.004	There is no theory to determine project success combining within the perspective of multiple stakeholder groups and success dimensions for a given project. This is omission using all stakeholder views and not a few selected to define project success.

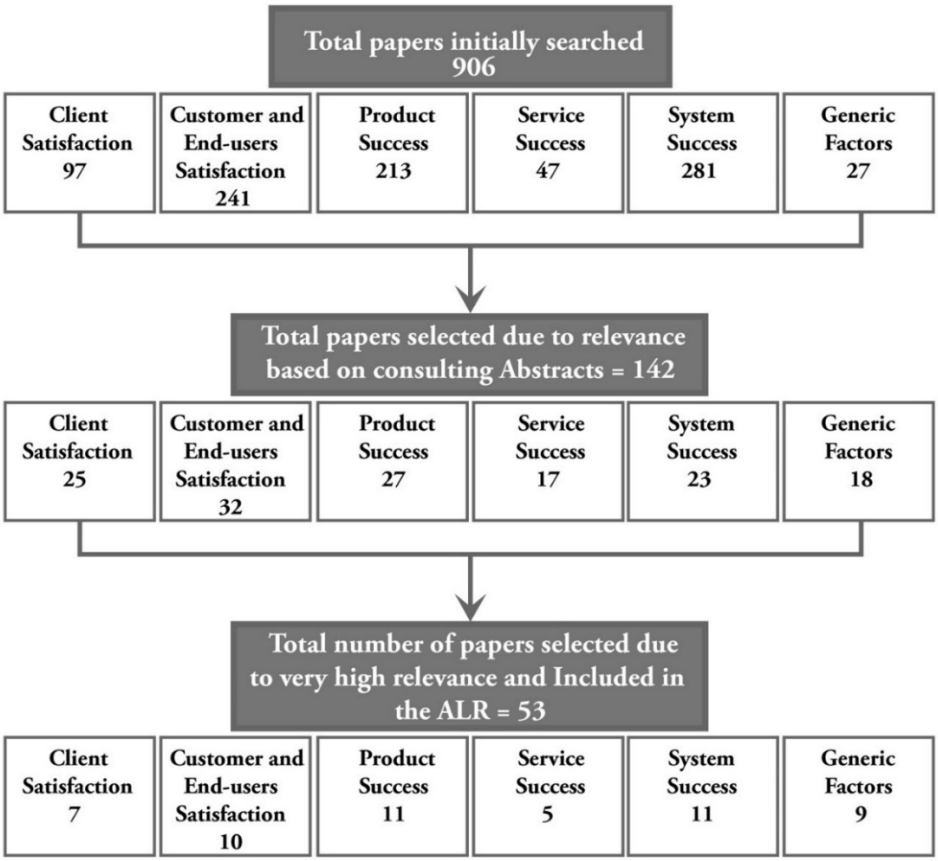
Table A.10. Major theme nine: deficiencies and gaps of past research (4 papers, 5%)

Article-No. under the theme	Authors of the articles	Year of publication	Title of the article	Name of journal, book or Thesis, and volume, issue, & DOI/Website	The essence of the paper and the major conclusion
1	Achterkamp & Vos	2008	Investigating the use of the stakeholder notion in project management literature: a meta-analysis	*International Journal of Project Management,26*(7), 749-757. https://doi.org/10.1016/j.ijproman.2007.10.001	The interests of stakeholders support the success of a project but only a few of the publications provide a clear definition and identification of stakeholders. A role-based stakeholder identification method can be a promising approach for this purpose.
2	Christenson & Walker	2008	Using vision as a critical success element in project management	*International Journal of Managing Projects in Business, 1*(4), 611-622. DOI: https://doi.org/10.1108/17538370810906291	A clear, well-articulated, and convincing vision of project outcomes when effectively communicated strongly impacted perceived project success. Four emergent issues are requiring further investigation, the benefits of an incremental or phased approach; the need for sustainment; the necessity of addressing horizontality, and the imperative of vision.
3	Albert, Balve & Spang	2017	Evaluation of project success: a structured literature review	*International Journal of Managing Projects in Business, 10*(4), 796-821. https://doi.org/10.1108/IJMPB-01-2017-0004	Barnes' ideas (Cost, Time, and Quality) are still an integral part of all approaches to success. The soft criteria (related to the satisfaction of stakeholder groups) could be substantiated. Factors influencing project success were not considered systematically in the past research and needed further research.
4	Haass & Guzman	2019	Understanding project evaluation: a review and reconceptualization	*International Journal of Managing Projects in Business, 13*(3), 573-599. DOI: https://doi.org/10.1108/IJMPB-10-2018-0217	The past project evaluation literature has mainly concentrated on the objective aspects of project evaluation and overlooked the subjective aspects that reflect the temporal, dynamic, complex, and subjective nature of projects.

The ILR was performed with reference to satisfaction of clients, customers, and end-users arising from projects (including products, services, systems, or occupancy performance).

In general, the ScienceDirect database was searched (for the period 2010 to 2020) for the collection of literature on marketing, psychology, information technology, post occupancy evaluation, success of product/service/system/occupancy and the satisfaction of various stakeholders (client, customers and end-users). In total, 906 articles were found using various keywords which were shortlisted to 142 after examination of the abstracts. However, all the shortlisted papers were not fully relevant to the subject matter being studied. Therefore, further screening was required. For that purpose, full texts were considered to ultimately select the most relevant articles, totalling 53, which have been included in the results (see Figure A.1). Key journals comprised Industrial Marketing Management (4 papers), Engineering, Construction and Architectural Management (3 papers), and International Journal of Information Systems and Project Management (2 papers). One paper each from all the other journals was found highly relevant to the subject matter. One reference was taken from a PhD dissertation.

Figure A.1. The screening and selection process of papers included in the ILR



Details for publications in each box shown in the last row of Figure A.1 are provided in Tables A.11 to 16 below.

Table A.11. Details of included papers relevant to client satisfaction (7 papers, 13%)

Name of Journal	Year, volume & Issue, pages	Authors	Title of the Article	Conclusions
Journal of Interprofessional Care	2018 32(2), 203-210, https://10.1080/13561820.2017.1395827	Zhao et al.	Assessing the quality of care through client satisfaction at an interprofessional student-run free clinic	Clients are highly satisfied with their experiences of performance of the student-run free clinics. Quality care is essential for the long-term retention of customers.
Journal of Management in Engineering	2014 30(1), 1-18 https://10.1061/(ASCE)ME.1943-5479.0000183	Rashvand & Abd Majid	Critical criteria on client and customer satisfaction for the issue of performance measurement	Expectation and perception are the two common critical satisfaction criteria for client and customer. Therefore, these must be considered where satisfaction is required.
Engineering, Construction and Architectural Management	2019 *26*(8), 1553-1573. https://10.1108/ECAM-04-2018-0181	He, Wang, Chan, Li & Chen	Identifying the gaps in project success research: a mixed bibliographic and bibliometric analysis	A review of a total of 164 peer-reviewed journal papers between 2007 and 2017 indicated that the largest number of published studies targeted the developed regions, whereas the papers related to the developing economies were lesser in number. Megaproject success, studies in developing countries, relationships between project success and human-related factors, and impacts on successful outcomes are directions for future study.
International Journal of Project Management	2017 35 (2017) 1639–1654 https://www.elsevier.com/locate/ijproman	Demirkesen & Ozorhon	Impact of integration management on construction project management performance	The integration of knowledge, processes, staff, supply chain, and changes; and management of performance, time, cost, quality, safety, and client satisfaction make the project successful and can satisfy clients and customers.
Journal of Construction Engineering & Management	2019 145(5), 05019006	Hussain, Fang & Zaigham	Examining influence of construction projects' quality factors on client satisfaction using partial least squares structural equation modeling	The lack of project quality directly affects client satisfaction while material-related factors were the two most significant factors for making a project successful.
International Journal of Information Systems and Project Management	2020 8(2), 49-78 https://10.12821/ijispm080203	Iriarte & Bayona	IT projects success factors: a literature review	There is no clear definition of project success concept in the past literature. Time, budget, project management, system quality, user satisfaction, and economic value are the most important project success criteria. There are some soft attributes as involvement, support, communication, and commitment.
Automation in Construction	29 (2013), 123–135. https://docs.google.com/document/d/1x5WSMo9fMtDtZQAaP2JsVu4mVKrkGk5NjaqsqRqJEEo/edit	Terry, Li, Ng & Skitmore	Evaluating stakeholder satisfaction during public participation in major infrastructure and construction projects: a fuzzy approach	Sometimes special interests of various stakeholders can be affected, positively or negatively by the implementation of an infrastructure project while their participation can solve this issue. The evaluation of the satisfaction of stakeholders can prove useful for which these authors introduced a model.

Table A.12. Details of included papers relevant to customers and end-user satisfaction (10 papers, 19%)

Name of Journal	Year, volume & Issue, pages	Authors	Title of the Article	Conclusions
Applied Clinical Informatics	2010 1 (2010), 268–285 http://10.4338/ACI-2010-03-RA-0020	Hoonakker, Carayon & Walker	Measurement of CPOE end-user satisfaction among ICU physicians and nurses	Testing of most of the questionnaires used for measuring end-user satisfaction for their reliability and validity indicated that many of these were reasonable, reliable, and valid. However, only one questionnaire, the Physician Order Entry User Satisfaction and Usage Survey (POESUS) met most of the criteria they developed for this purpose. The use of the POESUS showed that users are moderately satisfied with CPOE.
Total Quality Management	2010 21(11), 1103-1119. https://10.1080/14783363.2010.529329	Wang, Feng & Hsieh	A stakeholder perspective on urban transport system service quality	The importance-performance analysis revealed the existence of gaps between stakeholder expectations and fulfillment in transport infrastructure and services projects. Stakeholders are more concerned with reliability and safety dimensions during project delivery.
Project Management Journal	2012 43(5), 87–99. https://10.1002/pmj.21289	Turner & Zolin	Multiple perspectives by multiple stakeholders over multiple time frame	The large project may have many stakeholders and their lifetime output can last for years, or even decades. So, the interests of stakeholders remain to change as well. Such indicators must be developed which cover the entire life of projects and satisfy all stakeholders (Executives, managers, contractors, suppliers, customers, end-users, and community in case of government development projects). They suggested parameters like project planning, stakeholders' engagement, stakeholders' satisfaction, profitability, product specifications, and efficiency.
Energy and Buildings	2012 49, 471–478. https://docs.google.com/document/d/1nqCkgVbCwpOKx--tMNhK_cKAMEaAEP06c1VzPSaAnM0/edit	Mlecnik, Schütze, Jansen, de Vries, Visscher & van Hal	End-user experiences in nearly zero-energy houses	The post-occupancy evaluation study indicated that summer comfort design and the quality of heating and ventilation systems (indoor air quality) are critical factors that must be addressed to improve user satisfaction in nearly zero-energy dwellings in the Netherlands because of higher end-user satisfaction levels are key for the acceptance of houses.
Engineering, Construction, and Architectural Management	2017 24 (5), 736-756. https://10.1108/ECAM-07-2016-0159	Chan & Oppong	Managing the expectations of external stakeholders in construction projects	PMs can play safe by acknowledging the stakeholder expectations and employ such strategies to curtail resulting impacts and maximize mutual benefits. The list of expectations could also be used to promote equitable value optimization in projects, enhance needs fulfillment, and facilitate the evaluation of external stakeholder satisfaction.
European Journal of Information Systems	2017 26(4), 333-360. https://10.1057/s41303-016-0029-7	Laumer, Maier & Weitzel	Information quality, user satisfaction, and the manifestation of workarounds: a qualitative and quantitative study of enterprise content management system users	The information systems can be employed to evaluate the satisfaction of end-users for which the quality of information should be very good.

Journal of Medical Systems	2019 43 (2019), 36-51. https://10.1007/s10916-019-1161-4	Garcia & Adelakun	A conceptual framework and PiGroup study for examining telemedicine satisfaction research	Stakeholder satisfaction is often considered a key to the success of telemedicine systems. however, satisfaction evaluations vary in project designs and include satisfaction dimensions, stakeholders, type of care, type of system, context, and methodologies.
Sustainability	2020 *12* (2020), 2995, 1-29. https://10.3390/su12072995	Bughio, Schuetze & Maher	Comparative analysis of indoor environmental quality of architectural campus buildings' lecture halls and its' perception by building users, in Karachi, Pakistan	The research study found that users are dissatisfied with existing hot and humid indoor environment conditions caused by interactions of local outdoor climate conditions, the building's architecture, and inadequate ventilation within the building. Thus, the project planning was inappropriate to implement a successful project.
International Journal of Construction Management	2020 February 2020 (online). https://10.1080/15623599.2020.1721177	Ingle & Mahesh	Construction project performance areas for Indian construction projects	There are 10 areas for assessing project performance, customer relation, safety, schedule, cost, quality, productivity, finance, communication and collaboration, environment, and stakeholder satisfaction. The validity of all performance areas was established by confirmatory factor analysis.
International Journal of Information Systems and Project Management	2020 8(2), 49-78 https://10.12821/iijispm080203	Iriarte & Bayona	IT projects success factors: a literature review	Time, budget, project management, system quality, user satisfaction, and economic value are the most important project success criteria. There are some soft attributes as involvement, support, communication, and commitment.

Table A.13. Details of included papers relevant to product success (11 papers 21%)

Name of Journal	**Year, volume & Issue, pages**	**Authors**	**Title of the Article**	**Conclusions**
Industrial Marketing Management	2003	Huang, Soutar & Brown	Measuring new product success: an empirical investigation of Australian SMEs	The investigations of 276 SMEs from the two most innovative industries: the chemical and machinery industries of Australia revealed that four factors are important for product success measurement: financial performance, objective market acceptance, subjective market acceptance, and product-level measures.
System Engineering	2010 13, 389-404. https://10.1002/sys.20158	Hanawalt & Rouse	Car wars: factors underlying the success or failure of new car programs	Assessing (by seven experts) factors associated with automobile manufacturing often born from financial and corporate responses to the market crisis. So, financial and corporate responses in the market, coupled with leadership, are the central success factors.
International Journal of Market Research	2013 55 (1), 80-104 https://10.2501/IJMR-2013-008	Creusen, Huitink & Eling	Choice of consumer research methods in the front end of new product development	The insights of the consumer are most important for new product success. The methods used to assess consumers' requirements are important and must be selected from case to case.

Asia Pacific Business Review	2013 *19*(3), 303-319. https://10.1080/00346764.2013.774190	Huang & Tsai	Exploring the drivers of new product success for businesses in Asia: a meta-analysis	Success predictors for products of Asian firms are market orientation, marketing synergy, technological synergy, product advantage, product innovativeness, cross-functional integration, top management support, pre-development proficiency, technological proficiency, market potential, and technological turbulence. The major performance difference is the disparity between low-technology and high-technology products.
Industrial Marketing Management	2014 43 (2014), 862–872	O'Cass & Sok	Achieving new product success via the synchronization of exploration and exploitation across multiple levels and functional areas	The findings revealed that the exploitative product innovation and marketing is significantly better over separate left- and right-hand capabilities create distinct positional advantages to customers in the form of both differentiation and cost-efficiency. These positional advantages help to better explain the effects of exploratory and exploitative capabilities on new product market performance.
Foundations of Management	2014 5(2),8-21. https://10.1515/fman-2015-00077	Relich & Bzdyra	Estimating new product success with the use of intelligent systems	The success factors in new product development and selecting a new product portfolio are identified as an enterprise system, project management, marketing, and customer comments concerning. The model of measuring the success of a product includes the indicators such as duration and cost of product development and net profit from a product.
Industrial Marketing Management	2017 61, 170–181 https://10.1016/j.indmarman.2016.06.001	Zhang & Wu	Leveraging internal resources and external business networks for new product success: a dynamic capabilities perspective	A firm's business network power to sense and seize opportunities and creating vital dynamic capabilities impact the internal and external resources during the creation of a new product. Such dynamic capability also plays an important role in the new product's success.
Business Strategy and the Environment	2018 28(1), 88-97. https://10.1002/bse.2205	Song, Ren & Yu	Bridging the gap between corporate social responsibility and new green product success: the role of green organizational identity	A study of 150 companies in China indicted that corporate social responsibility can indirectly and positively affect new green product success and organizational identity. Therefore, managers must enhance their organizational sense of green identity and improve their organizational green adaptability resulting in their firm's sustainable development.
International Journal of Research in Marketing	2019 36 (2019), 39–62. https://10.1016/j.ijresmar.2018.09.007	Nguyen & Chaudhuri	Making new products go viral and succeed	An analysis of millions of consumers regarding 345 automobile products indicated that more innovative products generate more eWOM (electronic word-of-mouth) volume but surprisingly less positive sentiment. However, the use of rich-content communication, pre-announcement, and co-branding strengthens product innovativeness.
Asian Business Management	2019 18 (2019), 51–71. https://10.1057/s41291-018-0046-6	Wu & Wu	ISO certification and new product success in an emerging market	The performance of new product performance of 878 manufacturing and service firms indicated that ISO 9000 certification helped to promote new product success. It reduced the information asymmetry and increasing the firm's potential buyers in an emerging market. If the quality of local institutions is better, the local certification also creates a positive effect.

International Journal of Technology	2020 11(2) 322-332. https://10.14716/ijtech.v11i2.3428	Setyaningrum Subagyo & Wijaya	A mathematical model of factors driving product success in an Indonesian market using design of experiment	The study utilized 304 products from the Indonesian market and suggested that six standardized factors affected the success of various products: (1) price, (2) product performance, (3) brands, (4) aesthetic design, (5) services, and (6) marketing. These factors positively correlated to the increase in market share.

Table A.14. Summary of included papers relevant to service success (5 papers, 9%)

Name of Journal	Year, volume & Issue, pages	Authors	Title of the Article	Conclusions
Creativity and Innovation Management	2015 24(3), 478-493	Beltagui, Darler & Candi	Measuring the deliverable and impressible dimensions of service experience	The findings suggested that the customers perceive and can respond to the service employees and environment. These findings reinforce the tradition of emphasis on a few dimensions which are absorption, adventure, community, and spontaneity.
Public Management Review	2018 18(1), 65-90. https://10.1080/14719037.2014.957343	Högström, Lütgren & Johnson	Relevant and preferred public service: a study of user experiences and value creation in public transit	Public service success depends on the creation of value that can attract users. The study involving twenty-five public services and 930 users indicated that strategic choices and prioritization between various service requirements affect both the effectiveness and efficiency of service offerings.
International Journal of Information Management	2017 37 (2017), 1418–1427. https://10.1016/j.ijinfomgt.2016.10.004	Park, Kim & Kim	Investigating factors influencing the market success or failure of IT services in Korea	The investigations identified the critical factors affecting the market services in Korea. The success or failure factors were: (i) The success of services was mainly due to meeting customer needs (ii) Low facility investment costs (iii) Service competitiveness (iv) Support of ecosystem (v) Active marketing activities. (vi) The absence of a business model was related to the partial success of services. (vii) Government policy affected service success or failure
Industrial Marketing Management	2020 84 (2020), 105–125. https://10w.1016/j.indmarman.2019.06.004	Lexutt	Different roads to service success: a configurational analysis of financial and non-financial service performance	A service-oriented corporate culture, decentralized decision-making, and management commitment to services are identified as necessary for good service provision.
Sustainability	2020 12 (2020), 5119, 1-21	Um, Kim & Chung	How does an intelligence chatbot affect customers compared with self-service technology for sustainable services?	Many hotels are adopting sustainable service innovations (including robots, kiosks, and chatbots for service automation) to gain competitive advantages. The SST (Self- service technology) showed more positive perceptions by customers' successful service situation. The novelty and the need for interaction characteristics of customers showed significant differences in terms of service success and failure, respectively.

Table A.15. Summary of included papers relevant to system success (11 papers, 21%)

Name of Journal	Year, volume & Issue, pages	Authors	Title of the Article	Conclusions
The Journal of Systems and Software	2011 84 (2011), 2065–2078. https://10.1016/j.jss.2011.05.017	Ifinedo	Examining the influences of external expertise and in-house computer/IT knowledge on ERP system success	The essential factors for the success of complex information technology (IT) systems are external expertise and internal computer skills, including enterprise resource planning (ERP). The results of this research confirmed that external expertise (an exogenous factor) and internal computer/IT knowledge (endogenous factors) are pertinent to enhance the success of the ERP system of any organization.
Computers & Education	2012 Computers & Education, 58 (2012), 88-99.	Lin & Wang	Antecedents to continued intentions of adopting e-learning system in blended learning instruction: a contingency framework based on models of information system success and task-technology fit	The learner behaviour is affected by internal factors of perceived usefulness/system satisfaction and the strategy adopted by the instructors. Hence, the university should invest in developing/maintaining the e-learning system. it should also promote the system both among lecturers and students.
Journal of Biomedical Informatics	2012 45 (2012), 566–579. https://10.1016/j.jbi.2012.02.009	Aggelidis & Chatzoglou	Hospital information systems: measuring end-user computing satisfaction (EUCS)	During the past decade, many hospitals particularly in Greece, have implemented new hospital information systems (HISs) for automation. The results of the study proved usability and the generalizability of the EUCS (end-user computing satisfaction) system. instrument and its robustness as a valid measure of computing satisfaction and a surrogate for system success in a variety of cultural and linguistic settings. Although the psychometric properties of EUCS appear to be robust across studies and user groups, it should not be considered as the final chapter in the validation and refinement of these scales.
The Electronic Library	2015 33(6), 1174-1192. https://10.1108/EL-06-2014-0094	Huang, Pu, Chen & Chiu	Development and evaluation of the mobile library service system success model: a case study of Taiwan	The mobile library service system had a positive correlation with the usage status and students' satisfaction. Thus, the system might help them for improving their work efficiency, like reducing time spent searching for books and the cost of obtaining electronic resources. The students were also willing to continue using the mobile library service system.
Empirical Software Engineering	2015 20 (2015), 28–81. https://10.1007/s10664-013-9278-4	Abelian & Paech	Understanding the influence of user participation and involvement on system success: a systematic mapping study	An overview revealed, in most of the papers, positive correlations between aspects of development processes (including user participation), human aspects (including user involvement), and system success. The proposed solutions, from the method papers, were user participation and involvement in most of the activities within software development.

International Journal of Information Management	2017 37 (2017), 269–28. https://10.1016/j.ijinfomgt.2017.03.003	Fang, Zhao, Wen & Wang	Design and performance attributes driving mobile travel application engagement	The engagement (customer attraction and retention) of the customer with mobile travel applications is becoming highly important for travel-related companies due to the rising interest of people in traveling and tourism. This study proved the effectiveness of application design and application performance attributes. It was noticed that two application design features (user interface attractiveness and privacy/security) and three application performance attributes (compatibility, ease of use, and relative advantages) are important drivers of users' engagement to mobile travel applications.
Information Development	2017 33(1) 80–96. https://10.1177/0266666916639632	Vongsraluang & Bhatiasevi	The determinants of social commerce system success for SMEs in Thailand	The success of a social commerce system is related significantly to its use and user satisfaction and can be measured in terms of organizational benefits. Three factors are associated positively with system use: system quality, service quality, and trust. These three factors lead to user satisfaction.
International Journal of Hospitality Management	2019 77 (2019), 19-30. https://10.1016/j.ijhm.2018.06.002	Wang, Tseng, Wang, Shih & Chan	Developing and validating a mobile catering app success model	A mobile application can have components of product quality, perceived price, perceived promotions, and eWOM to form an e-commerce system success model. It was found that perceived value influences eWOM more strongly than does user satisfaction while user satisfaction affects intention to reuse more strongly than does perceived value.
Education and Information Technologies	2019 24 (2019),1173–1184. https://10.1007/s10639-018-9821-4	Kurt	Examining an e-learning system through the lens of the information systems success model: empirical evidence from Italy	The students' perception through the e-learning system employing the Information Systems Success Model (IS Success Model) is strengthening. Self-reported perception evaluations data of 144 students indicated that system quality significantly impacts system usage and user satisfaction, whereas information quality has a significant impact only on user satisfaction which may cause system success.
Interactive Learning Environments	2020 06 February 2020 (online). https://10.1080/10494820.2020.1723113	Zhang, Cao, Shu & Liu	Identifying key factors affecting college students' adoption of the e-learning system in mandatory blended learning environments	The system analysis indicated that system quality (SQ), social influence (SI), and facilitating conditions (FC) positively affect behavioural intention (BI) while information quality (IQ) has no impact on BI. The relationship among FC, BI, and user behaviour (UB) was found as non-significant. The male college students are more susceptible to the impact of system quality and social influence.
Open Engineering	2020 10(1), 282–293. https://10.1515/eng-2020-0003	Gao, Puryasana & Matsuo	Evaluating ERP system merging success in chemical companies: system quality, information quality, and service quality	The ERP (Enterprise Resource Planning System) is successful in increasing the system quality and easiness of use in a Chemical Company. The information emerged much more integrated and accurate after the ERP system merging. Besides, service quality was increased due to all activities and processes occurring in one efficient log system and monitored and handled one support team, an expert in IT applications.

Table A.16. Summary of enlisting satisfaction antecedents, attributes, and questionnaire/scale development (9 papers, 14%)

Name of Journal	Year, volume, The issue, pages, & DOI	Authors	Title of the Article	Conclusions
Book	2007 Reinventing project management: The diamond approach to successful growth and innovation. Boston, MA: Harvard Business School Press.	Shenhar & Dvir	-	Customer and end-user factors are meeting their satisfaction, loyalty, requirements, specification of the product/service, benefits, and usability.
Book	2009 The handbook of project-based management: Leading strategic change in organizations (3rd ed.). London, UK: McGraw-Hill.	Turner	-	The new asset must produce a product or provides a service easy to operate and consumers want to buy it.
Project Management Journal	2012 21289 (online), 1-13. https://10.1002/pmj.21289	Turner & Zolin	Forecasting success on large projects: developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames	Consumers' interest lies in the price of product/service benefit, features, competitive advantage, technological innovation, and development with time
Ph. D. Dissertation	2013 The Faculty of the C.T. Bauer College of Business University of Houston, Texas, USA	Vaezi	User satisfaction with information systems: a comprehensive model of attribute satisfaction	This study investigated the effects of three aspects of user satisfaction, information satisfaction, system satisfaction, and service satisfaction within an Information system. The author defined seven attributes in an Information System which are reliability, currency, accuracy, understandability, format, completeness, and credibility. However, the author also referred to 29 variables, from previous authors, having relation to consumers' satisfaction.
International Journal of Business and Management Invention (Online)	2016 3 (8), 79-84 https://www.ijbmi.org	Almsalam	The effects of customer expectation and perceived service quality on customer satisfaction	The relationship of the two most important antecedents of customer satisfaction (customer expectation and perceived service quality) and customer satisfaction was studied. Data of 250 customers from the 5 Banks in Damascus, Syria indicated that customer expectation and perceived service quality have a positive effect on customer satisfaction.
International Journal of Project Management	2014 32(7), 1108-1122 https://10.1016/j.ijproman.2014.02.010	Missonier & Loufrani-Fedida	Stakeholder analysis and engagement in projects: from stakeholder relational perspective to stakeholder relational ontology	The findings demonstrate that the ANT (Actor-Network Theory) approach can improve the analysis and engagement of stakeholders in any project. The relationships between stakeholders co-evolve with the project's definition and trajectory. Consequently, project managers can adopt a relevant approach that enables them what, when, and how to observe in stakeholder project networks.

Project Management Journal	2018 49 (5), 38-47. https://10.1177/8756972818786663https://doi.org/10.1177/8756972818786663	Davis	Reconciling views of project success: a multiple stakeholder model	A new model comprising of all the important critical attributes to measure project success among different stakeholder groups. The project failure is a result of the interpretations of criteria and factors differently by multiple stakeholder groups. Some projects must have unique outcome parameters that must be monitored and controlled to minimize the chances of failure. Testing of their model may help more informed decision-making.
Electronic Commerce Research and Applications	2018 29 (May-June 2018), 1-11. https://10.1016/j.elerap.2018.03.003	Wang, Lu & Tan	Impact of product attributes on customer satisfaction: an analysis of online reviews for washing machines	For estimating the impact of various product attributes on scores of customer satisfaction, a logistic regression model was proposed by the authors. As the nature of the product is important in deciding attributes of satisfaction, for washing machines product properties impacting users' satisfaction are drainage mode, loading type, frequency conversion, display, color, and capacity. Although, the impact of the price is important but cheap and expensive purchasers should be considered differently.
Frontiers in Public Health	2018 6 (June 2018), Article 49. https://10.3389/fpubh.2018.00149	Boateng, Neilands, Frongillo, Melgar-Quiñonez & Young	Best practices for developing and validating scales for health, social, and behavioral research: a primer	Measuring and evaluating work and performance are critical in the fields of health, social, and behavioral sciences which need Scale development and validation. Three phases and nine steps have been identified in this study. The first phase is meant for the generation and validation of items and their content while in the second phase scales are constructed which include pre-testing the questions, administering the survey, reducing the number of items, and understanding how many factors the scale captures. During the third phase, the scale is evaluated, and the number of dimensions, reliability, and validity are assessed.

Appendix 2: Qualtrics® online survey

This appendix presents the survey instrument used to collect end-user responses concerning opinions and relevance for each of the attributes across desirable, adaptable, practicable, and serviceable critical success factors. The Gold Coast Light Rail (GCLR) project was used as the example provided. A few demographic questions were included in case it might be necessary to interpret the findings. The first question seeks ethical consent to participate. The survey is estimated to take 10 minutes to complete.

For each set of attributes, end-users can add up to two personal attributes if they feel something important was not included in the generic list. This opportunity was seldom taken up by respondents.

The survey has embedded checks to ensure that entered data are complete. Respondents can move backwards should they wish to reconsider an earlier response. Only surveys that answered all questions were included in the analysis.

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EXPLANATORY STATEMENT

This Survey forms part of a research project on "Measuring End-User Delight: Is Success in Project Design and Delivery Enough?" with BUHREC Protocol Number (MA03051) by Bond University as part of our PhD research.

The survey is intended to apply to any "project" which could include a physical product, service or asset (such as a building or other infrastructure). The purpose is to gauge user satisfaction based on four categories: desirable (attractiveness), adaptable (flexibility), practicable (fit for purpose), and serviceable (enduring). Each category is divided into ten generic attributes plus two users defined attributes.

Some attributes may not relate to every project type, and in this case, you can ignore them by selecting 'no opinion' in your response.

When questions refer to the "Project", it means the (G:link | Gold Coast Light Rail).

This online survey should take on average about 10 minutes to complete. Participation in this research is entirely voluntary, and there are no known or anticipated risks to your involvement.

Your identity and the data you provide will be anonymous and will not be able to be identified by anyone. Once the project is complete, you are welcome to request a digital copy of the work. Your anonymous response will be kept in a secure place for 5 years, and then appropriately destroyed.

Should you have any further questions regarding the nature of this study, please contact the Chief Researcher, Professor Craig Langston, at clangsto@bond.edu.au or (07) 5595 2233.

PARTICIPANT CONSENT

I certify that I am at least 18 years old and that I am willing to participate in the Bond University research project described in the above Explanatory Statement.

I clearly understand the purpose and objectives of the study, its limits and the risks associated with participation.

I am aware that my identity will be kept confidential and will not be revealed in any written report or to any other party. The information generated from me will be securely kept at the Chief Investigator's office located at Bond University and destroyed at the appropriate time.

I have read the Explanatory Statement, and I understand that the information I provide will be anonymous. At any time should I feel uncomfortable, I am aware that I can withdraw from the research without penalty.

Please indicate your consent to proceed

◉ I agree

Survey Completion

0% 100%

→

Survey Powered By Qualtrics

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1. Demographics

Within the context of this project **(G:link | Gold Coast Light Rail),** please answer the following demographic questions.

1.1 What is your age:

18-24	25-35	35-44	45-54	55+
○	○	○	○	○

1.3 On average, how frequent do you use the G:link | Gold Coast Light Rail?

Less than once a week	Once a week	A few times a week
◉	○	○

Survey Completion

0% 100%

← →

Survey Powered By Qualtrics

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2. Within the context of this project please tell us about your personal opinion by indicating the extent to which the project achieved the following attributes, and by indicating how important that attribute is to you?

Please tick for both opinion and relevance:

Opinion: your perception of the extent to which the project achieved each attribute.
Relevance: how important the attribute is to you when using the project?

If the attribute has no meaning in this project, then choose no "No opinion" for that attribute.

2.1 DESIRABLE

	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Nice to look at ?	○	○	○	○	○	○	○	○	○	○
High quality?	○	○	○	○	○	○	○	○	○	○
Profitable?	○	○	○	○	○	○	○	○	○	○
Well-designed?	○	○	○	○	○	○	○	○	○	○
Valuable?	○	○	○	○	○	○	○	○	○	○
Prestigious?	○	○	○	○	○	○	○	○	○	○
Durable?	○	○	○	○	○	○	○	○	○	○
Popular?	○	○	○	○	○	○	○	○	○	○
Joyful?	○	○	○	○	○	○	○	○	○	○
Unique?	○	○	○	○	○	○	○	○	○	○

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	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○

Survey Completion
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Please tick for both opinion and relevance:

Opinion: your perception of the extent to which the project achieved each attribute.
Relevance: how important the attribute is to you when using the project?

If the attribute has no meaning in this project, then choose no "No opinion" for that attribute.

2.2 ADAPTABLE

	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Versatile?	○	○	○	○	○	○	○	○	○	○
Easily modified?	○	○	○	○	○	○	○	○	○	○
Able to be customized?	○	○	○	○	○	○	○	○	○	○
Multi-use?	○	○	○	○	○	○	○	○	○	○
Transportable?	○	○	○	○	○	○	○	○	○	○
Better with age?	○	○	○	○	○	○	○	○	○	○
Modular?	○	○	○	○	○	○	○	○	○	○
Scalable?	○	○	○	○	○	○	○	○	○	○
Technically clever?	○	○	○	○	○	○	○	○	○	○
Timeless?	○	○	○	○	○	○	○	○	○	○

	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○

Survey Completion
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Please tick for both opinion and relevance:

Opinion: your perception of the extent to which the project achieved each attribute.
Relevance: how important the attribute is to you when using the project?

If the attribute has no meaning in this project, then choose no "No opinion" for that attribute.

2.3 PRACTICABLE

	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Functional?	○	○	○	○	○	○	○	○	○	○
Appropriate?	○	○	○	○	○	○	○	○	○	○
Robust?	○	○	○	○	○	○	○	○	○	○
Safe?	○	○	○	○	○	○	○	○	○	○
Healthy?	○	○	○	○	○	○	○	○	○	○
Problem-solving?	○	○	○	○	○	○	○	○	○	○
Easy to use?	○	○	○	○	○	○	○	○	○	○
Affordable?	○	○	○	○	○	○	○	○	○	○
Comfortable?	○	○	○	○	○	○	○	○	○	○
Ethical?	○	○	○	○	○	○	○	○	○	○

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	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○

Survey Completion
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Please tick for both opinion and relevance:

Opinion: your perception of the extent to which the project achieved each attribute.
Relevance: how important the attribute is to you when using the project?

If the attribute has no meaning in this project, then choose no "No opinion" for that attribute.

2.4 SERVICEABLE

	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Low maintenance?	○	○	○	○	○	○	○	○	○	○
Easily cleaned?	○	○	○	○	○	○	○	○	○	○
Recyclable?	○	○	○	○	○	○	○	○	○	○
Non-toxic?	○	○	○	○	○	○	○	○	○	○
Repairable?	○	○	○	○	○	○	○	○	○	○
Energy efficient?	○	○	○	○	○	○	○	○	○	○
Reliable?	○	○	○	○	○	○	○	○	○	○
Accessible?	○	○	○	○	○	○	○	○	○	○
Regenerative?	○	○	○	○	○	○	○	○	○	○
Habitat-safe?	○	○	○	○	○	○	○	○	○	○

Done

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	Opinion					Relevance				
	Strongly agree	Agree	No opinion	Disagree	Strongly disagree	Very important	Slightly important	Neutral	Slightly unimportant	Not important
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○
Any other attributes? Please specify:	○	○	○	○	○	○	○	○	○	○

Survey Completion
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We thank you for your time spent taking this survey.
Your response has been recorded.

Survey Completion

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Appendix 3: Ethics approval

BOND UNIVERSITY

HUMAN RESEARCH
ETHICS COMMITTEE
Bond University
Gold Coast Queensland 4229
Australia

Phone: +61 7 5595 4194
(from overseas)

Email: ethics@bond.edu.au

ABN 88 010 694 121
CRICOS Provider Code 00017B

24 May 2019

Craig Ashley Langston
Faculty of Society & Design
Bond University

Dear Chief Investigator

Project: **MA03051: Measuring End-User Delight: Is Success in Project Design and Delivery Enough?**
Researchers: **Craig Ashley Langston, Muath Abu Arqoub**

I am pleased to confirm that your project was reviewed by Bond University Human Research Ethics Committee. The proposal meets the requirements of the National Statement on Ethical Conduct in Human Research (2007) and you have been granted approval to proceed.

The Committee requires, as a condition of approval, that all investigations be carried out in accordance with the National Statement and continued approval is subject to conduct of the research in accordance with the requirements set out in the National Statement.

Approval is given subject to the protocol of the study being undertaken as described in your application, and approved amendments. As you may be aware the Ethics Committee is required to report annually on the progress of research it has approved. We would greatly appreciate if you could respond promptly and fully to the request for information on this project which will be distributed in March/April each year.

Under the terms of the National statement BUHREC has a role to monitor approved research projects and if necessary may withdraw approval. Conduct of unapproved research or deviation from the approved protocol may constitute academic misconduct and will be investigated in accordance with the Guide to Managing and Investigating Potential Breaches of the Australian Code for the Responsible Conduct of Research. Please refer to the Research Ethics website for more detail on Research Integrity and Bond University processes for dealing with instances of research misconduct.

You are reminded that the Principal Investigator must immediately report anything that might warrant review of ethical approval of the project. Should you have any queries or experience any problems, please contact us promptly.

We wish you well with your research project.

Yours sincerely

Dr Mark Bahr
Chair Bond University Human Research Ethics Committee

bond.edu.au

Appendix 4: Primary data

This appendix sets out the primary data collected from the Qualtrics® online survey. There were seven case studies investigated, comprising:

Group 1 (small projects/pilot):

1. *Sports Centre:* this project is an example of product creation, designed as an asset for a university campus.
2. *Cinema Complex:* this project is an example of a service provision, designed as an entertainment venue with associated retail and food service spaces.
3. *iLearn Platform:* this project is an example of a system development, design as learning management software supporting learning and teaching activities.
4. *HSM Building:* this project is an example of an inhabited building to cater for students, staff and visitors.

Group 2 (large projects/megaproject):

5. *HZMB:* this project is an example of product creation, designed as an asset linking Hong Kong with Macau across the Pearl River Delta.
6. *BEUE:* this project is an example of service provision, designed as supplying electricity to households in rural Bangladesh.
7. *GCLR:* this project is an example of system development, designed as a public transport network of trams and stations to service the Gold Coast community.

Case studies 5 and 6 required translations from English to local language and were assisted by a third-party data collection agency. The remainder of cases were conducted in English.

CASE STUDY: SPORTS CENTRE (PRODUCT CREATION) GROUP 1

DESIRABLE

Nice to look at?	8 8 1 8 -4 2 2 -6 3 -1 6 1 2 -1 -3 -4 5 5 3 5 4 4 8 8 1 6 1 1 8 5 4 5 5 1 8 -5 -5 8 8 1 5 1 8 5 1 -6 -4 1 -8 -3 -4 6 4 -2 4 -4 4 1 1 4 5 4 8 5 -4 4 -4 8 1 1 1 5 -5 4 -5 5 8 4 1
High quality?	8 1 1 4 -3 3 -1 4 -5 2 -2 -8 -1 5 5 -8 3 6 5 4 5 5 5 4 5 5 8 4 1 8 5 1 8 4 4 5 5 1 1 5 8 1 1 5 5 4 1 -2 -2 2 8 -1 -4 4 6 4 4 5 -4 1 4 1 5 5 8 4 -5 4 -4 4 -5 1 5 8 5 1 -5 1 4 4 4 5
Profitable?	1 3 -4 1 -1 4 -1 -4 2 8 1 -6 6 3 4 1 3 5 5 4 5 5 4 4 4 1 4 6 8 5 1 8 5 8 5 5 8 6 -5 1 1 1 5 1 6 -4 4 1 8 -8 8 6 -4 -6 5 4 4 -4 4 1 4 1 5 5 -5 4 -5 4 -4 4 8 8 5 8 5 1 -5 1 4 4 8 1
Well-designed?	8 8 4 2 5 1 3 1 6 -5 -2 2 8 1 4 5 5 4 8 8 4 5 4 1 8 5 4 1 1 8 4 1 1 5 8 5 -5 5 1 1 5 8 8 6 4 1 -2 3 4 6 4 4 8 8 -8 5 4 4 4 5 8 4 1 5 5 -5 4 4 -8 4 4 8 1 5 5 5 -5 5 -4 8 1
Valuable?	5 8 -2 -5 -3 -8 4 -2 -6 3 -2 -5 2 1 5 1 1 5 8 5 4 4 8 8 5 1 5 1 1 1 1 1 4 1 1 -5 1 1 5 1 8 8 4 1 2 5 2 2 -4 -1 1 -5 2 1 4 4 4 5 8 4 5 5 5 -5 4 -5 8 -8 4 5 -4 1 5 4 4 5 1 4 -4 4 1
Prestigious?	4 5 1 -2 2 -4 2 6 4 4 -4 -2 -3 1 5 1 5 5 8 5 5 4 8 8 4 5 8 1 5 5 1 5 1 4 -5 -5 1 5 8 5 8 5 8 -6 6 3 -1 4 4 -8 2 4 4 -4 5 4 4 5 1 -5 4 -5 8 -8 4 1 1 4 -5 4 5 1 8 -4 4 1
Durable?	1 4 3 -5 4 -4 4 -6 -2 1 1 4 2 1 -1 8 2 5 4 5 4 1 8 4 5 4 8 8 5 8 1 8 1 8 1 1 4 1 5 -5 -5 1 1 8 5 1 8 5 8 -8 -2 -3 4 -5 5 -5 2 5 4 -4 -4 4 4 1 8 -5 5 -1 4 -8 4 -4 1 1 8 -5 4 5 5 8 -4 5 1
Popular?	8 8 4 1 -5 1 8 -4 5 1 -1 -6 5 3 -2 -4 8 3 4 1 8 4 5 4 4 8 4 5 8 1 1 1 4 1 4 1 1 -5 -5 1 1 8 5 1 8 1 5 1 -1 3 5 -8 6 -1 2 -8 4 4 4 -4 8 4 1 4 1 -5 5 -1 4 -1 5 -4 8 1 4 -5 1 5 4 1 -4 4 1
Joyful?	5 1 -1 4 -3 -2 3 -6 -1 -1 -2 3 1 4 1 8 4 1 1 4 5 3 4 8 8 1 5 1 1 1 5 8 1 1 1 -4 8 8 8 1 8 8 5 1 4 2 4 4 2 -4 6 2 8 5 4 4 5 -4 5 5 8 4 1 -1 4 -4 8 -1 8 -5 -5 8 5 -5 1 8 1 -4 1
Unique?	4 5 -2 8 -4 -8 4 4 -4 4 3 8 -8 -2 2 -8 2 -5 -1 1 5 5 1 1 5 5 3 5 1 2 1 1 1 1 1 1 8 1 4 1 5 -5 5 8 8 4 8 5 1 5 1 5 -1 4 8 3 -1 -4 -6 5 1 5 -4 5 5 8 5 1 -1 4 -4 1 -1 8 -5 -5 1 1 -1 1 5 8 1 -4 1
User-defined …	
User-defined …	

ADAPTABLE

Versatile?	4 2 4 2 -4 -2 -2 -8 -4 5 8 -6 -3 -2 4 -1 5 -3 5 5 4 4 1 8 5 2 4 8 5 5 8 1 8 5 1 -4 4 1 1 1 -4 -5 -8 4 1 -6 4 1 6 -6 4 -4 -5 4 -1 1 8 1 1 4 -5 5 -4 4 -4 1 1 -5 1 5 -1 -1 5 -5 1 5 -4 4 5
Easily modified?	4 5 4 2 -4 6 8 -2 4 3 2 1 -2 1 1 1 6 3 5 1 4 5 4 1 8 4 5 2 4 4 8 1 4 4 1 8 1 8 5 5 -4 4 1 1 1 -5 5 -5 -3 -3 5 -5 -6 4 -1 3 5 -4 -5 8 -5 8 4 5 1 -4 -4 5 -4 8 5 5 1 -5 4 1 -5 -5 5 5 -5 4 -4 5 5
Able to be customized?	1 1 4 -1 8 1 -4 -1 -1 3 -5 -1 -2 1 3 5 1 -3 5 8 1 1 3 1 2 8 2 8 8 8 4 8 1 8 5 -1 5 1 1 5 -5 5 4 -5 -4 1 4 1 -3 -6 3 4 3 4 5 8 -5 1 4 5 1 4 -5 5 -5 1 5 5 1 -4 5 8 -5 -5 5 5 8 5 4 5 5
Multi-use?	1 2 1 -4 -2 -5 1 2 -2 4 -5 6 1 -2 -3 4 5 1 4 4 1 1 3 1 2 4 2 1 4 5 4 8 8 8 5 -5 5 1 5 1 -5 5 4 -5 -4 5 6 -6 -2 5 6 1 -3 -3 -2 4 5 8 -5 1 4 1 1 -5 -5 4 -5 1 4 5 4 -5 5 4 -5 -5 5 5 8 5 4 4 5
Transportable?	-4 1 -6 8 6 -4 4 4 4 2 -8 1 6 5 1 2 -3 -1 5 1 5 4 1 5 4 1 4 8 2 1 5 5 8 1 1 5 5 1 -8 5 1 4 5 5 4 5 -5 -4 5 -1 1 1 -1 -4 3 4 5 8 -5 1 4 1 1 -5 -5 4 -5 1 4 -5 4 -5 1 1 -4 -5 5 5 5 5 4 5 5
Better with age?	6 4 -6 -4 5 -4 1 1 -4 -8 -6 1 1 -5 -3 1 -1 5 1 5 8 1 8 8 2 1 5 1 4 8 1 8 4 5 -4 4 4 8 1 -5 5 5 -4 5 2 -8 -1 3 1 -4 5 -1 -3 4 5 8 -5 1 4 1 1 -5 -5 5 -4 8 4 -5 4 -5 1 1 4 -5 5 5 4 -5 4 8 5
Modular?	4 4 -1 4 3 8 6 1 -4 2 -8 1 -2 -2 1 -1 -1 4 8 8 8 1 4 1 4 8 4 1 3 3 8 1 8 5 4 -4 8 4 5 5 5 4 8 -4 -4 5 6 -6 -2 -6 -5 1 1 4 4 4 1 1 4 1 1 -5 5 4 -5 8 4 4 -5 1 5 4 4 -5 4 1 -5 4 8 5
Scalable?	1 5 4 3 -8 -8 1 2 1 6 -3 -2 -4 6 -4 -1 5 1 4 8 8 8 4 4 1 5 4 8 5 5 4 3 8 1 8 5 4 5 1 5 4 1 4 8 -4 -4 4 -6 4 5 4 -1 -4 -2 -4 5 4 1 1 4 8 1 -5 8 4 -5 8 4 4 8 1 1 5 5 5 -5 8 8 -4 4 8 5
Technically clever?	1 4 2 -8 -2 4 -4 1 -6 3 -6 -5 8 -8 -2 4 -3 5 1 5 8 4 8 4 4 8 5 4 4 4 1 1 4 8 5 1 8 5 4 -5 -5 1 1 4 1 4 4 -5 -5 5 5 -1 -1 1 -5 3 4 4 4 8 5 8 5 1 1 -5 8 4 -5 4 8 4 1 5 1 1 5 5 -5 1 1 -4 4 8 4
Timeless?	1 1 -2 4 -8 -2 1 3 5 5 1 3 4 -1 -5 5 1 5 1 5 8 5 4 1 8 4 8 1 4 4 4 5 5 1 5 5 -5 1 1 1 1 4 5 -5 -5 5 3 -2 5 4 -1 2 -8 1 4 5 8 4 1 5 1 1 -5 1 5 -5 5 8 5 1 5 1 1 5 5 -5 5 8 -8 4 4
User-defined …	
User-defined …	

PRACTICABLE

Functional?	1 8 5 -4 3 -5 5 2 -8 -1 4 -3 -6 -6 -2 3 2 1 -4 5 -8 8 5 4 5 5 5 5 -4 1 4 3 1 5 4 8 1 -4 1 5 8 1 8 5 8 -1 -4 -5 -3 8 -2 4 4 -2 2 3 2 -4 -4 -4 1 1 1 1 -4 5 5 5 5 -1 1 4 1 1 1 -5 1 5 1 1 5 5 5 5
Appropriate?	5 8 5 2 -2 -8 -6 4 5 -4 8 -8 1 -8 2 2 6 3 5 -3 8 -4 1 5 5 1 1 -2 3 1 5 3 8 5 5 8 1 -4 1 5 6 1 5 8 -1 -4 -5 -4 -2 -8 -1 -4 4 -5 1 1 1 5 -4 5 5 5 4 5 -5 5 4 5 5 8 -5 1 5 1 1 5 5 5 1
Robust?	5 8 5 -4 4 2 2 1 -1 4 -5 1 -2 4 4 1 4 5 -3 8 3 4 5 4 4 1 5 4 4 1 5 3 8 5 5 8 1 1 5 8 1 8 5 1 -5 -5 -5 8 -1 1 -2 6 4 1 -4 5 -4 1 8 5 5 -5 -4 5 5 5 4 -4 5 5 5 5 1 -5 5 5 1 5 5 1 5 1
Safe?	1 6 1 -1 1 -6 1 8 -3 -5 -1 8 8 -4 -1 -1 5 -4 -2 4 5 8 4 5 8 4 8 1 1 2 6 1 5 4 8 5 5 8 5 -5 1 1 8 5 4 5 1 -5 -5 -5 4 2 -8 6 -3 6 -2 6 -1 8 5 -5 1 4 5 5 -5 -4 5 5 5 5 -4 5 5 5 4 -5 -4 5 5 1 5 5 1 5 5
Healthy?	5 4 1 -6 -4 -2 -5 -1 -4 -1 1 -6 -6 8 -5 4 5 4 8 8 -5 8 4 1 1 8 4 1 5 1 5 4 8 4 -5 1 1 8 5 4 5 8 -5 5 -4 3 3 -2 -1 -2 -4 -5 8 5 -4 5 4 8 4 -5 -4 5 5 5 5 8 1 8 1 8 -5 8 4 5 1 5 4 5 5 5
Problem-solving?	5 1 8 1 3 -8 -4 -8 -4 4 -4 -5 -1 1 8 2 1 -3 1 -2 5 1 8 8 -2 8 4 5 5 2 6 1 4 3 8 5 8 5 -5 1 1 8 8 5 1 -5 4 5 2 -1 2 -5 4 -2 -5 4 -5 -5 5 8 8 4 -5 -4 5 5 5 4 8 8 8 1 1 -5 8 4 5 1 5 4 5 4 1
Easy to use?	1 6 1 6 -1 -4 -2 4 4 4 -3 -1 -4 -4 -6 -4 4 5 1 8 -4 8 1 1 1 4 5 5 -2 8 1 4 4 4 4 8 5 -1 1 1 8 8 8 5 8 -5 5 5 3 2 6 -4 3 -8 1 4 -5 -4 4 8 4 4 -5 -4 8 5 5 5 1 4 8 5 1 -4 1 -5 5 5 1 8 1 5 1
Affordable?	1 5 1 3 5 -3 3 1 -8 -4 -3 -6 2 -3 -5 5 5 1 8 8 1 4 5 4 5 1 3 1 1 4 4 8 5 5 8 1 -5 5 4 8 8 5 5 8 -5 5 5 -1 -1 -4 -3 -8 6 4 8 4 -5 -4 4 8 8 8 5 -4 -4 5 5 5 1 5 8 5 1 -5 1 5 5 5 1 -5 5 1 4
Comfortable?	5 1 4 -2 4 -2 2 -2 5 1 -8 -6 -5 -8 1 4 5 1 8 4 8 1 8 1 8 5 1 4 1 1 4 5 8 5 1 8 -5 5 8 8 1 5 1 8 -5 5 3 5 -2 -4 8 3 -4 4 -5 -5 4 1 8 8 1 -5 -4 5 1 1 8 5 8 5 8 -5 1 -5 5 1 1 -5 1 1 4
Ethical?	1 5 1 1 -4 -2 -1 8 -2 8 1 -5 -6 2 -4 -8 5 4 4 1 1 8 -5 8 6 1 8 1 8 1 4 4 8 1 8 -5 1 8 8 1 5 1 1 -1 5 6 -1 8 -2 1 4 4 4 -4 -5 4 1 1 5 1 -5 -5 1 1 1 8 4 1 1 4 -5 -5 -5 5 8 1 -5 1 8 5
User-defined …	
User-defined …	

SERVICEABLE

Low maintenance?	4 5 4 -2 4 -1 3 1 8 -6 6 -4 2 -1 5 5 1 5 5 8 5 8 3 1 5 5 1 8 5 3 3 8 8 3 4 8 6 4 1 1 6 5 8 1 5 5 -2 3 1 2 1 4 2 1 5 5 5 5 5 1 8 4 8 5 4 5 4 1 5 1 4 1 1 8 -1 5 5 4 5 1 5
Easily cleaned?	5 1 6 3 1 3 4 2 5 8 1 4 3 -4 -4 4 1 4 1 4 1 3 1 5 5 1 4 5 4 3 8 8 3 4 8 3 5 5 1 1 6 5 8 5 5 5 4 1 4 3 5 4 1 2 -6 3 1 1 1 5 4 1 4 5 8 5 4 5 5 5 5 1 4 5 5 8 5 5 5 4 4 1 5 4
Recyclable?	1 1 4 1 -2 -8 4 5 -8 2 5 -8 6 4 4 4 1 4 4 4 5 8 4 1 5 1 1 4 5 4 3 3 8 8 3 4 1 3 4 1 1 3 5 5 5 5 1 4 6 3 4 -2 4 5 6 5 1 1 5 5 1 4 4 4 4 5 5 5 5 5 1 4 5 5 4 5 5 5 5 4 1 5 8
Non-toxic?	1 5 5 -6 -6 1 1 1 1 -4 -8 5 2 2 5 5 1 4 6 4 5 1 4 1 1 1 1 4 2 4 3 8 8 3 4 5 4 5 4 1 8 3 5 5 1 5 1 4 1 3 8 1 2 2 -2 5 5 5 5 5 1 4 4 4 5 5 5 4 1 4 1 5 5 5 5 5 5 5 5 1 8
Repairable?	5 4 -4 5 6 -2 4 3 -2 -2 4 8 -6 -8 2 1 1 4 8 8 5 1 5 1 1 1 1 4 2 4 6 8 8 4 8 3 4 5 8 5 3 5 3 1 5 5 4 2 -2 -2 1 1 -6 1 5 5 5 5 4 1 4 4 4 5 4 5 5 4 4 8 1 5 4 5 1 4 4 4 5 1 5
Energy efficient?	4 1 5 8 5 -4 -4 5 6 6 -8 1 8 8 -4 5 1 5 8 8 8 8 4 1 4 1 1 4 5 5 4 8 8 6 4 8 4 4 4 4 8 4 3 5 4 4 5 5 4 1 -1 1 -2 -4 4 6 8 1 5 5 8 1 4 1 8 5 4 5 4 5 4 5 5 4 4 8 5 4 5 1 5 5 5 1 5 1
Reliable?	4 5 5 4 -1 -1 4 2 4 -6 -4 1 3 3 4 8 -6 1 4 1 1 8 8 8 8 1 1 1 1 4 4 4 8 8 8 4 5 8 4 4 8 8 4 5 4 5 5 5 8 8 3 8 6 3 -4 -1 5 4 8 8 4 1 4 5 4 5 4 5 4 4 5 8 5 8 4 5 5 1 1 5 4 5 5 1
Accessible?	4 1 5 3 4 4 4 3 -8 2 3 2 -4 5 5 4 5 1 1 1 8 8 4 5 1 8 8 1 3 2 4 8 8 6 5 5 8 4 5 5 4 4 5 4 8 5 5 5 -2 2 3 2 2 -6 -1 -8 -4 5 4 1 8 5 1 5 -1 5 5 5 5 5 5 5 1 5 8 5 8 4 5 5 5 5 5 1 5
Regenerative?	8 8 -4 -8 1 4 -2 8 6 1 2 2 2 -6 3 -4 1 1 1 8 4 1 4 1 4 8 1 3 4 8 5 4 8 6 8 5 1 4 5 5 5 5 4 5 4 5 5 5 -4 2 -2 5 -6 6 5 5 1 5 5 1 5 -1 5 4 5 8 1 5 8 1 5 5 5 1 4 8 5 5 1 1 1 4
Habitat-safe?	5 8 5 3 4 -8 5 2 -6 5 2 1 4 2 8 -2 1 1 5 4 1 1 4 1 1 8 1 5 5 8 5 5 8 1 8 5 1 6 5 5 1 1 5 5 5 1 5 6 2 -8 8 4 2 -2 4 5 5 5 1 5 5 1 5 -1 5 5 5 1 8 5 8 1 5 5 5 1 5 1 5 1 1 1 1 5
User-defined …	
User-defined …	

CASE STUDY: CINEMA COMPLEX (SERVICE PROVISION) GROUP 1

DESIRABLE

Nice to look at?	10 10 5 10 3 4 4 3 10 4 3 10 4 3 8 4 4 2 10 10 2 10 2 4 5 4 10 2 5 -2 -3 8 -6 -8 6 -4 4 -2 -4 10 -4 3 8 10 10 8 2 3 2 5 3 4 4 -10 8 4 -4 -1 -1 -2 -4 4 -4 2 -1 -10 -1 -8 1 4 -8 -5 1 -2 8 -5 -4 -6 1 1 2 -3 -6 -1 -2 3 6 4 -1 -4 2 -2 -2 -1 10 -4 10 1 -5 2 -2 -1
High quality?	10 10 8 10 3 3 4 10 4 3 10 4 3 8 4 5 2 10 2 4 2 10 3 5 4 4 5 5 -2 -5 -4 2 -2 -3 5 3 -6 3 6 10 10 10 8 6 4 -6 -2 -10 8 10 -8 3 4 -2 -4 6 -1 2 2 8 5 4 -3 -8 -2 -4 -6 3 1 2 -8 8 10 -2 10 6 8 -3 4 2 -2 -4 4 2 2 -5 -2 2 -1 -10 -4 6 -1 6 -2 5 5 -4 -4
Profitable?	10 3 4 8 3 4 3 10 4 3 4 2 4 6 -4 -10 6 -4 -10 -2 4 -5 10 -5 4 10 3 10 10 6 5 8 3 4 -4 -6 -3 6 4 -6 -1 2 -4 4 6 8 6 6 4 -2 -5 6 4 3 4 -1 6 1 -4 -2 -6 -6 5 4 10 -4 -1 1 -5 -4 10 8 3 -4 5 4 -3 -5 10 -2 10 5 -2 4 -2
Well-designed?	10 4 4 8 3 4 4 8 4 3 10 4 3 4 2 2 4 4 5 -2 -4 -2 -4 -5 10 -2 -2 -2 -1 -2 2 -8 8 10 10 6 6 6 5 3 4 -8 8 4 -1 -4 3 -10 5 2 2 -2 -4 -4 8 -3 -2 -2 10 8 -6 -5 10 -1 8 4 -5 2 2 5 4 -4 6 6 -3 -3 8 -3 -1 8 2 2 -8 -10 10 -4 1 -5 2 4 -5 4 4 8 4
Valuable?	10 5 4 4 4 -3 3 4 -5 3 10 4 3 4 2 2 8 8 -2 -2 -4 -4 -5 5 2 2 -2 4 10 4 -3 4 2 10 10 8 1 6 6 3 4 -3 6 8 8 -1 3 -10 4 8 -2 8 -3 -6 -5 2 -2 -2 5 -4 6 -3 3 -8 -8 6 -10 -2 6 10 -8 2 1 4 -2 -2 -6 2 -10 -6 2 -3 8 4 -1 -8 -2 -2 4 -4 -4 10 4 2 -4
Prestigious?	10 5 10 4 6 4 3 2 4 -10 3 10 4 3 4 2 4 5 2 4 2 3 1 5 6 -4 -8 1 -4 -2 6 4 -2 -5 -10 4 2 8 10 8 6 4 4 8 4 -4 -1 5 1 -3 4 2 -4 -2 5 2 8 4 5 -3 5 -1 -1 1 -6 4 -8 4 6 -10 4 4 1 10 -6 10 -6 3 8 4 5 -1 1 2 2 -8 6 3 3 -4 -4 4 -5 -2 8 -6 8 -4 6 2 -3
Durable?	10 3 4 3 -5 5 4 -3 3 10 4 3 4 3 2 6 4 5 -2 2 2 6 4 -4 6 -4 2 -2 -2 1 10 10 6 1 8 8 4 6 2 4 4 1 -10 2 -1 2 -2 2 -10 -4 1 2 3 -3 -8 -3 8 2 -10 -4 -4 -2 -6 8 -8 4 -1 -3 -6 6 5 -2 2 4 -4 -4 -1 -4 2 10 -2 -2 -2 -3 6 -6 8 -10 4 2 -6 -1
Popular?	10 3 5 4 4 -5 3 4 -3 3 10 4 3 4 4 2 4 2 2 1 4 1 5 5 -5 -3 -2 -10 -6 -4 2 -5 10 4 3 10 10 8 4 8 6 4 3 -2 -4 8 10 10 8 4 4 4 -4 1 5 -4 -4 -3 5 6 2 6 6 3 4 -2 -5 -2 2 -3 -3 -2 -10 -4 -3 -6 8 -3 3 -6 -4 8 1 3 -4 1 2 2 -3 -6 4 -2 -6 -10 2
Joyful?	10 10 4 4 3 2 3 4 4 -4 3 10 4 3 4 3 4 5 4 2 2 2 4 4 2 10 5 4 -4 3 2 8 -4 -4 4 4 6 -4 -5 4 10 10 8 2 8 4 8 3 8 10 8 -4 -4 2 5 -5 -3 -3 2 4 2 3 5 -1 -4 6 4 10 2 -4 5 3 5 4 -4 3 10 -2 10 3 1 -10 -8 -4 -10 -10 -6 -2 -6 -4 4 4 -4 8 3 3 2 -8 6 10 6 8
Unique?	10 5 10 4 6 -3 -6 2 4 -3 3 10 4 3 4 -2 4 5 2 2 -1 -2 1 4 -2 8 2 4 2 10 -3 -4 -4 6 1 -3 6 2 4 6 10 10 8 2 10 3 2 4 6 8 -2 10 -2 -5 1 8 -2 -4 -8 2 -2 -6 -5 2 8 -4 5 -1 -2 -1 -3 4 -3 -4 1 1 4 6 8 -2 2 10 4 -3 5 -2 -5 2 8 4 -3 -2 8 -4 -4 6 2 2 -2 -8 8 2 -5 -6
User-defined …	
User-defined …	

ADAPTABLE

Versatile?	10 -2 5 10 3 4 5 6 4 10 4 3 -1 -2 6 -1 10 5 3 10 4 -3 1 -2 -8 -1 10 8 -8 10 3 2 5 8 3 3 10 4 -2 1 -6 -4 -10 -10 -2 1 -4 5 -2 3 -2 -8 -4 -8 1 -2 10 -2 -2 1 -2 3 -1 3 -5 -10 -4 -1 4 -5 2 -6 -2 -2 -4 10 4 10 -10 1 1 4 1 4 4 8 10 10 -2 4 -2 3 4
Easily modified?	10 8 4 8 4 3 4 10 4 3 -1 -2 3 -1 5 10 10 -8 2 -10 -4 6 3 1 2 2 -5 -8 -8 8 -4 8 4 5 4 4 8 8 -10 2 -8 -2 -4 2 3 -6 -5 3 10 -8 4 -4 -8 -8 -2 -4 5 -6 5 -8 1 10 1 10 6 -4 4 -3 6 -4 2 8 4 2 -6 -1 -5 -4 -6 -8 -3 -1 4 -2 10 8 -2 1 1 1
Able to be customized?	10 -3 4 10 4 3 8 3 4 10 4 3 -1 -2 -1 8 5 -2 -1 3 -4 10 -4 5 10 3 3 -4 4 8 5 4 5 10 4 3 1 5 2 -6 10 -2 5 -2 -8 -4 -4 -10 5 -4 8 2 -4 -2 2 -10 -1 5 10 -6 2 6 8 2 -3 1 2 6 8 -2 -4 -1 -3 -8 -3 8 -10 -6 -2 5 5 -6 6 5 -8 8 5 3 -1
Multi-use?	10 -3 4 5 3 -4 3 4 10 4 3 -1 -2 -2 -1 5 5 -4 -3 2 3 -3 3 2 8 3 -4 4 2 -5 5 -3 4 8 10 5 5 8 -4 6 -8 -6 -8 1 2 -4 -8 4 -2 10 -3 -1 1 -2 -4 3 -2 3 -6 -10 4 -4 4 -4 -3 -3 -2 -10 -2 -2 4 -4 -10 4 1 4 -10 6 -6 8 -4 2 8 -1 -8 -4 -8 3 -2 -5 1 5 -4
Transportable?	10 10 4 5 4 5 4 10 4 2 -1 2 -2 -1 8 -1 -6 -6 -3 -1 -8 3 -1 -5 10 -8 8 8 5 8 4 4 5 10 8 3 -2 -4 -1 -10 4 3 4 -4 -4 10 1 -1 -2 -3 -3 6 -6 -2 -4 -1 -3 -5 2 5 -3 10 -10 -4 -3 4 4 2 -4 -2 3 5 1 -6 -1 -1 4 -2 -2 2 3 -5 -1 2 -1 1 10 -4 -4 -4
Better with age?	10 10 5 5 3 -4 -5 4 10 4 5 3 10 5 -1 2 3 -1 4 5 -10 6 -5 -6 8 -8 2 5 -4 -4 1 10 5 10 4 -6 5 10 8 2 -2 -1 -6 -4 -2 10 -5 6 -10 4 2 -1 -6 -8 -2 8 10 -4 4 10 3 -3 2 2 10 -2 -6 -8 6 -4 3 -1 10 4 -3 -4 -3 4 -4 -4 -1 -1 4 -6 -2 -6 2 -3 8 6 -2
Modular?	10 10 4 5 4 3 4 10 4 3 -1 -2 3 -1 4 4 6 4 1 -8 2 -8 -4 4 4 -6 -10 -5 5 10 8 5 10 8 4 -10 5 -4 -4 -2 -4 2 -4 -1 10 5 -8 2 -3 5 -6 -8 -4 4 -4 -4 -4 -2 10 -2 8 -3 8 4 6 4 2 3 2 5 1 1 -4 4 -5 1 -2 6 5 -5 3 2 3 -4 -4 -2 6 4 -5 1 5 2
Scalable?	10 10 8 4 4 8 4 10 4 3 -1 -2 -1 10 4 10 -4 -2 -2 -1 3 2 -4 -10 -4 -2 -6 -3 5 5 8 8 4 5 10 4 8 -5 -10 -1 -5 4 2 -3 -4 -5 4 -2 4 -5 6 -6 -4 2 2 10 4 -5 -10 4 -2 -6 3 1 -2 6 -8 1 8 4 -3 -3 -10 4 -4 -6 -4 -4 4 1 -8 -4 -1 1 -6 -10 -2 -2 4 -4 2 -2 -1
Technically clever?	10 10 4 2 -10 4 10 4 3 -1 -2 -3 -1 4 10 -3 -3 -8 5 -5 2 2 1 4 5 6 -6 -6 -5 5 8 4 8 5 10 3 6 6 5 4 -8 -4 4 2 2 -10 -2 -2 -10 2 -2 -6 10 5 -2 2 -2 -2 -3 3 -1 3 3 4 6 5 4 -4 -10 1 -4 -6 -4 2 6 4 6 -8 -6 -4 -8 -2 2 -6 -2 -8 -2 1 5
Timeless?	10 3 3 -4 5 10 4 10 4 3 -1 2 -2 -3 -1 10 10 1 1 10 -10 -10 5 -10 4 4 -3 5 -5 8 10 10 5 10 4 1 -6 2 2 -6 -2 -2 2 -5 -4 4 3 -1 4 8 6 -10 -4 -8 -6 3 8 -6 6 4 -6 -8 4 3 2 -1 -10 -2 8 -1 -1 -10 -10 -8 4 -4 -4 2 4 -4 4 4 6 2 2 6 1 8
User-defined …	
User-defined …	

PRACTICABLE

Functional?	8 4 5 3 4 3 8 4 6 5 10 4 -2 -2 4 5 5 -4 10 -4 -6 -4 2 -5 -4 -2 2 1 4 -5 8 4 10 3 4 5 2 -2 -4 4 3 8 -10 4 -10 6 -5 2 1 1 8 6 -2 -10 -5 -4 -10 6 -2 -2 2 2 -6 -3 -5 -4 -4 -10 -2 10 8 4 -2 8 -8 4 8 5 4 4 -2 -10 6 -4 5 2 2 -4 10 -3 3
Appropriate?	3 4 5 8 10 3 6 4 -10 4 10 4 2 4 -2 -2 4 5 5 4 -3 -2 5 10 -5 1 4 1 -8 -5 4 4 -10 8 4 10 3 2 4 -2 -4 2 -2 -2 2 -4 2 4 -3 -4 -8 4 -4 -8 -5 -1 -4 -6 5 2 8 -2 -4 -3 -10 -2 -3 -6 -3 -6 -4 4 -5 4 -4 2 -6 8 4 -8 2 -1 -3 10 -5 6 2 5 10
Robust?	3 3 4 4 3 3 8 4 6 5 10 2 4 -2 -2 8 8 5 3 -6 5 -3 2 -3 -3 -4 3 5 4 2 -2 5 -10 8 5 4 10 4 2 6 -6 -1 1 1 -2 10 -8 -2 -10 -5 4 -4 -10 6 2 3 1 3 2 -5 -10 4 -4 -4 4 2 -10 1 -5 -3 4 4 3 2 -2 -5 -3 4 3 2 5 -10 5 -4 5 -10 -4 -2 -4 4 -10 -2 5 -1 1
Safe?	4 10 4 4 2 4 3 5 8 5 4 10 8 5 4 4 5 10 4 4 8 5 4 4 4 5 -3 10 -6 -6 -10 4 5 -1 -2 1 -6 10 -5 8 10 5 5 10 4 6 -4 -4 1 -1 4 1 -3 -6 2 -6 4 -4 4 4 -4 5 3 10 -2 -4 1 8 -3 -1 -4 2 -2 2 10 5 5 1 -1 -4 -2 2 -4 -2 -10 4 4 -4 -4 5 -10 4 3 -1 2 -2 4 5 -3 -2
Healthy?	10 4 5 6 3 4 8 -5 3 10 8 5 4 4 10 4 4 8 5 4 4 -4 5 5 -3 -5 4 8 2 5 1 -2 5 2 -3 -1 -3 8 -10 10 5 -4 10 5 8 5 -1 -5 -5 8 -5 3 1 -1 4 8 -2 2 5 -1 -5 -6 -5 8 -2 1 10 -1 6 2 -4 4 -2 -10 -5 -2 -3 -2 4 -3 -2 2 -10 -6 4 -6 8 4 -1 6 -3 5 -4 1 1 -4
Problem-solving?	10 -4 5 3 3 4 -10 4 10 4 5 -3 -2 -2 4 4 -2 -2 8 1 -8 1 2 2 2 2 6 8 -5 10 5 -2 10 5 8 -2 10 4 -3 -10 -2 2 4 5 2 5 -6 -6 1 -1 1 -8 10 -3 10 -10 -3 -2 2 4 3 10 -10 10 -2 -1 4 8 -4 4 -4 4 -3 -10 -8 2 10 -2 8 -2 -2 5 8 -1 -2 4
Easy to use?	-3 10 4 4 3 6 3 3 4 -3 4 10 8 4 4 4 4 -3 -2 2 4 5 10 6 -6 2 3 2 4 1 -4 -3 -4 2 8 10 4 5 -4 10 5 8 -10 -3 -4 -4 8 4 -4 -1 4 -5 10 -5 -4 -2 -8 -4 3 4 -8 6 -3 10 -6 2 -5 5 -4 -3 1 -3 -1 10 -5 -2 3 -8 5 -1 4 4 10 -4 -5 1 2 4 2 -10 -6 -4 -5 -6 -6 2 -2
Affordable?	-4 10 5 4 3 3 4 4 3 10 8 5 4 5 4 4 -3 2 -2 3 4 -5 4 -8 5 4 -10 -1 5 -4 -10 -10 3 4 10 -10 10 5 8 5 -4 10 5 4 4 -4 -6 4 -4 6 6 10 -6 1 4 1 -4 -4 -8 -3 -10 4 5 3 -1 4 -3 -4 5 -10 -4 3 1 -4 10 -10 2 -5 8 4 -4 4 -10 -3 -3 -8 4 -6 -6 2 -3 -2 2 2 -6 1 -2 -2 -5 8 10 -6 -8 -5 4
Comfortable?	10 4 8 3 6 3 4 10 3 10 8 5 4 4 4 4 -3 2 2 10 10 -4 -4 8 -6 10 -5 6 -4 -8 10 -2 -8 8 -5 10 10 -4 10 4 5 10 1 3 -5 6 -1 2 2 6 5 -4 4 -5 2 8 4 3 -2 -3 4 4 -6 2 6 3 -2 -3 4 -4 5 -6 -10 10 -2 -6 -4 3 2 -1 -8 -2 1 -4 3 -1 -4 6 -1 -2 2
Ethical?	10 4 4 3 3 -4 4 -10 3 10 8 -3 -2 -2 4 3 2 10 -2 -6 10 -4 -10 -1 -8 -8 -8 8 10 -4 10 5 5 3 2 2 3 -1 10 8 1 10 -6 -2 -1 2 4 -10 3 8 -2 -4 4 -2 3 -4 -5 2 8 5 -2 10 -2 1 -2 -3 1 -4 5 -3 8 8 3 -4 -10 -2 -6 2 4 -2 -4 1 4 -4 -2 -8
User-defined …	
User-defined …	

SERVICEABLE

Low maintenance?	8 -10 4 5 3 5 8 5 4 10 4 2 4 -2 10 5 2 4 -8 -8 1 4 4 5 -8 -5 4 4 -10 8 8 10 6 5 4 5 5 -2 -3 -3 1 2 2 -2 -2 4 3 2 -4 1 -10 -3 -3 10 10 8 8 -4 -2 6 4 -2 -1 -4 -10 -3 -8 -6 2 10 3 2 -10 -5 4 -2 4 4 -8 -8 1 5 4 10 -4 -2 -5 -3 4 4
Easily cleaned?	5 10 5 5 4 -3 4 8 5 4 10 4 5 4 5 2 4 2 4 3 10 10 -6 -10 -2 -6 3 -4 1 3 -2 10 6 5 5 4 -10 8 10 5 10 -2 6 4 3 -5 -5 5 -1 -4 -3 10 2 1 4 2 2 -5 2 -8 3 -2 -2 -10 6 8 -10 -8 4 3 5 -2 -2 6 -1 2 2 -4 6 3 -10 2 4 4 6 2 8 2 3 -1 1 6
Recyclable?	5 10 4 5 5 8 4 10 4 4 4 2 4 2 3 5 -2 -5 -8 -1 5 -10 -8 -4 -6 -4 -6 3 -5 -2 -5 5 -4 -10 8 10 4 10 10 -8 -8 -4 2 3 10 2 -2 1 8 -4 -4 -2 -2 2 -3 2 -8 -1 -4 10 2 -1 -6 3 4 2 4 4 4 -5 -5 -2 -4 8 10 -6 2 3 8 2 2 -4 -2 -6 10 -10 -6 6 2 4 1 8 -8 2 -2 -4 -8 2 5
Non-toxic?	5 10 5 5 3 4 3 4 8 3 3 10 4 2 4 4 -2 5 -8 -10 4 -2 -8 3 -3 -10 4 -8 -3 8 6 5 5 5 4 4 10 3 8 4 2 -3 -8 5 4 -5 10 4 -1 10 4 2 3 -3 -1 2 -6 -2 -6 -6 -5 10 1 3 -8 1 4 10 -1 6 5 -10 -4 -4 5 2 -4 -10 -5 2 -2 -2 1 2 4 -4 -5 -4 -4 5
Repairable?	-5 10 4 5 3 8 3 4 8 3 10 4 2 4 8 10 -1 2 5 -1 -3 -4 -10 -10 5 -2 -2 1 4 -5 5 3 5 8 10 3 4 4 -2 -6 -2 1 -4 -2 6 -3 -2 -1 1 2 6 -1 8 -2 10 5 4 -1 2 2 -4 -8 -4 4 4 -2 -3 -8 2 8 8 6 -1 10 -2 -6 2 -1 4 6 -4 6 -2 -6 -4 -2 2 -5 -4 -1 3 -6 6
Energy efficient?	-5 10 5 4 3 3 5 8 3 10 4 2 2 4 2 4 10 -5 -2 6 10 10 5 1 -4 -3 -2 -1 5 -5 6 5 -8 8 8 4 3 -2 6 -5 -6 5 -8 -2 3 -3 4 -2 6 -5 -2 -2 -10 6 6 10 1 -3 10 2 2 4 5 -4 -2 -4 10 10 -2 3 2 -6 6 -4 4 -2 4 3 -10 -6 -1 -5 4 10 8 -3 6 -5 -2 -4 2 -5
Reliable?	0 10 4 4 4 4 3 5 8 3 5 10 4 4 2 2 4 5 10 -8 -2 -10 8 -4 -8 -2 3 -6 -3 -1 4 2 -4 -4 5 8 5 4 -4 5 2 8 3 -2 -4 4 -5 -10 -8 2 -1 -4 -3 -4 -4 -2 10 4 10 -8 4 -1 -6 4 -5 -3 10 10 -5 -4 3 -6 -10 -5 2 -2 5 -3 2 -8 -2 5 1 10 5 8 2 -2 8 4 4 -2 2 -3 10 -6 -10 -2 -1 8 -4
Accessible?	4 10 4 5 4 3 5 8 3 5 10 4 4 5 4 2 4 2 4 10 10 5 -5 4 3 6 5 2 -8 -2 -5 2 2 -2 10 10 5 8 -8 10 4 4 2 8 -5 3 5 -4 2 5 -2 -8 5 3 -8 -8 6 1 -1 -6 3 -6 -3 -4 -5 5 5 -4 -10 -4 4 2 -4 -5 -2 -10 4 -4 -5 -3 -2 6 -4 -8 -6 4 2 -8 4 5 5 2 1 2 -4 4
Regenerative?	4 10 5 5 3 3 5 8 4 5 10 4 4 -3 4 -1 5 -2 6 10 -2 -2 -4 2 2 -1 4 3 -10 5 -5 10 8 3 8 10 5 -10 -2 4 -3 4 -4 5 1 -3 -2 6 -2 2 -3 2 -3 -2 -2 -2 4 -1 -4 -5 10 6 -5 -2 -1 1 -1 4 -2 -2 1 -5 10 10 -10 -2 -8 -3 5 -4 -5 -5 10 2 -8 4
Habitat-safe?	5 10 4 5 4 3 5 8 -10 3 10 4 2 3 10 5 6 6 -4 5 -4 2 2 -5 -1 1 -3 -8 5 -5 5 10 -10 8 10 4 -4 6 8 -1 6 -4 5 -2 -8 -2 8 -10 2 -1 5 1 8 -2 -8 -1 4 -4 -6 -4 4 6 -10 8 5 -2 4 3 10 -2 10 -4 6 10 -2 -2 2 4 1 -6 -6 -8 1 -3 4 -2 2 5 10 -4 -2 -2 2 8
User-defined …	
User-defined …	

CASE STUDY: ILEARN PLATFORM (SYSTEM DEVELOPMENT)

GROUP 1

DESIRABLE

Nice to look at?	2 -4 10 -6 4 -1 1 1 -6 -2 2 -2 -4 2 4 4 2 2 2 -1 2 -2 2 -2 2 2 4 4 -2 -2 1 1 2 -1 2 1 5 1 4 2 -2 4 4 -5 -4 4 2 6 1 2 1 -1
High quality?	-1 -2 4 8 -8 -2 5 -6 -4 2 -4 3 -2 -1 4 2 2 4 1 1 -1 4 -2 2 -2 2 -2 4 -2 -2 -2 2 2 2 2 4 -1 10 -2 -3 -8 10 1 -8 -1 4 2 -3 2 2 2 3 1 2 1 -1
Profitable?	-3 1 -10 5 6 6 -10 4 -8 4 2 -2 4 2 -1 2 2 -1 -1 1 -2 -1 -1 2 -2 -2 2 1 2 1 1 1 2 1 2 8 10 -10 2 3 6 4 -4 -8 -4 -5 1 1 2 3 1 2 -1 -1
Well-designed?	-1 -6 1 -4 8 2 -4 1 6 2 2 2 -1 2 3 -1 -2 -2 2 -4 1 -2 2 -2 1 1 -1 1 2 2 2 2 8 2 1 6 -8 -6 8 4 -4 -1 -1 2 -1 4 1 2 1 -1
Valuable?	-4 3 10 -10 5 -5 -8 -6 10 8 -5 -5 -6 1 -8 -3 -4 1 2 1 2 -2 1 -4 2 2 1 -3 1 2 1 2 2 4 2 2 4 1 4 1 4 -1 -6 1 -4 -6 -6 -6 2 -1 4 1 1 -1 -1
Prestigious?	1 -2 4 -6 -4 -4 10 -5 3 -5 4 2 4 -5 -2 1 -1 2 1 1 -2 -2 -2 4 2 -4 -2 -2 2 -3 2 -1 2 2 2 2 2 4 1 1 8 1 -2 6 2 -1 10 10 -2 -4 -8 -2 -6 1 -1 4 1 1 -1 -1
Durable?	-1 -5 10 -2 -1 2 5 4 10 -10 -8 -4 -4 4 1 -1 1 2 -2 4 -2 -2 -4 -1 -1 2 -2 2 2 2 2 1 2 8 2 -2 -1 -4 -4 -6 6 -10 4 10 2 1 -1 1 4 1 1 -1 -1
Popular?	-1 -4 10 -10 10 10 10 5 4 5 -8 2 2 5 -1 2 2 1 2 -2 -4 -2 2 -2 -2 -2 -2 2 -2 1 -1 2 4 2 2 1 2 4 4 4 2 4 10 -10 -2 -2 -3 1 1 1 4 -1 -1 -1
Joyful?	-4 -2 2 -6 10 6 6 -4 -2 3 2 -4 -3 2 -2 2 2 -2 -2 1 1 -2 -2 -2 2 2 -3 2 -2 -2 2 3 2 1 1 5 1 -8 -8 4 8 -3 4 10 5 -3 -6 -2 -2 2 1 2 3 -1 -1 -1 -1
Unique?	1 2 1 4 -1 3 2 -1 3 -2 5 6 -2 3 -4 -4 2 1 2 -2 -2 4 2 -1 4 -4 1 1 -1 -1 1 1 2 2 1 1 10 2 -2 -4 6 -1 8 3 2 -10 -5 1 1 2 2 4 -1 -1 -1 -1
User-defined …	
User-defined …	

ADAPTABLE

Versatile?	-5 -10 4 10 -2 8 -2 -6 1 4 4 6 6 1 -5 2 4 4 -4 -2 5 5 -5 10 -4 4 5 4 4 -8 5 -5 5 4 5 4 4 10 10 5 4 3 10 -8 -2 1 -4 -10 1 6 2 4 4 5 5 -5 -5 5
Easily modified?	5 -8 -5 2 8 1 5 -6 3 1 -4 -4 -2 6 5 5 -2 -5 5 3 10 -4 5 5 4 4 -8 -4 -5 10 4 10 5 8 10 5 5 4 6 -4 1 -3 -4 1 4 4 4 10 5 5 -5 -5 5
Able to be customized?	4 -2 1 -10 -4 -5 4 -3 4 -5 -6 2 2 -6 4 4 3 5 5 -2 -5 -4 4 10 8 -5 -10 4 -4 -4 5 5 10 5 5 5 5 10 10 8 8 8 1 3 6 3 -5 2 -5 1 10 -5 5 8 5 5 -5 5 5
Multi-use?	4 5 -3 -2 1 8 -3 4 10 10 -4 -4 -10 4 -8 5 8 -5 -10 -5 -3 -4 -5 5 4 -10 -3 5 5 4 10 5 5 8 10 10 10 8 4 1 -10 -1 2 -2 6 -6 -4 3 -2 -6 5 -5 5 5 5 -5 5 5
Transportable?	4 5 8 2 1 -10 1 4 -6 3 -3 4 8 3 -4 2 5 10 -10 5 -5 -2 -3 -5 5 4 3 -5 -3 5 -4 5 5 10 4 5 10 5 10 10 4 8 8 -6 5 1 3 -1 8 -4 -2 8 -5 5 4 5 -5 5 5
Better with age?	5 1 10 -3 1 5 -6 -8 2 -1 5 -3 5 3 -4 3 5 -10 -2 -2 -4 4 5 4 8 -5 5 -4 5 5 8 4 8 8 10 10 10 10 8 -5 -1 2 -10 -5 -2 -8 -4 3 1 3 10 -5 8 8 5 -5 5 5
Modular?	10 1 8 -4 -1 -4 -1 3 -8 1 2 4 -4 4 5 -5 -1 -8 -5 3 -5 5 -5 5 5 4 4 8 4 8 4 10 10 8 4 -2 -5 3 -2 6 3 1 -2 2 -2 10 -5 8 5 5 -5 5 5
Scalable?	5 -2 6 1 -4 -6 -5 -2 2 -6 -1 -2 2 -5 5 3 4 4 -8 5 -4 -4 4 5 -10 5 5 -5 4 -4 4 8 4 8 8 10 10 4 5 4 -4 -4 -3 3 -4 -8 8 4 2 -2 10 -5 4 5 5 -5 5 5
Technically clever?	10 -10 8 1 -8 -2 5 -8 -10 5 8 -5 -3 -4 -4 5 -4 5 -4 2 5 4 -4 5 4 -2 4 -5 4 4 4 8 8 10 10 10 10 -4 5 -4 -1 -4 8 3 3 -10 -8 3 -2 5 -5 8 5 5 -5 4 5
Timeless?	5 -3 -10 -3 6 4 -5 -10 10 4 3 -6 -10 -3 -1 -5 -5 5 4 -5 5 4 -5 5 -5 4 5 5 5 10 10 10 10 8 10 -5 1 8 -2 -4 3 1 -5 -10 -6 4 2 8 -5 10 5 5 -5 4 4
User-defined …	
User-defined …	

PRACTICABLE

Functional?	5 -4 2 3 10 -4 10 -10 3 -3 -10 2 -8 2 -10 8 4 4 10 5 -5 -10 10 5 4 -2 4 4 -4 5 10 10 2 5 10 4 4 -4 -4 4 -2 -5 -3 -4 4 1 6 6 -6 -5 5 10 5 5 5 10 5 5
Appropriate?	6 -2 8 4 -3 -2 2 3 -8 3 -1 -4 -6 -5 4 4 5 3 5 -5 -5 -5 8 4 8 -2 4 -4 4 -5 -5 10 8 4 5 10 5 4 4 8 3 -6 2 4 -2 -4 6 -2 10 10 5 10 5 5 5
Robust?	3 6 6 -2 4 4 1 4 -3 1 4 5 5 -10 10 5 3 6 10 4 5 -5 5 4 10 -4 -4 -4 5 -4 2 4 -5 -5 8 10 8 2 5 5 10 5 6 2 -2 -4 -1 3 8 10 10 5 5 5 10
Safe?	3 -5 2 3 -6 -5 4 3 10 4 -10 -3 10 5 4 10 10 -5 -5 4 10 4 5 4 6 4 4 -5 8 10 10 2 5 4 5 10 6 -4 -2 10 4 2 -6 -8 -4 -5 10 5 10 10 10 5 5 -5
Healthy?	4 1 3 8 -10 10 4 4 -5 4 1 2 8 10 10 5 10 4 -4 4 -4 8 10 4 10 4 4 5 -4 10 10 8 2 5 8 10 10 3 -2 10 -4 6 3 -2 4 -4 10 10 5 4 10 5 5 10
Problem-solving?	3 2 2 8 2 -8 1 -4 5 1 -4 4 5 5 4 2 10 5 -5 5 -5 -4 4 -8 -4 -4 4 4 4 5 4 4 8 4 4 -4 4 10 4 1 5 8 10 10 4 4 3 -6 10 10 1 -4 -5 -2 10 10 10 10 4 5 4 5 -5
Easy to use?	3 2 -2 -6 -4 -1 -4 -2 2 5 1 5 8 5 5 -2 5 -4 5 -5 -8 -4 -8 4 4 -4 8 4 8 4 4 -4 4 10 4 2 5 4 4 5 -8 10 -2 6 4 2 -8 8 -3 -6 -8 4 5 8 5 5 5 5 10
Affordable?	4 -4 10 8 -6 -8 -4 8 -10 10 -1 -5 -5 2 2 10 10 -4 4 5 -8 5 -4 -4 -4 4 -5 4 4 8 4 4 5 10 5 2 5 10 8 10 -1 -2 -8 -6 -2 -5 10 3 -4 5 5 8 10 10 4 -5 -5
Comfortable?	4 -5 4 4 -5 4 2 5 -2 8 -8 3 -4 6 5 10 10 -4 -4 -5 -4 4 -4 -4 -4 -4 -4 8 4 -4 8 4 5 10 5 4 5 10 4 5 -1 10 -1 2 -8 4 -6 6 -3 -8 5 5 8 10 10 4 -5 -5
Ethical?	4 5 8 -4 -1 1 -1 2 -4 2 -5 4 -10 2 10 10 10 3 4 5 -10 5 -4 -5 -5 8 8 -4 -4 -5 8 5 4 10 10 3 5 10 5 10 -2 -2 10 -4 10 -4 1 8 2 6 -3 -3 10 10 8 10 5 4 -5 -5
User-defined …	
User-defined …	

SERVICEABLE

Low maintenance?	10 1 5 -6 6 -1 4 8 -3 -4 -4 -5 -2 2 6 -4 4 8 4 5 5 -5 -5 8 5 -5 4 4 -8 -6 4 3 -5 4 5 10 10 5 5 4 3 -5 4 -5 -3 10 2 -1 -10 2 -4 -4 4 4 5 10 5 5 5 5
Easily cleaned?	10 -4 3 1 -3 2 5 -3 10 -2 -8 2 4 -8 8 8 -4 4 5 4 -4 -5 4 -4 -5 5 5 4 -6 -4 3 4 3 6 10 5 10 4 8 10 3 -2 -8 -3 -2 -2 -6 4 4 5 4 5 5 5 5 5 5
Recyclable?	4 2 1 -10 -5 -4 -8 4 4 4 -10 2 8 8 -3 4 4 4 -10 -8 -4 4 -5 5 3 4 3 -3 -4 4 4 6 -5 6 10 5 10 8 4 10 -10 -2 -6 -4 4 2 -2 -6 -2 -4 5 5 5 5 5 10 10 5
Non-toxic?	5 1 4 -4 6 4 -1 8 10 -2 -2 2 2 -1 1 10 10 5 -4 3 8 8 4 -4 -4 -4 3 6 4 -4 8 4 5 8 -4 6 5 10 10 8 4 10 -3 10 -4 6 -2 -4 1 -8 5 6 5 5 5 5 5 10 5
Repairable?	-3 3 1 -4 -5 -1 -8 6 -5 -3 -5 -5 -5 5 10 5 -4 5 -4 5 5 10 -5 -4 -4 -4 -5 3 6 4 -5 4 5 -5 6 5 10 5 8 5 5 -8 10 -6 1 -4 -1 5 -5 8 6 4 5 5 5 5 10 10 5
Energy efficient?	5 -4 1 -10 8 -3 5 2 -4 -4 -10 -2 4 4 -10 5 4 -5 -4 -4 -4 4 3 4 5 -4 5 10 8 4 8 4 5 -4 -4 -2 10 3 -5 -3 -6 8 10 5 5 5 5 8 10 5
Reliable?	4 -10 -2 -6 2 -8 -10 6 -4 -10 2 -3 -6 -1 -10 5 8 5 5 -10 -5 4 4 5 4 -8 -8 -4 4 4 -4 -5 5 10 -4 10 8 10 5 8 5 4 8 -8 4 -4 10 6 8 -4 -5 -2 6 -1 8 -5 10 5 5 -5 4 10 5
Accessible?	8 -10 -1 -2 -8 10 2 -10 4 -2 -2 8 3 -10 5 2 -5 4 3 -5 -5 10 4 -4 -5 -4 -8 -5 -4 4 4 -4 -4 4 4 8 -5 10 8 8 5 8 5 4 6 5 1 -8 -6 -2 8 3 -4 -4 -5 10 5 5 -5 5 5 5
Regenerative?	-5 -3 2 -5 -3 2 -6 -4 -8 2 10 -1 -2 5 4 5 4 -5 4 -4 -5 -5 -4 -5 -4 4 4 -4 -8 5 4 4 4 8 4 5 5 5 5 -2 -4 4 -1 -3 8 10 -1 -2 -4 5 10 5 -5 10 5 5
Habitat-safe?	5 2 -4 -10 -3 4 5 -8 10 6 -5 -4 2 10 5 -4 5 3 5 8 4 -5 -5 -4 5 4 -3 -8 5 5 4 5 10 10 10 10 8 5 4 10 6 -5 5 -2 2 -10 2 2 2 4 -2 -5 10 10 5 -5 10 5 5
User-defined …	
User-defined …	

CASE STUDY: HSM BUILDING (POST OCCUPANCY EVALUATION)

GROUP 1

DESIRABLE

Nice to look at?	4	-6		5	-2	2	-5		-6	-5		10	8	5	-5	5	5	-4	10	4	4	10	8	10	4	5	10	4	4	4	-4	4	-5	8	-4	4	10	8	-4	5	4	8	8	3	-4	4		8	5	10	-4		4	8	4	5	5	5	-5	5	4
High quality?	10	8	-6	-6	5	2	8	-1	10	-2		10	8	5	-4	10	5	-4	5	4	8	5	8	10	10	5	10	4	-4	4	-4	4	-4	5	-4	4	10	-4	-4	4	4	10	8	4	-5	4	5	4	5	8	-4		4	5	8	4	5	4	5	5	4
Profitable?	4		-2		-10	10	3	-8		-1	2	5	10	10	4	10	5	2	4	8	-4	5	4	5	10	5	10	5	4	4	4	4	4	5	-4	4	10	4	4	4	5	10	5	4	-5	4	4	10	5	4	-4		4	5	5	4	5	4	-5	5	4
Well-designed?	4		4		6	-2	4	-4	-2	4	5	4	10	10	4	4	5	4	8	4	5	5	8	5	8	5	10	10	4	4	8	10	4	5	-5	4	10	-4	4	5	5	10	-4	4	5		4	10	5	5	8	4	4	10	8	10	5	4	5	5	4
Valuable?	4	4		4		2		4	2	10		8	4	10	4	10	5	4	10	4	5	10	4	5	8	5	10	10	-4	-4	8	5	5	5	-4	4	5	-4	4	5	5	10	4		5		4	5	5	5	8	4	8	5	10	10	5	5	4	5	4
Prestigious?	4		-5	-2	-4			6		-2	3	4	4	10	8	10	5	-4	10	8	-5	10	10	5	8	5	8	8	-4	-4	8	5	-5	5	-4	5	5	-4	4	4	5	5	2	-2	5			10	5	5	2		4	4	10	5	5	4	4	5	4
Durable?	4		-8	1	2	5	10	2	-5	-4	-8	4	5	10	4	10	5	2	10	4	4	10	10	5	8	5	8	8	4	-4	8	8	-5	5	-5	4	5	-4	-4	4	4	5	2	-4	5	4	2	10	5	4	4		8	4	10	10	5	-4	4	4	5
Popular?	4	8		-10	-10		6	-2	1		-2	5	-10	4	8	10	5	4	10	8	-4	5	10	4	8	5	8	4	4	-4	4	8	4	4	5	4	5	-4	-4	5	4	5	4	-5	5		2	10	5	5	2	4	8	4	10	4	5	-4	4	4	5
Joyful?	4	-2			-4	-6		3	2	8	4	10	-10	4	10	4	5	-4	8	8	-4	8	10	8	10	5	10	4	4	-4	8	8	4	4	5	5	5	-4	-4	5	4	10	-3	-4	5	4		5	5	4	2		5	5	10	4	5	-5	4	4	5
Unique?	10	-3		-6	-2	-10	-1			3	4	5	-10	8	5	10	5	4	10	4	-4	10	5	8	5	10	10	10	4	4	8	5	-4	4	5	5	5	-4	4	4	4	10	-4	4	5	4	-4	5		5	2	4	10	5	5	8	5	-4	4	5	5
User-defined …																																																													
User-defined …																																																													

ADAPTABLE

Versatile?	5	2	6	-8	-8	-8	2	-6	-3	3	-6	-8	5	10	10	2	5	8	4	4	-5	8	8	4	10	4	4	4	4	4	4	4	-4	5	-4	4	4	2	4	4	-4	10	8	5	5	4	10	5	8	5	-8	-4	5	4	-4	4	10	5	-10	10	5
Easily modified?	8	4	4	4	8	8				6	6	-4	5	5	5		5	10	5	4	-4	8	8	4	10	4	4	4	4	4	-5	4	-4	5	-4	4	4		4	5	-4	4	8	3	8	8	10	10	8	5	-5	-4	5	-4	-4	4	10	5	5	10	10
Able to be customized?	10		-4			5	4	-4	-8	1	2	-4	10	10	5	4	5	10	5	4		10	5	5	5	4	4	4	4	4	-4	5	-5	5	-4	-4	4	-2	5	5	4	4	4	5	4	5	10	5	8	8	-4	-4	5	-4	-5	5	10	5	5	5	10
Multi-use?		-3	6	2	4	-3	-5	3	4	4	-8	-4	10	5	4	5	5	10	5	3		5	5	5	5	4	4		4	4	-4	4	-5	5	-4	4	4	-4	5	5	4	5	4	5	5	8	8	5	8	5	-2	-4	5	-4	-5	4	10	5	5	10	5
Transportable?	5	-6	3	1	-5	-3	-8	3	1	4	-10	-4	10	10	8	4	5	4	10	8	5	5	10	5	5	-4	2	3	4	4	4	4	-5	8	-4	-4	4	-4	5	5	4	10	4	2	10	5	8	10	8	5	-4	-4	10	-4	4	5	10	4	5	5	10
Better with age?	10	6	-2	3	10	4	6	-2	4	-2	-1	-4	5	5	10	4	5	10	10	4	5	10	5	5	5	-4	2	4	4	4	4	4	-5	5	-4	-4	-4	-4	5	5	-4	10	4	-5	10	10	5	10	8	4	4	-4	10	-4	4	5	10	4	5	5	5
Modular?	5	-4		4	-1	-6		2		8		-4	5	10	10		5	8	8	8	5	10	4	5	5	-2	3	5	4	4	5	4	4	5	-4	-4	-4	-4	5	5	-4	4	4	4	4	8	4	5	8	5	5	-4	5	-4	5	4	10	8	5	5	10
Scalable?	5	8	-6	10	-2	-3	4	5	-10	10	1	-4	-5	10	8	5	5	5	10	4	5	10	10	5	10	-4	-4	5	8	8	-4	4	4	8	-4	-4	-4	-2	5	5	-4	5	4	-4	8	5	5	4	8	5	4	-4	8	4	5	5	10	4	5	-5	5
Technically clever?	10		-8	4	-3	2	10	-4	-8	1	8	-4	10	5	5	5	5	5	10	8	4	10	10	5	10	4	-4	4	8	8	4	4	5	8	-4	-4	-4	-2	5	5	-4	5	4	5	10	5	5	5	8	5	2	-4	10	5	8	4	10	8	5	-5	10
Timeless?	10	-2		-2	-3	-10	3	-8	-4	10	-8	-4	10	8	5	-5	5	5	10	4	4	5	5	8	10	-4	-1	4	8	8	4	4	4	4	-4	-4	4	-2	10	5	-4	4		4	10	5		5	8	5	2	-4	5	5	5	5	10	10	10	-5	10
User-defined …																																																												
User-defined …																																																												

PRACTICABLE

Functional?	-10	5	1		4		8	-1		-10		4	5	-5	8	10	5	5	5	4	10	10	4	8	8	5	5	5	8	10	10	5	10	5	5	10	5	5	10	4	4	8	5	5	8	10	10	5	10	5	10	5	5	5	5	-4	5	5	10	4	5
Appropriate?	-5	1	-4	8	-1	10	2	-1	-3	-2	-8	4	-5	5	8	5	5	5	5	4	4	10	5	8	10	5	10	5	8	10	5	10	10	5	5	5	5	4	10	4	5	4	4	5	8	8	10	3	10	10	10	5	10	5	5	-4	5	5	10	8	5
Robust?		2	2	-3		4	1	2			-10	4	-5	5	10	10	5	5	5	4	8	10	5	4	5	5	10	5	10	10	5	10	10	5	5	5	5	5	10	-4	5	8	4	5	4	8	10	10	10	5	10	5	10	5	5	4	5	10	10	8	10
Safe?	10			-8	5	6	-8			-5		4	-5	5	10	10	5	10	5	4	10	5	8	4	5	5	10	5	10	10	5	5	5		5	5	5	5	10	4	4	10	10	5	4	8	10	4	10	5	10	5	4	5	5	10	5	5	10	10	5
Healthy?	5	5		2		2	1	-8		5		4	-5	-4	10	4	5	10	5	5	4	5	5	10	10	-5	10	5	8	10	5	10	5	4	5	5	5	5	10	4	5	5	10	5	4	10	10	3	10	5	10	5	5	5	5	5	5	5	10	10	10
Problem-solving?		4	5	-2	1	2		6	8	-5	-4	5	-5	4	8	8	5	10	10	5	10	10	5	10	10	-5	10	5	8	5	5	10	4	5	5	5	5	4	10	-4	4	5	5	10	4	5	10	-4	10	5	10	5	5	5	5	5	5	10	10	10	10
Easy to use?	-5	-10		-8	5	3	4	2	-6	-5	-1	5	4	5	10	4	5	10	10	5	10	10	5	8	8	-5	10	5	8	5	5	10	4	5	5	5	5	4	10	-4	5	10	5	10	4	10	10		10	5	10	5	10	5	5	5	5	5	10	5	5
Affordable?	-5	-3	-2	2	-5	4		10	-1	-10	6	10	4	5	10	8	5	5	10	5	10	8	10	8	4	-5	10	5	8	5	10	5	4	5	5		5	4	10	-4	4	8	10	10	10	5	10	-4	10	5	5	5	5	5	-5	5	-5	10	10	10	10
Comfortable?	-5			-2		5	5	-4		2	1	10	4	5	10	10	5	10	10	5	8	8	10	10	5	-5	10	5	8	5	10	5	5	5	5	5	5		10	-4	4	4	4	5	10	10	10	-4	10	5	5	5	5	5	5	4	5	5	10	10	5
Ethical?	-10	-3	-4	-4	-4		-4		-8	-6	1	8	8	5	10	10	5	10	10	4	10	8	10	8	10	-4	4	5	8	4	10	5	5	5	5	5	5	5	10	-4	4	8	4	5	8	10	10	5	10	5	5	5	5	5	5	5	5	10	10	10	10
User-defined …																																																												
User-defined …																																																												

SERVICEABLE

Low maintenance?				-6	-10	6	6	1	4	-2		-4	5	8	8	5	8	10	5	4	5	5	4	10	5	5	5	5	5	4	5	5	5	10	5	10	4	5	5	5	5	4	5	10	10	5	10	4	5	4	5	5	4	5	5	4	10	5	5	5	10
Easily cleaned?		4	-4	3	3		-1	-6	6	4	-5	5	10	4	10	5	8	5	5	10	5	5	5	10	5	5	-5	5	10	5	5	5	5	10	5	5	4	5	10	10	5	4	5	10	8	5	5	8	10	10	5	5	5	5	5	10	10	5	5	5	5
Recyclable?	4		-4	-5	10	-3	-2	4			1	5	5	5	10	8	4	10	10	4	10	10	4	5	5	5	5	5	10	4	5	5	4	10	5	5	5	5	5	4	10	8	5	5	10	5	8	8	10	8	5	5	5	5	5	10	10	5	10	5	10
Non-toxic?	4	-4		-2	2	3	2	-1		-5	-5	4	5	5	10	4	10	10	10	10	10	5	10	4	5	10	5	5	10	5	5	10	5	10	5	5	5	5	10	10	10	5	5	5	5	5	10	4	5	10	10	5	5	4	5	4	10	4	10	4	5
Repairable?	8	-6	-2	-10	-1	10	4	-1	10	2	10	-4	5	5	10	10	5	10	10	5	10	10	4	10	5	10	4	4	10	5	10	10	-5	10	5	5	4	4	5	5	10	8	5	5	4	5	10	4	5	10	10	5	5	5	5	4	10	5	10	10	10
Energy efficient?	8	2	2	-10	-4		-2	-3	-5	-5		-5	8	5	8	4	4	10	8	10	10	5	10	8	5	10	4	-4	10	5	10	-5	-5	10	5	5	5	4	5	5	10	8	5	5	10	5	10	4	4	4	10	5	10	4	5	5	10	4	10	5	5
Reliable?	8	10	2	1	4	8		-2	4	-4	-5	5	5	5	10	8	5	10	10	5	10	5	10	8	5	5	-4	4	10	10	5	-5	-5	10	5	5	4	5	5	4	10	5	5	10	4	5	10	8	8	10	5	5	5	5	5	4	10	5	10	5	10
Accessible?	4	1		-4			-4	-4		6	3	5	5	10	10	10	4	5	5	5	8	5	10	5	5	5	-5	-5	10	5	5	-5	4	10	5	10	5	5	5	4	5	4	5	10	10	5	10	4	8	10	10	5	5	5	5	5	10	5	10	5	5
Regenerative?	10	-6		-5	-10	4		-3	-2	4	4	4	10	10	10	10	5	5	10	5	10	5	10	10	5	5	-5	5	10	5	10	-5	4	10	5	10	5	5	10	5	5	5	5	10	10	5	10	10	4	10	5	5	10	5	5	5	10	10	8	5	5
Habitat-safe?	10	-2	-8	-2	-10		-4	2	6	8	-5	5	10	10	4	10	5	10	10	5	5	5	5	5	10	10	5	5	10	5	10	5	5	10	5	10	5	5	10	5	10	5	5	10	5	5	10	10	4	10	5	5	5	5	10	4	10	10	8	5	5
User-defined …																																																												
User-defined …																																																												

DESIRABLE

Nice to look at?	3 6 6 8 6 -8 2 6 3 8 8 6 -1 4 1 8 8 8 3 2 -1 3 -4 3 3 2 2 -2 3 -1 2 4 6 8 3 6 8 8 3 8 8 8 8 6 4 3 6 4 6 8 3 8 6 4 6 8 6 8 -4 2 4 4 4 -4 2 -4 -4 5 -1 4 8 2 4 -1 2 10 4 4 4 4 -3 2 4 -2
High quality?	6 8 4 8 4 -8 3 4 8 8 3 -1 4 -4 8 8 3 -4 3 3 6 -4 8 3 4 -2 -4 -4 4 3 -4 -8 3 8 8 4 4 3 4 4 4 8 6 4 4 8 8 3 8 8 3 8 4 8 6 4 3 8 6 3 3 4 3 5 10 4 -5 5 -8 -5 5 4 -4 -5 5 5 10 -4 5 4 -4 -5 8 4 4 5 5 -4 5 -4
Profitable?	4 4 4 8 6 -8 -3 -2 6 -4 3 8 4 -1 8 -2 4 3 -8 6 4 3 3 3 2 -8 -4 2 2 -4 -6 8 6 6 3 8 3 3 8 6 3 3 8 8 4 3 8 6 3 3 4 3 6 4 3 3 6 6 5 3 8 10 -4 -10 4 -4 2 4 5 -4 -1 4 4 -1 4 -3 -4 -2 4 -2 4 -5
Well-designed?	3 6 3 8 4 -8 3 4 4 8 8 6 -1 8 -1 8 8 8 3 2 3 4 -4 3 2 -2 4 -1 -2 2 3 -2 -3 2 3 5 4 8 3 8 6 6 4 6 6 3 8 8 4 3 8 6 3 6 3 4 6 6 3 3 8 8 3 4 2 4 4 -4 4 -5 4 2 4 4 -4 -4 8 10 -3 4 2 4 4 -3 5 4 4 8 -3 2 4
Valuable?	6 8 3 8 8 -8 4 6 8 8 4 -1 6 -4 8 8 4 2 2 8 -3 8 3 3 3 3 -3 -8 3 8 4 6 8 3 3 8 4 8 8 3 4 6 8 8 3 4 4 3 4 4 8 6 8 8 4 6 4 3 4 8 4 4 5 4 4 8 10 4 4 4 4 4 -4 4 10 10 -4 4 4 4 4 5 3 4 5 8 -3 4 4 5
Prestigious?	6 3 8 8 4 -8 4 -3 8 8 3 -1 6 -4 8 8 6 3 -4 4 -2 2 3 -2 -4 2 3 -2 -2 3 2 6 8 8 3 6 4 4 6 8 4 8 8 6 3 6 6 8 3 8 6 4 6 4 6 8 6 3 4 4 4 4 3 4 4 4 5 4 4 3 5 -4 1 8 10 1 2 4 3 4 -2 6 4 4 4 2 -3 4 4 4
Durable?	4 8 4 8 8 -8 6 -4 8 8 3 -1 3 8 8 3 3 2 8 -4 2 3 -2 5 -1 -4 4 3 -4 -8 3 2 4 4 4 3 3 8 8 6 8 6 8 3 4 8 4 3 6 6 6 4 3 3 6 3 4 3 3 8 4 5 10 0 4 8 5 5 4 4 5 5 10 10 5 5 5 4 5 10 10 4 4 10 4 5 5
Popular?	4 8 3 8 8 -8 -3 -2 4 8 8 4 -1 4 -3 3 8 8 2 3 -4 8 -4 6 2 -2 -1 -3 -1 3 -2 -6 3 6 10 6 4 3 8 2 6 6 4 3 6 6 8 4 2 4 4 3 4 3 8 6 3 3 3 4 8 4 3 4 10 3 2 3 4 4 4 4 4 4 -4 5 10 4 4 -1 10 4 5 1 3 4 4
Joyful?	4 3 6 8 8 -8 3 6 8 8 6 -1 4 -3 8 8 4 4 -4 8 -4 3 -1 -2 -2 2 3 3 1 8 4 6 3 8 8 8 6 8 4 8 4 6 3 3 8 8 3 6 8 8 8 8 8 8 6 4 2 8 3 2 -2 4 4 4 4 3 4 -4 4 10 -3 4 2 3 -3 2 -4 3 4 4 5 1 4 -4 4
Unique?	4 8 4 8 8 -8 3 8 3 8 8 4 -1 8 4 8 3 3 3 -2 4 2 3 2 3 3 -2 1 2 2 3 4 6 8 3 8 4 4 8 8 8 8 8 8 4 6 6 8 6 4 3 4 3 3 3 3 3 6 5 4 8 2 4 4 -1 10 4 2 8 -3 4 4 4 10 4 8 8 1 4 3 6 4 4 5 2 -3 2 4 8
User-defined ...	8 8 8 8 8 3
User-defined ...	6 8 8 8 8 8

ADAPTABLE

Versatile?	3 6 2 8 -4 -8 -3 4 6 8 8 6 -1 8 4 8 8 8 3 -3 2 -4 3 3 -3 3 3 -2 -2 8 8 6 4 4 4 4 4 8 3 8 6 8 8 8 8 4 6 6 8 6 8 6 3 3 4 3 6 6 3 4 3 4 4 4 4 4 4 5 4 4 5 4 -3 4 8 -3 4 5 4 6 3 4 4 4 4 4 4 4 -4
Easily modified?	8 4 6 8 -4 -8 3 -4 -2 8 8 4 -1 8 -6 8 8 3 8 3 3 2 3 8 2 3 -2 -8 -4 3 -2 -4 3 3 6 8 6 3 8 4 6 4 3 4 8 4 -1 4 3 4 8 4 3 6 4 6 8 4 8 8 4 8 4 -4 -8 -4 -4 -4 -5 4 4 5 8 -3 5 4 3 5 4 -4 3 4 -2 3 4 4 -2 6 -4 2 3 -8
Able to be customized?	3 8 8 8 4 -8 2 8 8 6 -1 6 -2 8 8 3 3 3 3 4 3 4 -1 -2 3 -2 3 -3 3 4 3 8 3 2 3 6 6 3 8 6 3 8 6 8 6 1 3 8 6 3 3 8 4 3 3 3 3 3 3 8 3 2 4 3 -2 4 -4 -2 4 1 10 8 4 4 4 1 4 3 4 -3 3 8 4 -2 -3 2 4
Multi-use?	6 3 3 8 8 -8 3 3 4 6 -4 8 8 3 -1 3 -4 8 8 8 3 3 -3 3 -4 3 3 2 4 -1 4 3 2 -4 -3 3 4 3 8 8 4 3 8 8 3 6 4 6 8 3 8 6 6 8 6 3 8 6 8 8 8 4 4 6 6 4 10 5 3 4 10 -5 10 4 1 10 5 4 5 10 -4 4 10 4 3 5 10 8 4 4 -4 -4 4 4 5
Transportable?	8 8 3 8 8 -8 3 8 3 8 8 8 3 -1 3 4 6 8 4 3 6 4 2 2 4 -1 -4 8 4 3 4 3 8 4 8 3 6 3 -3 8 4 4 3 8 3 4 4 4 4 4 3 4 8 8 3 6 3 6 6 4 4 6 5 4 10 5 3 -10 -10 -4 8 4 4 5 2 -4 10 5 4 4 10 5 5 8 -4 4 -2 10 12 4 10 5
Better with age?	6 8 8 8 -4 -8 -3 8 6 -4 8 8 3 -1 4 -4 8 8 6 8 3 -2 3 3 3 4 -1 -3 3 -2 -3 3 4 3 6 4 3 8 6 4 6 8 4 8 -1 3 6 8 3 4 6 6 6 4 6 6 3 4 4 4 10 4 -3 4 4 4 5 -5 5 4 5 4 -3 4 5 -3 4 4 4 4 5 5 8 4 4 -2 12 4 4
Modular?	4 3 3 8 8 -8 -3 8 4 2 8 8 8 -1 8 8 8 3 8 2 3 -2 3 3 3 2 3 -2 3 3 3 3 3 4 6 4 8 3 8 8 8 8 6 8 6 8 3 6 8 6 3 3 8 4 4 6 4 8 6 6 5 4 8 4 3 4 2 4 4 10 4 1 8 4 4 4 4 5 10 8 4 5 -4 12 5 4 4
Scalable?	6 4 6 8 8 -8 -3 8 8 4 8 8 6 -1 8 8 8 4 3 2 3 4 3 2 4 -2 3 3 2 -1 3 4 4 8 6 3 8 6 4 4 8 4 3 8 4 4 4 6 8 6 4 8 6 4 4 3 4 4 4 10 5 3 -4 3 5 4 5 4 8 10 8 5 10 5 3 4 10 4 4 4 6 10 4 5 4 6 4 4 4 5
Technically clever?	4 8 2 8 4 -8 4 8 8 4 -1 8 -4 8 6 6 4 2 3 -4 3 2 4 -2 3 3 3 -3 -8 2 8 4 8 3 4 3 8 8 3 6 3 4 6 8 4 8 8 3 6 4 3 8 6 6 8 6 6 8 3 6 4 4 10 4 3 -4 8 4 8 4 -5 4 -3 10 10 4 5 4 8 5 6 8 4 5 -4 -5 4 4 10
Timeless?	8 3 8 8 -8 -3 3 4 3 8 8 3 -1 8 1 8 8 8 6 2 3 8 3 2 4 -1 -3 3 3 -6 3 8 4 6 6 8 3 4 8 6 8 6 8 8 8 6 -3 6 8 4 3 4 8 4 3 3 3 3 3 6 4 4 4 4 5 3 5 10 4 5 5 4 4 10 4 4 10 10 4 5 4 4 4 10 4 4 5 4 12 4 4 4
User-defined ...	8 8 8 8 8 3
User-defined ...	8 8 8 8 8 8

PRACTICABLE

Functional?	3 6 6 8 8 -8 -3 2 6 4 8 3 3 -5 3 8 8 8 8 6 -2 -3 6 3 3 3 3 -3 -2 6 8 3 4 3 8 3 8 8 6 6 4 8 8 6 8 6 6 8 6 6 8 6 6 8 8 6 6 3 3 3 3 8 4 10 4 4 5 5 4 10 4 5 5 4 8 5 8 -3 5 5 -5 3 4 5 4 5 4 4 2 4 5
Appropriate?	4 4 2 8 8 -8 -3 8 4 8 4 -5 3 3 8 8 8 3 4 3 3 3 -3 8 2 3 3 3 3 5 8 4 6 8 6 3 3 8 8 3 4 8 8 8 6 4 4 3 4 4 4 4 3 8 6 8 4 4 4 8 3 4 8 10 4 4 -5 4 10 -4 -4 4 4 4 10 8 5 4 5 1 5 -2 3 4 8 4 4 4 4 4 4 4
Robust?	3 6 8 8 8 -8 3 3 6 8 8 3 -5 8 8 8 8 3 8 2 3 4 4 3 4 -2 -4 -4 3 -4 -8 -2 4 4 4 3 8 3 4 3 3 8 8 6 3 8 4 4 6 8 3 8 6 6 3 4 3 6 8 4 6 4 8 8 8 6 3 4 10 10 -4 3 5 5 5 4 -5 5 10 10 5 5 5 5 5 8 5 5 5 5 4 8 10
Safe?	6 4 4 8 8 -8 3 4 4 4 8 4 -5 8 8 8 4 4 6 3 3 -4 6 3 4 -2 4 2 -4 5 2 4 8 8 3 3 4 6 6 8 6 3 6 8 4 8 3 8 6 6 6 6 8 4 6 3 6 6 3 4 2 4 10 10 -5 5 5 10 4 5 5 10 10 10 4 5 5 5 5 -5 5 5 5 5 5 5 4 4 5 10
Healthy?	3 3 3 8 8 -8 -3 6 4 8 4 -5 8 3 8 4 8 4 2 3 4 2 -1 -2 2 4 6 3 8 3 4 3 8 8 3 3 8 8 8 6 4 4 3 8 3 6 4 3 3 8 4 4 4 6 -4 4 4 10 -3 10 8 -4 10 10 4 5 5 8 10 10 6 4 4 5 -4 4 5 4 3 4 4 5
Problem-solving?	3 4 6 8 8 -8 -3 4 3 8 8 3 -5 3 -2 4 4 3 3 2 -4 3 -2 2 3 -1 -8 3 3 2 4 8 6 3 3 8 4 8 3 3 8 8 4 8 6 8 6 3 4 3 4 4 3 3 8 6 6 3 3 6 4 4 10 10 5 4 8 -4 5 4 4 5 -4 4 10 10 5 5 5 4 4 5 8 5 5 8 4 4 4
Easy to use?	6 8 8 8 8 -8 -3 8 8 8 -5 3 -8 8 8 6 8 4 3 4 6 3 -2 4 -4 3 3 2 3 3 -4 4 3 4 8 3 6 3 3 3 8 8 3 4 8 4 4 3 8 3 8 8 6 6 3 6 3 4 6 6 8 4 -5 10 4 -5 4 4 -5 4 4 5 4 10 10 10 8 5 8 5 4 8 3 5 8 5 5 -4 4 4 4 5 8
Affordable?	4 8 4 8 8 -8 3 3 8 8 4 -5 6 8 8 4 4 4 3 2 -2 4 3 3 2 4 5 3 4 8 8 4 3 6 6 6 8 3 6 6 8 8 8 4 4 8 3 6 3 8 3 4 8 6 4 4 4 4 4 10 8 4 4 6 10 4 5 8 -4 10 5 10 10 10 8 5 4 4 10 5 4 5 5 5 4 4 4 5 8
Comfortable?	8 3 3 8 -8 3 6 8 8 8 -5 8 -3 8 8 6 8 3 2 4 8 3 -2 -3 3 3 8 3 6 3 3 3 8 8 6 8 8 6 8 6 3 6 6 8 3 4 8 4 6 4 3 6 3 6 4 4 4 8 4 4 8 4 5 2 4 -4 4 10 10 3 4 5 4 3 2 10 4 4 5 5 4 4 4 8
Ethical?	3 4 8 8 8 -8 -3 3 4 8 8 4 -5 8 -8 8 8 4 4 4 3 3 -2 -2 -3 3 2 3 4 4 8 8 4 4 3 8 8 8 4 8 4 4 8 6 8 3 8 4 8 6 4 3 3 6 4 8 6 3 -1 3 4 10 -3 0 5 4 4 5 4 4 4 4 10 5 4 3 5 5 4 2 5
User-defined ...	8 8 8 4 4 4
User-defined ...	4 8 8 3 8 4 6

SERVICEABLE

Low maintenance?	3 3 2 4 -2 -8 -3 -4 -3 -4 3 4 -10 3 8 4 4 10 2 -1 -6 -3 2 3 -2 -3 -2 -8 -4 -1 3 -3 -4 -4 4 4 3 -3 3 8 6 6 8 8 8 8 -1 6 3 8 4 8 6 3 -4 6 6 4 6 6 6 3 5 -4 -5 2 -4 4 4 -4 2 1 5 4 3 -4 5 5 -4 -3 4 3 -4 -2 -4 -3 4 -10
Easily cleaned?	3 3 6 4 3 -8 3 4 3 4 2 -10 6 -4 8 4 6 5 3 -2 -1 6 3 -2 -3 -3 3 -6 -1 6 6 6 6 3 4 8 8 4 3 4 4 8 8 4 8 4 6 4 3 6 -1 8 4 6 4 4 8 4 -4 -3 -4 3 4 -4 -2 4 -4 10 -4 -5 5 4 3 -4 5 4 4 8 4 4 2 -4 4 4 4 4
Recyclable?	3 3 4 4 3 -8 6 4 4 -10 8 3 8 6 -1 6 -4 3 2 -2 4 -1 -2 -1 2 -4 -4 3 6 4 8 4 3 2 8 8 3 8 8 6 6 4 3 6 8 6 4 6 8 8 6 6 4 6 6 3 4 10 4 4 3 -5 5 10 4 -5 5 2 -1 5 10 5 5 3 8 3 4 5 2 -4 5 5
Non-toxic?	6 8 4 3 -8 -3 8 4 4 2 -10 8 8 4 -10 3 -2 -4 -4 -4 3 -2 -2 -3 -4 -3 2 -4 4 8 6 3 4 8 3 6 6 8 6 6 4 3 4 3 3 6 3 6 4 4 3 8 6 4 6 4 10 5 -3 -5 5 8 5 10 5 -5 -5 4 -5 5 10 -4 5 10 3 10 -4 4 -4 -5 4 5 10
Repairable?	8 6 6 4 3 -8 8 6 4 3 4 2 -10 4 8 8 8 8 4 -2 6 2 3 3 4 -2 3 -4 2 3 -3 6 4 8 3 4 3 3 8 6 8 8 3 4 4 8 8 8 6 6 4 6 4 3 3 3 8 3 3 6 4 6 4 10 5 3 4 4 5 4 10 5 4 4 4 5 5 10 5 4 5 10 4 4 4 4 5 4 5 4 4 4 4 -4 5 5
Energy efficient?	6 4 4 4 3 -8 -3 3 6 4 4 -10 4 -1 8 4 3 4 -1 -4 4 3 3 4 -2 -4 3 -6 4 6 8 6 3 4 8 4 4 4 4 6 8 8 8 8 8 4 8 8 4 4 6 6 3 3 8 4 6 4 4 3 8 5 4 -10 8 5 -4 10 4 4 5 2 1 5 10 -4 4 5 5 4 5 4 5 5 -1 3 -4 5 4
Reliable?	3 6 8 4 3 -8 8 8 4 4 4 -10 8 4 4 6 5 2 -4 -4 -4 4 3 -2 -1 -4 4 2 -4 -4 -2 8 4 4 4 3 4 8 8 8 6 8 6 6 8 3 8 3 8 8 3 6 4 8 4 6 8 8 6 8 4 4 5 5 -3 4 5 10 5 10 4 4 5 8 -5 5 10 -5 5 5 5 4 -5 4 5 5 8 5 -4 4 3 -5 5 8
Accessible?	4 3 3 4 3 -8 -3 6 4 2 -10 8 6 8 4 4 3 -1 -2 4 6 3 -2 4 3 3 -3 6 8 6 3 3 6 6 6 6 4 6 4 8 6 3 3 6 3 6 8 6 4 2 4 3 4 3 3 6 4 4 4 5 -3 4 -2 4 4 8 4 -5 2 4 5 4 4 8 4 3 -4 10 4 5 -4 4 3 4 4 8
Regenerative?	8 8 4 -8 -3 1 6 4 2 -10 8 6 -1 8 4 3 8 -2 3 -2 3 -2 -2 2 -4 6 -1 -4 6 4 4 3 3 4 8 8 8 6 4 8 8 8 8 -3 8 4 6 4 3 4 6 6 8 6 4 6 3 8 -4 4 -3 4 2 4 -4 10 4 4 -5 8 -1 5 4 3 4 -3 4 8 4 5 -1 -3 -2 5 -5
Habitat-safe?	8 8 4 -3 -8 -3 8 4 3 4 5 -10 8 -8 8 8 -10 3 -1 -4 -3 -4 2 3 -1 -3 -3 -3 2 -4 -8 -2 -4 8 6 3 3 4 8 3 4 4 8 8 6 8 4 3 3 8 8 3 8 8 8 4 4 8 3 6 8 8 12 8 5 4 -2 -5 4 -5 5 4 -4 5 -4 -4 5 10 -4 5 4 -5 -3 3 5 5 -4 -5 5 -4 4 -5
User-defined ...	8 3 4 4 3 6 2 8
User-defined ...	8 3 2 4 8 3 4

CASE STUDY: BEUE (SERVICE PROVISION) GROUP 2

CASE STUDY: GCLR (SYSTEM DEVELOPMENT) GROUP 2

DESIRABLE

Criterion	Ratings
Nice to look at?	-10 10 1 4 5 2 -10 10 4 3 4 4 5 4 8 4 -5 10 5 4 5 10 5 10 3 4 4 3 10 8 1 10 8 5 4 10 10 4 2 -4 4 3 10 8 5 10 -2 -1 -5 5 -6 -10 -10 -4 5 5 -5 10 -4 -4 2 10 5 4 1 6 -4 -8 4 2 1 -2 3 -6 2 3 -10 5 5 5 10 10 4 10 10 -4 5 4 5 4 5 5 8 -6 4 1 4 2 8 5 10 5 4 5 4 5 5 10 4 -8 -6 -6 -2 1 1 -8 -8 4 4 8 5 4 10
High quality?	-10 10 5 4 5 5 -10 10 5 3 5 5 8 10 10 10 5 10 10 4 5 5 5 10 10 5 5 4 10 10 5 8 4 10 10 4 10 -5 4 1 5 10 8 6 5 5 4 4 8 5 6 5 -8 -8 -10 -4 2 4 4 1 4 -4 2 4 5 4 4 3 8 -8 -5 5 2 -8 2 1 -2 -3 5 5 5 10 10 4 10 10 -4 5 8 10 4 5 5 5 4 6 4 5 5 5 10 5 5 5 4 -5 4 5 10 4 -4 -4 1 2 -3 -2 -10 -2 2 2 -2 5 4 10
Profitable?	-10 -4 4 -10 4 3 3 4 8 -4 5 -2 4 4 -3 4 10 5 5 4 5 5 4 5 4 5 2 6 4 5 10 5 -8 10 2 -2 4 10 5 -8 -3 -10 -4 2 1 3 1 3 -4 2 2 4 5 2 2 -6 -2 2 3 4 3 6 8 6 10 5 -10 5 5 -4 10 3 5 -5 -4 5 10 5 10 5 5 4 -4 -2 5 5 5 4 -5 4 4 -5 6 3 -2 2 -4 -10 1 5
Well-designed?	-10 5 4 5 4 -10 4 5 3 5 10 10 10 -5 5 10 5 4 5 5 10 8 10 4 4 5 4 5 5 4 10 10 4 4 4 8 5 4 -4 5 -5 4 -4 4 5 -8 -10 -4 2 5 2 1 3 -10 2 2 4 5 2 -10 6 -4 -1 -8 1 -1 -4 1 -6 3 -4 -4 -6 5 5 5 10 10 4 5 5 -4 4 10 5 8 5 5 1 1 2 1 1 1 5 5 10 5 5 5 4 -5 4 4 4 -5 -5 -3 -2 8 6 2 5 5 -10 3 5 4 10
Valuable?	-10 10 4 10 4 -10 3 3 4 8 4 10 5 10 -2 4 5 10 5 10 10 4 10 4 4 10 3 5 10 10 5 4 5 6 -10 4 4 8 5 4 8 4 -10 6 8 5 -8 -10 -4 2 8 -1 -5 2 -4 2 4 4 4 4 -4 -6 10 -10 1 -6 1 -4 10 4 4 1 5 10 4 10 3 5 -5 4 5 10 10 3 5 5 -4 1 -3 5 5 5 10 5 4 -4 4 4 10 4 -5 3 4 4 4 4 4 2 4 -3 10
Prestigious?	-6 2 -2 4 -10 5 3 4 8 3 4 -2 -1 -3 4 10 4 4 4 3 3 -3 10 4 5 8 8 5 4 8 5 8 5 10 5 10 10 10 4 -4 1 -4 -10 -4 2 -4 2 -5 2 -4 2 4 5 4 2 2 -5 -8 -10 -6 -6 -10 -8 5 -5 8 10 10 4 5 -5 -5 4 5 5 -5 4 5 5 2 2 -1 5 10 5 4 -4 4 4 5 4 -5 -8 2 6 5 -6 -5 -1 8 4 -10 4 8
Durable?	-10 5 4 -10 5 3 5 5 10 10 5 10 10 4 5 5 5 4 8 10 8 4 10 5 5 5 5 10 5 4 8 10 4 3 8 8 5 5 10 4 8 6 5 1 -4 -10 -4 2 -5 6 -2 1 -4 2 -4 4 5 8 2 -1 8 -1 6 4 10 -4 -8 -8 -1 -10 2 -4 5 5 10 3 4 -5 -3 4 10 5 8 8 5 5 4 1 10 -5 10 5 5 5 10 4 4 -5 5 5 4 -5 -2 3 -2 -2 2 3 6 -1 -10 1 6 5 3 5
Popular?	-10 10 6 10 -10 10 5 3 5 3 8 5 8 -5 8 5 4 4 4 8 8 4 10 4 10 8 4 10 4 5 10 -5 5 8 10 3 5 4 4 5 10 2 -4 -4 1 -4 5 -10 -4 -5 8 -4 -2 -4 2 -4 4 5 4 4 -8 4 -4 -3 6 -2 4 -2 5 10 10 4 10 4 4 -5 -5 5 5 10 8 8 -5 10 6 -3 4 4 3 4 4 5 10 4 4 -5 5 5 4 -2 -2 -1 4 2 2 -4 8 6 5 5 10
Joyful?	-6 8 -2 5 3 -10 3 3 5 3 5 2 -1 -5 4 4 10 6 5 4 4 4 -5 4 4 10 4 4 5 5 8 2 10 5 4 10 8 5 10 8 4 -4 -2 10 1 -4 4 -10 -4 -10 -4 5 -2 -2 -4 2 -10 4 5 4 10 -2 -3 -10 2 4 -6 -10 2 3 -5 -10 -6 5 4 5 4 5 -4 -5 5 5 10 10 10 -5 -8 2 8 2 3 10 8 4 -5 -4 5 5 4 5 6 2 8 3 2 3 -4 -2 2 10
Unique?	-6 1 -2 -4 -10 -2 -4 3 3 -3 3 6 10 -2 -1 2 -1 -2 4 4 10 3 4 1 4 4 4 4 10 10 8 -4 3 4 4 4 5 -8 5 8 4 -2 2 1 -4 -10 -4 -6 4 4 -8 -4 -4 2 -10 4 5 4 5 -2 -4 -8 -4 -2 8 5 4 8 -8 5 8 -6 -6 5 -2 10 10 4 4 -10 -5 -5 5 -5 5 5 4 8 2 10 -8 -2 3 5 10 8 4 -5 -4 5 5 5 -6 1 -6 -4 -2 -6 5 -8 5 -2 10
User-defined ...	2 2 1 1 2 -1 2 2 1 2
User-defined ...	2 -1 2 1 2 1

ADAPTABLE

Criterion	Ratings
Versatile?	-10 5 4 -10 5 3 -4 -2 8 10 -5 10 -10 4 -3 5 4 4 2 4 -5 4 5 -4 2 4 10 5 10 -4 5 5 6 10 10 8 10 10 5 10 -8 10 10 10 2 10 -10 -10 4 8 5 2 10 2 -10 2 5 10 10 10 4 -10 -2 3 5 -2 -1 -4 10 5 10 2 6 -2 4 5 8 5 5 4 5 2 -5 -5 -5 10 5 -10 4 -3 -1 -2 5 4 -2 5 5 -2 -10 -5 5 5 5 -5 -1 4 8 -2 -3 -4 8 -5 -4 -4 4
Easily modified?	-10 -2 -3 5 4 -10 3 -2 -4 4 10 -4 -5 -10 4 4 5 -3 5 4 5 4 -4 4 10 -5 2 -3 4 10 4 5 -4 8 4 4 5 4 5 4 4 4 10 4 8 5 4 2 3 6 2 -4 2 10 4 2 -4 4 8 4 4 8 4 -2 6 2 -10 -2 -4 4 1 -8 3 -4 5 1 4 10 4 5 5 4 5 2 -5 -5 -5 5 4 4 -5 -10 10 2 2 4 -5 10 5 5 -4 -10 -5 5 4 5 -5 6 2 -2 -2 -5 -4 -2 1 10 -2 -3 -4
Able to be customized?	-10 4 4 -10 4 3 -2 2 5 10 -4 -5 -10 4 -3 4 5 8 4 4 10 -5 2 8 8 4 5 5 8 4 2 5 5 4 4 8 5 8 5 2 8 -10 10 8 1 3 4 -10 4 4 8 4 1 2 -5 -2 3 2 -4 1 -10 10 5 -10 6 4 10 5 5 5 5 2 5 -5 -5 4 5 -8 4 -2 4 -2 4 3 5 5 -5 -2 -10 -5 -5 4 8 -5 -4 -4 10 8 6 -5 2 -4 6 -1 -4
Multi-use?	-10 4 -10 5 3 -2 4 8 5 -4 -5 -10 -3 -6 4 4 4 10 10 4 -4 4 10 -5 2 4 8 10 5 -6 8 1 -2 5 8 10 10 10 5 8 -5 4 8 2 -3 -8 -4 6 -2 5 -6 -4 4 2 4 4 10 -3 2 2 -3 3 8 -3 5 1 -4 4 4 8 4 4 -5 8 4 5 5 5 5 2 5 -5 5 5 -5 3 10 -4 2 4 -3 4 4 5 5 -5 -2 -5 -5 10 -5 -4 2 6 2 -2 -3 -10 -4 -3 2 -4 3
Transportable?	-10 3 4 -10 4 5 3 -3 2 -3 4 10 -10 4 4 4 8 4 5 4 5 4 4 -4 2 4 10 5 4 -6 8 8 5 5 -3 4 8 5 -6 10 4 -5 -3 1 -4 10 -10 10 10 4 5 -10 -8 4 4 10 -5 -8 5 8 -2 -2 -4 10 10 -5 -4 -3 -3 10 4 10 5 5 10 2 5 -5 5 -5 4 -5 2 1 3 4 1 4 5 5 -4 -2 -10 -5 -4 10 -10 -4 2 10 1 4 2 -6 1 -3 4 4
Better with age?	-10 3 -10 10 3 -2 -1 -3 5 5 -8 -1 -5 4 -4 4 8 4 5 -5 2 4 10 4 4 -8 5 10 2 10 10 8 5 8 4 8 4 4 5 -8 8 -10 -10 -10 2 -10 4 -4 -10 2 5 4 4 10 -4 -2 2 -4 8 -3 -8 1 -8 1 -8 1 4 -3 8 5 5 5 10 2 5 -5 -5 -4 5 4 -5 -4 10 3 6 4 5 4 -5 -2 -5 -5 4 10 -4 -2 3 4 -6 4 3 2 4 -4 4
Modular?	-10 4 -10 3 -2 5 3 -8 8 3 4 4 8 4 4 10 -3 2 4 10 8 4 -8 4 4 2 10 8 8 5 4 -6 3 5 -8 -10 -8 10 -10 2 -1 5 4 -10 2 4 4 4 10 -10 -5 -4 -1 -1 2 -5 -2 -6 -8 6 10 2 3 4 8 10 4 4 5 5 10 4 5 -5 -5 4 4 5 -5 -2 -3 2 -2 6 10 5 5 -5 -2 -10 -5 -5 4 5 -8 -8 2 -3 2 -4 8 10 -4 4
Scalable?	-10 5 10 4 -10 3 8 8 10 10 5 -8 8 10 8 4 4 4 10 8 3 2 10 10 4 4 -6 5 4 1 5 8 5 10 4 10 4 -5 2 -10 5 -4 10 -10 5 -5 -10 2 -2 4 4 8 4 2 3 1 10 3 -4 6 -1 4 -2 4 10 10 5 -5 5 5 5 4 -5 -5 -5 4 4 5 -4 2 -2 8 4 8 4 4 10 5 5 -4 -2 -8 -5 -5 4 5 -5 -3 -5 -8 -4 -4 -3 3 -4 -2 -4 3
Technically clever?	-10 2 10 4 -10 3 6 10 10 8 4 -10 10 10 8 5 4 4 10 6 5 2 8 10 4 5 -8 4 2 1 5 10 4 8 4 8 2 -4 2 -2 3 -3 10 -8 4 -4 -8 2 -2 4 4 8 2 10 1 1 2 3 -6 2 -5 8 -2 4 6 10 5 -4 5 4 4 -5 -5 -5 4 4 5 -5 6 -1 10 1 4 5 4 8 5 5 -4 -2 -8 -5 -5 5 5 -5 -2 -3 -8 -2 -3 -2 3 -8 -10 -4 4
Timeless?	-10 -1 4 4 -10 3 -2 -6 10 5 1 -8 -1 5 4 -10 10 4 4 -4 4 -5 2 4 5 10 10 5 -10 10 5 1 5 8 -8 8 8 5 2 5 -4 2 -2 -10 2 -4 10 1 2 5 2 5 4 4 5 5 -4 8 2 -6 -1 -5 -8 2 4 -10 3 3 6 4 5 -4 4 8 4 5 -5 -5 -4 4 5 5 6 -4 -3 -10 5 4 5 5 -4 -4 -8 -5 -5 4 5 -10 -2 6 6 -6 1 -4 -2 6 2 -4 1 10 4
User-defined ...	
User-defined ...	

PRACTICABLE

Criterion	Ratings
Functional?	-10 10 5 5 10 4 -10 5 5 3 4 10 8 10 10 10 10 5 -5 10 5 10 5 5 10 10 10 10 4 4 10 8 10 8 8 10 10 4 5 5 5 10 2 8 8 10 10 10 8 2 10 -5 10 10 6 4 3 -4 10 5 10 4 10 10 10 10 10 10 10 8 2 1 10 8 10 -1 -2 6 -3 -1 6 -4 5 4 10 10 10 5 -10 8 5 5 5 5 4 5 5 5 5 4 -2 2 5 5 10 5 10 10 -5 5 5 10 5 10 5 5 -5 -3 8 4 1 -6 5 4 4 10
Appropriate?	-10 10 10 4 10 4 -10 5 5 3 4 4 8 4 10 10 10 5 -10 3 10 4 10 5 10 4 3 4 4 4 10 10 10 8 10 10 10 4 10 5 4 5 2 8 4 4 4 10 5 6 8 4 4 8 3 -5 4 10 2 5 4 4 4 4 4 4 8 8 2 4 10 8 4 6 8 2 -5 4 4 3 1 -2 3 4 8 8 10 5 -10 8 4 5 4 5 4 5 10 5 5 10 5 10 8 2 3 -1 6 10 5 10 10 -5 5 5 10 5 4 4 5 -5 -10 -2 6 2 4 3 -1 -3 3 4 -4
Robust?	-10 5 10 4 -10 5 3 5 3 4 10 10 10 5 -4 5 5 -2 4 5 10 4 4 10 -2 8 8 10 10 10 10 4 10 4 4 -2 5 8 4 5 4 1 10 2 1 8 -4 10 2 5 4 3 4 5 -5 4 8 8 2 5 10 8 2 2 4 6 5 -4 3 4 3 1 6 5 4 10 10 -5 10 3 4 4 4 5 5 10 5 5 10 10 6 5 -2 5 10 5 10 10 -5 5 5 10 5 4 4 5 10 -6 8 -2 -3 4 -8 2 5 6 4 10
Safe?	-10 5 5 5 10 10 -10 5 10 3 4 10 5 4 10 10 10 5 -10 10 10 10 5 5 4 10 4 4 10 10 5 5 8 10 10 10 10 4 8 5 8 -4 8 5 4 10 5 8 5 5 2 2 -3 -3 -4 10 8 8 4 4 4 8 4 5 10 4 8 2 10 10 8 2 -4 3 4 4 -1 -4 -1 -10 -1 2 2 4 5 10 10 5 -5 3 4 5 4 5 -5 5 5 5 5 6 6 -4 -3 8 10 5 3 5 10 10 -5 5 5 10 5 4 5 5 5 1 5 2 5 5 5 1 -2 4 6 5 10
Healthy?	-10 5 -5 10 4 -10 4 3 5 3 5 5 5 10 5 10 5 5 10 10 5 5 8 10 10 10 10 5 4 10 4 6 4 4 4 5 10 5 3 4 6 -3 -4 4 -4 10 1 4 2 4 3 5 5 8 8 2 2 10 8 -4 4 6 8 -4 4 8 4 -1 -5 5 -8 4 4 5 8 5 -5 4 5 5 4 5 10 5 5 5 -6 -10 4 4 4 10 10 -5 4 5 10 5 4 4 5 10 4 -10 3 -4 1 5 -3 -3 -2 10 4 10
Problem-solving?	-10 5 5 4 10 -10 4 3 4 4 4 5 10 -5 4 4 4 8 10 4 4 -5 5 8 8 8 10 10 5 5 5 4 1 2 10 8 10 -5 -5 8 2 5 10 4 -2 2 -4 10 2 2 4 1 8 4 4 3 8 8 2 10 10 8 6 -4 -6 5 1 3 4 4 -2 4 -2 1 4 5 10 -5 -5 4 3 5 5 5 10 -4 5 5 4 4 8 3 4 4 2 10 -5 5 10 10 4 4 5 5 10 2 10 2 6 -8 -10 8 4 6 5 10
Easy to use?	-10 4 10 5 10 3 -10 5 5 3 4 10 4 3 5 8 10 5 -5 10 10 10 10 5 10 10 8 5 4 4 10 -3 5 8 10 10 10 4 5 5 4 4 2 6 4 5 4 5 5 4 4 8 -3 1 -4 10 -5 10 4 2 8 2 5 5 8 8 2 8 10 4 5 5 6 4 4 8 1 -3 8 4 -4 -5 4 4 10 10 10 -5 -10 4 5 5 5 -10 10 -4 5 5 -5 3 10 5 10 10 10 10 -5 5 5 10 5 4 4 5 10 -6 -4 -5 -4 -8 1 4 2 4 10
Affordable?	-10 5 5 10 4 -10 5 -5 3 4 10 -5 4 5 10 5 -5 10 5 10 10 5 10 10 10 10 4 10 5 4 5 8 10 10 10 10 5 4 8 5 4 3 4 5 8 10 10 -4 2 10 10 4 -4 4 4 4 -4 10 2 5 4 2 8 4 8 10 4 8 2 8 8 8 3 5 -3 -8 -3 8 -10 -6 -6 -10 -4 6 4 4 5 8 -5 -10 -4 5 4 5 -10 5 10 -8 5 5 -4 -4 8 8 5 10 10 5 10 -5 5 -10 5 5 4 4 5 -4 -2 3 -2 -6 2 5 -4 -2 -8 8 4 10
Comfortable?	-10 5 5 4 10 4 -10 10 5 3 4 10 6 10 5 10 5 10 5 4 10 5 10 10 8 5 4 4 4 -10 5 8 4 10 10 8 10 4 4 5 5 10 8 4 10 10 10 8 4 2 8 1 -4 10 2 5 4 1 8 5 8 2 4 8 2 8 10 8 2 2 -4 2 -4 2 4 3 1 -6 3 -4 -6 -8 -2 -4 4 5 10 10 -5 -10 4 5 5 5 5 10 -5 5 10 -4 4 4 5 5 4 4 10 -5 5 10 5 10 5 4 5 5 -2 -2 10 -6 -4 4 4 4 10
Ethical?	-10 10 4 10 4 -10 3 10 10 10 5 -10 4 10 5 10 3 3 10 4 4 5 5 8 5 10 10 10 4 5 4 4 -2 4 4 8 5 10 2 -8 10 8 3 10 -4 10 5 4 1 4 1 10 4 4 8 2 8 10 8 -2 4 4 -10 -4 -6 -6 -10 2 5 -3 8 4 4 8 10 -5 -5 -4 5 3 5 5 3 10 -5 3 10 1 -6 -2 10 5 8 10 -5 5 5 10 5 5 5 5 10 10 1 -1 -5 4 1 -5 1 8
User-defined ...	
User-defined ...	

SERVICEABLE

Criterion	Ratings
Low maintenance?	-10 -3 -5 4 -10 4 -1 10 10 -5 8 5 3 5 -5 10 10 4 5 5 4 10 -5 5 8 5 10 4 8 8 10 10 10 10 5 5 10 10 10 8 4 -2 4 10 4 -5 10 -4 10 -3 5 10 4 -4 10 4 -4 -3 10 4 -6 6 3 1 -6 -8 6 2 -2 -2 5 10 10 -8 -3 -5 4 5 -5 4 5 10 5 10 5 -6 2 2 6 4 -5 5 -5 -5 5 5 4 5 -5 6 3 10 4 -1 -4 -10 6 5 4
Easily cleaned?	-10 5 4 -10 4 5 4 5 4 5 4 10 8 5 3 5 4 5 10 10 5 4 4 5 10 -5 5 5 10 10 10 4 8 4 4 4 4 4 4 4 8 8 4 10 3 -3 4 4 2 -5 -8 -4 -8 2 5 4 5 3 -4 -4 -4 6 -6 -10 -5 -1 -2 4 -10 2 -10 5 5 8 10 -4 -3 -4 4 10 10 4 5 4 5 10 8 8 2 -5 4 5 4 4 4 5 -5 -5 -5 5 10 4 4 2 -2 4 -2 -2 8 4 4 5
Recyclable?	-10 -4 4 -10 -3 4 -4 5 5 -5 10 5 3 -4 5 4 10 5 5 4 10 -5 10 5 4 10 5 2 10 2 5 3 10 4 5 3 4 1 8 4 -8 -6 1 6 -4 5 8 5 5 10 4 -4 10 10 -3 -2 6 -3 -4 -4 -1 -6 -4 -1 -10 -1 5 10 10 -4 -4 4 4 10 10 4 5 4 5 5 4 5 1 2 8 4 -4 5 10 -5 -5 5 4 10 4 5 -4 -4 4 4 -1 -10 4 -4 -1 5
Non-toxic?	-10 10 4 -10 4 10 6 -5 5 5 10 5 10 5 4 6 10 4 10 4 4 -5 10 10 5 4 8 5 2 8 6 -4 10 8 8 4 10 1 10 1 3 -4 -3 -5 4 6 -4 -6 -8 10 4 -5 8 4 -4 10 -8 -6 10 6 -10 -10 4 -8 2 6 8 4 5 10 10 -5 -3 -4 4 10 10 4 5 5 4 8 -2 -8 -2 5 10 5 -5 5 4 5 5 10 -5 -8 -1 2 5 4 4 4 3
Repairable?	-10 10 4 5 4 -10 10 -4 10 8 5 10 10 5 10 10 3 5 5 5 10 10 10 5 10 4 5 10 10 8 5 8 8 5 2 5 3 5 5 4 10 4 5 1 4 6 8 4 3 -4 10 -8 4 5 2 -6 -5 -6 5 4 10 4 5 4 4 4 -4 6 4 6 3 3 6 3 3 3 6 2 -4 3 5 10 10 -5 -3 -4 4 5 5 4 5 10 5 4 10 3 10 -8 6 10 5 8 5 10 5 5 10 5 5 8 -5 -5 10 -4 -6 -1 -1 -2 -8 6 -8 4 4
Energy efficient?	-10 10 3 10 10 -10 10 -4 10 4 5 10 10 10 10 10 5 10 10 10 5 10 4 10 10 10 5 10 8 4 2 4 2 3 5 5 8 5 4 2 4 8 4 -4 3 4 -8 10 -5 -4 -4 2 -4 -8 -4 4 5 8 4 8 -4 -4 1 4 4 10 -6 -2 -4 6 4 1 2 5 10 8 10 -4 -3 -6 4 10 5 5 10 5 -5 5 10 3 -5 2 -10 -5 5 10 5 -5 5 5 4 5 4 1 -3 -6 -4 -2 -5 4 -4 -3 5 4 5
Reliable?	-10 10 5 10 4 -10 10 5 -4 5 5 10 10 10 10 10 10 10 5 10 8 10 4 3 4 10 10 10 10 10 4 4 2 4 2 2 5 -1 5 4 8 3 -10 8 8 8 3 -6 -8 -4 10 2 -5 1 8 10 4 10 8 4 6 -4 -2 5 3 -5 4 -1 4 1 -6 2 10 -10 5 10 10 10 -5 -3 -4 4 4 10 4 5 5 5 5 8 -1 3 4 10 5 8 5 10 5 5 8 5 10 4 5 -2 -1 -2 -6 1 5 2 1 5 10
Accessible?	-10 10 5 4 10 4 -10 4 5 -4 5 4 3 10 10 10 -5 10 5 10 10 5 10 10 3 10 4 10 -10 10 10 10 10 10 10 10 4 5 4 10 2 4 4 8 4 10 4 8 10 3 8 5 -6 -6 4 5 5 10 2 -5 -4 -8 -4 10 8 4 6 -4 -2 4 -8 -5 8 -1 -8 -2 2 1 5 10 10 -4 5 8 4 5 4 5 5 4 5 10 -6 6 2 10 5 -10 10 5 10 10 5 5 5 4 8 10 -5 -2 -1 -1 6 -8 -3 -3 5 4 10
Regenerative?	-10 -3 3 -10 -1 3 8 5 -4 4 -4 -3 4 -4 10 5 4 10 10 5 4 4 -4 10 5 5 4 -4 10 5 10 5 1 5 10 8 2 3 4 5 5 -10 2 -4 10 10 8 5 4 10 8 4 3 -4 6 -3 2 3 -2 -5 10 4 10 -1 5 4 10 -5 8 4 4 8 4 5 5 5 5 5 5 5 8 -1 3 4 -4 2 5 10 5 5 5 10 4 4 -3 -5 -2 -5 -8 8 -2 1 5 4
Habitat-safe?	-10 10 10 5 3 -10 4 -3 3 5 10 -10 4 -5 5 -5 10 4 4 -3 10 5 8 5 10 8 5 10 8 2 8 -2 4 4 4 8 8 4 8 10 4 3 10 8 -10 10 -4 -4 -1 4 4 5 5 4 4 2 -4 4 -4 3 -3 -10 4 -2 -1 3 -2 -3 5 4 10 -5 4 -5 5 5 10 5 5 5 5 10 10 -3 -8 4 -8 -4 4 1 5 10 5 10 10 5 5 4 4 10 4 -2 -10 4 4 -3 -2 10 -8 -5 5 4 5
User-defined ...	
User-defined ...	

Appendix 5: EUS integration with *i3d3*

This appendix sets out examples of EUS integration into *i3d3* using the three Group 2 case studies. It highlights how the pre-implementation (design), implementation (deliver) and post-implementation (delight) phases are integrated together. Information collected as part of these examples was possible because of the high public interest in these projects and the wealth of online data including historical newspaper articles.

HZMB shows an *i3d3* ranking of 22. When broken down into the four consequences of financial, social, ethical and environmental, it scores -13, 24, 56 and 21 respectively. When looked at by the three phases of initiate (design), implement (deliver) and influence (delight), DSS = 22, PDS = -21 and EUS = 65, respectively. It deserves a humanity index of 40 by contributing to UN SDG 16 and 17. It also displays a net benefit score of 25, with stakeholder groups representing 5 winners and 2 losers. Its complexity score is 27.

BEUE shows an *i3d3* ranking of 50. When broken down into the four consequences of financial, social, ethical and environmental, it scores 69, 21, 57 and 54 respectively. When looked at by the three phases of initiate (design), implement (deliver) and influence (delight), DSS = 79, PDS = -17 and EUS = 88, respectively. It deserves a humanity index of 80 by contributing to UN SDG 7, 9, 10 and 17. It also displays a net benefit score of 67, with stakeholder groups representing 6 winners and 1 loser. Its complexity score is 12.

GCLR shows an *i3d3* ranking of 23. When broken down into the four consequences of financial, social, ethical and environmental, it scores 14, 23, 26 and 28 respectively. When looked at by the three phases of initiate (design), implement (deliver) and influence (delight), DSS = 28, PDS = 5 and EUS = 35, respectively. It deserves a humanity index of 20 by contributing to UN SDG 17. It also displays a net benefit score of 24, with stakeholder groups representing 7 winners and 0 losers. Its complexity score is 12.

The above represents all the performance data needed to evaluate project success. BEUE is ranked best, then GCLR closely followed by HZMB. This ranking was not reflected by end-user delight scores. Should any *i3d3* ranking be equal, overall position is decided based on the humanity index, and if these are also equal, then the number of winners would come into play.

Each *i3d3* analysis comprises six pages.

i3d3 RANKING	22	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

CONSEQUENCES	Project Initiate	Project Implement	Project Influence	Score (%)
Financial (long life)	-70	-35	65	**-13**
Social (loose fit)	41	-35	66	**24**
Ethical (least pain)	100	0	67	**56**
Environmental (low energy)	17	-15	62	**21**
Score (%)	**22**	**-21**	**65**	**22**

The HZMB is a megaproject, and one of the most iconic infrastructure investments of this century. It is the longest sea crossing in the world. Situated in the Pearl River Delta and owned by the People's Republic of China, it connects Hong Kong, Zhuhai and Macau with a six lane toll road including elevated bridge deck, three large cable-stay spans, artificial islands, undersea tunnel, link roads and border control facilities for each region. The engineering challenge was extremely complex and ambitious. However, its contribution to the economy of the region, to tourism and to the productivity of transport and trade is significant. It is a beacon of ingenuity and human endeavour, but took nearly nine years to build. During this time, 20 workers were killed on the project, and there were over 500 injuries reported. Some news stories point to the bridge being a 'white elephant', as work has already commenced on another sea link between Shenzhen and Zhongshan (including a high speed rail service) that is now expected to reduce demand for HZMB. This is on top of much lower demand figures than expected (currently 2,416-4,791 vehicles/day recorded over first year of operation, down from 33,100 in feasibility study), caused by complexities in immigration, high cost of road toll (RMB 200/trip), triple certification required for third party insurance across three jurisdictions, and current civil unrest in Hong Kong. In the latter case, the bridge is now seen by some as having a political agenda to more tightly connect the special administrative regions to Mainland China control.

i3d3 ranking
Success is measured on a scale of -100 to +100, where the border of success and fail is set at zero. The above table shows success according to project phases and consequences. Each value in this table is assigned equal weight. Light red shaded cells are problems. Success can be a surrogate for wider project 'quality'.

NET BENEFIT	25	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

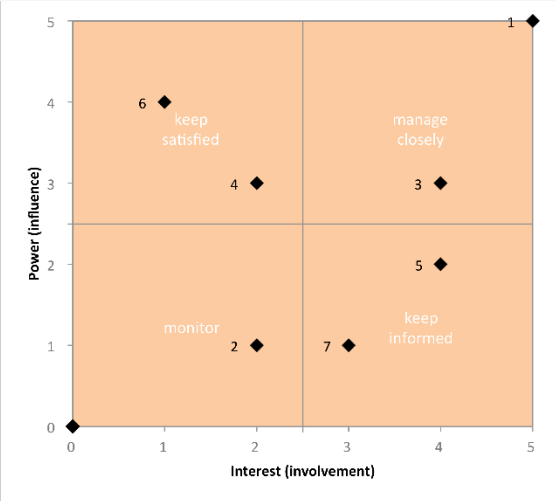
BENEFIT REALIZATION	winners	5	losers	2

Stakeholders:

	stakeholder ID#	power 1-5	interest 1-5	expected value (%)
Owner/sponsor	1	5.0	5.0	-70
Local community	2	1.0	2.0	41
Shareholders/authorities	3	3.0	4.0	100
Environmentalists	4	3.0	2.0	17
Project team	5	2.0	4.0	-21
Client/end-user	6	4.0	1.0	65
Wider society	7	1.0	3.0	40
	8			
	9			
	10			
	11			
	12			

key: 1=minimal 2=low 3=moderate 4=high 5=extreme

25

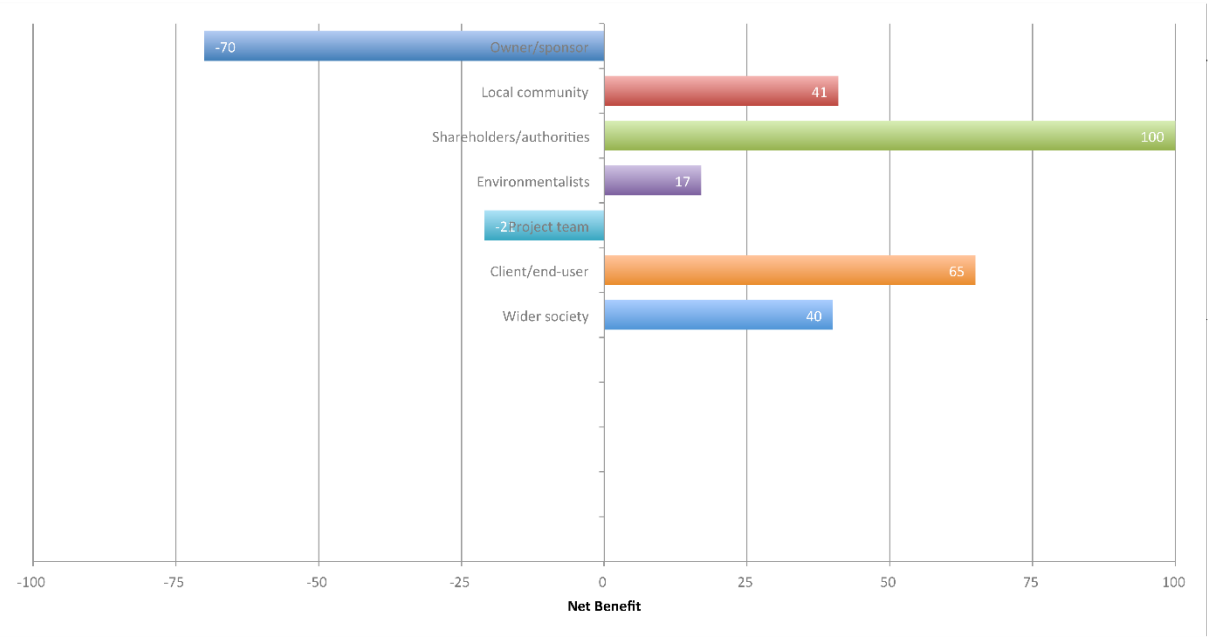


Benefit Register:

	benefit ID#	T/I	D/I	P/E	S/M/L	stakeholder ID#	expected value (%)	realized? Y/N	comments
BCR success score (design) > 0	1	T	D	P	M	1	-70	Y	Project has a negative BCR
LPS success score (design) > 0	2	I	I	P	S/M/L	2	41	Y	
RAR success score (design) > 0	3	T/I	D/I	P	M/L	3	100	Y	
EFP success score (design) > 0	4	I	I	E	L	4	17	Y	
PDS success score (deliver) > 0	5	T	D	P	S	5	-21	Y	Project delivery was considerably delayed
EUS success score (delight) > 0	6	T	D/I	P	S/M/L	6	65	Y	
SDG humanity index > 0	7	I	I	P/E	L	7	40	Y	
	8								
	9								
	10								
	11								
	12								

key: tangible / intangible; direct / indirect; planned / emergent; short term / medium term / long term

mean = 25%



HUMANITY INDEX	40	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOAL (SDG) CONTRIBUTIONS	benefit justification

Financial: 0

investments in infrastructure are crucial to achieving sustainable development

not eligible 9

HZMB was financially unviable and delivered well over budget, but otherwise would have contributed to SDG#9 if its financial performance was better.

Social: 0

not eligible

Not applicable.

Ethical: 20

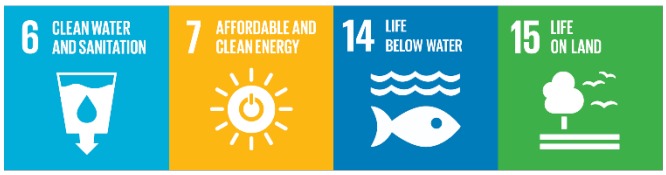
access to justice for all, and building effective, accountable institutions at all levels

enter primary SDG# here > 16

HZMB serves as an important and unifying piece of infrastructure connecting three different Chinese cities with three different governance systems.

Environmental: 20

careful management of this essential global resource is a key feature of a sustainable future



not eligible 14 0

The project had minimal impact on the long-term environmental quality of the Pearl River Delta.

revitalize the global partnership for sustainable development

enter SDG#17* here > 17 20 *this SDG is only available when the complexity score (delivery) is 12 or more

HZMB was a nation-building project of the People's Republic of China, and involved collaboration with the Special Administrative Regions of both Hong Kong and Macau. It required design and delivery expertise from a large number of international enterprises.

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DESIGN (DSS)	22	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR	feasible	-70	useable	41	achievable	100	sustainable	17

Profit:

Benefit-cost ratio (BCR) **0.2964**

year	benefit	discounted benefit	cost	discounted cost
0		-	120	120
1		-	3,500	3,431
2		-	5,500	5,286
3		-	6,500	6,125
4		-	7,000	6,467
5		-	6,500	5,887
6		-	5,500	4,884
7		-	3,500	3,047
8	672	573	34	29
9	672	562	34	28
10	672	551	34	28
11	672	540	34	27
12	672	530	34	26
13	672	519	34	26
14	672	509	184	139
15	672	499	34	25
16	672	489	34	24
17	672	480	34	24
18	672	470	34	24
19	672	461	34	23
20	672	452	34	23
21	672	443	184	121
22	672	434	34	22
23	672	426	34	21
24	672	418	34	21
25	672	409	34	20
26	672	401	34	20
27	672	393	34	20
28	672	386	184	105
29	672	378	34	19
30	672	371	34	19
		10,695		36,081

discount	2.00 %
currency	RMB (million)
assume BCR	(override)

Notes

Benefits and costs should exclude intangible cash flows
Discount rate is net of inflation (i.e. real discount rate)
Cash flows are expressed in Year 0 terms
BCR can be entered directly using 'assume BCR' cell
Immigration operating costs are not included in the project
Life expectancy of bridge estimated at 120-170 years
The project commenced in December 2009
Feasibility study downgraded to 9,200 vehicles/day
Average toll is RMB 200 per vehicle
Maintenance, repair and energy costs assumed at 5% of income
Road resurfacing undertaken every 7 years

People:

Statement: *I support this proposed project*

Local project support (LPS) **0.8252**

strongly disagree	disagree	no opinion	agree	strongly agree	responses
2	11	11	58	21	103

sample return rate	N/A 0%

Politics:

Risk and reward (RAR) **2.2436**

ID	reward (opportunities) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Key link between HK and 9 other Guangdong cities	3	3	9
B*	A megaproject of Chinese national pride	2	1	2
C*	Increased trade, tourism and visitor flow	2	3	6
D*	33,100 vehicles and 171,800 passenger trips/day	2	3	6
E*	Economic prosperity for the Guangdong province	2	3	6
F	Social inclusion for people in the region	3	2	6
G				
			mean	5.83

ID	risk (threats) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Competition from future road/rail links	2	2	4
B*	Lower traffic volumes than expected	1	3	3
C*	Immigration complexities (1 country, 3 policies)	2	1	2
D*	White elephant label	1	1	1
E*	Toll charges	3	1	3
F				
G				
			mean	2.60

Planet:

Ecological footprint (EFP) **14.0000**

environmental categories (impacts)	extreme (0 stars)	high (1 star)	moderate (2 stars)	low (3 stars)	minimal (4 stars)	regenerative (5 stars)
non-renewable energy demand (embodied carbon)		Y				
water quality impacts			Y			
air pollution	Y					
natural resource depletion					Y	
biodiversity loss					Y	
non-degradable or non-recyclable waste to landfill				Y		
	1	1	1	1	2	0

DELIVER (PDS)	-21	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR	within budget	-35	on schedule	-35	as specified	0	no surprises	-15

-70.42 -70.61 50.00 0.00 -29.08

-100 ≤ PDS ≤ 100

Cost:

	planned	actual	change
Construction (RMB million)	38,120.00	48,070.00	26.10%

Time:

	planned	actual		change
Onsite activity (calendar month)	84.00	106.00		26.19%

Scope:

	planned	actual		change
Length of journey (km)	55.00	55.00	✔	0.00%

Risk:

	planned	actual	change
√ mean risk level (1-3)	2.14	2.35	9.35%
	0.02	0.01	42.53

KPIs

0.02	value (scope/cost)		-20.70%
(20.70)	efficiency (cost/time)		-0.07%
	speed (scope/time)		-20.75%
	innovation (risk/cost)		-13.29%
	complication (time/risk)	✔	15.40%
	impact (scope/risk)		-8.55%
0.02			
(20.75)	profit (scope²/cost²)		-37.11%
	people (scope²/time²)		-37.20%
	planet (scope²/risk²)		-16.36%
	progress (TBL mean)		-30.23%
0.02			
-	COMPLEXITY		1-3
	27	X: scale	3
		Y: uncertainty	3
		Z: stakeholders	3
0.02	chaotic		
(8.55)			

Planned risk events	ID	risk event - * must complete 5	planned probability 1-3	planned consequence 1-3	planned risk level 1-9
Probability and consequence are assessed after any mitigation strategies have been included in scope, cost and time estimates	A*	Industrial accidents	3	3	9
	B*	White dolphin impacts near Lantau Island constructions	2	2	4
	C*	Complicated construction procedures in open sea	2	2	4
	D*	Erosion of artificial islands at tunnel mouth	2	1	2
	E*	Delays and overrun due to engineering complexity	2	2	4
	F	NEW (ACTUAL) RISKS:			
	G	Fake concrete test results by corrupt contractors			
	H				
	I				
	J				
	K				
	L				
	M				
	N				
	O				
	P				
	Q				
	R				
	S				
	T				
				√ mean	2.14

Actual risk events	ID	risk event - * must complete 5	actual probability 1-3	actual consequence 1-3	actual risk level 1-9
Consequence is determined based on final project outcomes, and should include any unanticipated risk events	A*	Industrial accidents	3	3	9
	B*	White dolphin impacts near Lantau Island constructions	3	1	3
	C*	Complicated construction procedures in open sea	3	2	6
	D*	Erosion of artificial islands at tunnel mouth	3	2	6
	E*	Delays and overrun due to engineering complexity	3	2	6
	F	NEW (ACTUAL) RISKS:	3	-	
	G	Fake concrete test results by corrupt contractors	3	1	3
	H		-		
	I		-		
	J		-		
	K		-		
	L		-		
	M		-		
	N		-		
	O		-		
	P		-		
	Q		-		
	R		-		
	S		-		
	T		-		
				√ mean	2.35

DELIGHT (EUS)	65	Hong Kong - Zhuhai - Macau Bridge (HZMB), Pearl River Delta, PRC

SUCCESS FACTOR	desirable	65	adaptable	66	practicable	67	serviceable	62

Attractiveness:

	mean	influence
Nice to look at?	3.70	
High quality?	3.08	
Profitable?	2.35	
Well-designed?	3.39	
Valuable?	4.36	
Prestigious?	3.71	
Durable?	4.28	
Popular?	3.49	
Joyful?	3.78	
Unique?	4.30	
User-defined ...	7.17	
User-defined ...	7.67	
	4.27	25.41%
	25.07	

Flexibility:

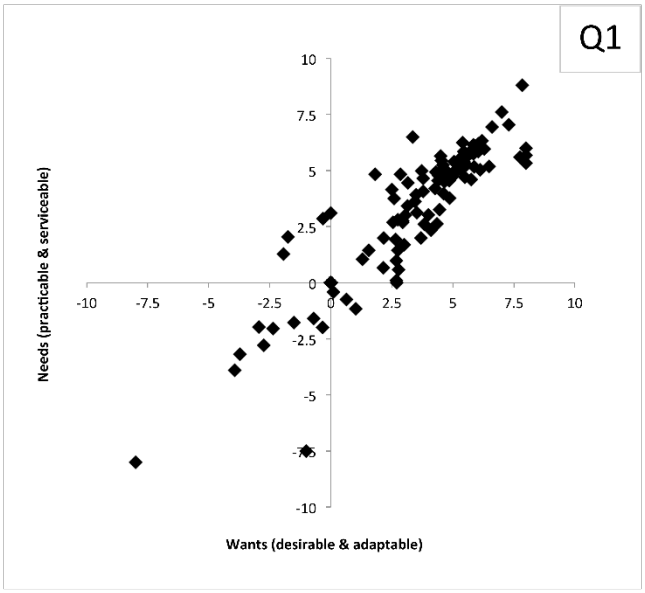
	mean
Versatile?	3.84
Easily modified?	2.52
Able to be customized?	3.46
Multi-use?	4.08
Transportable?	4.15
Better with age?	3.69
Modular?	4.67
Scalable?	4.70
Technically clever?	4.10
Timeless?	4.64
User-defined ...	7.17
User-defined ...	8.00
	4.59	27.27%
	25.40	

Fit for Purpose:

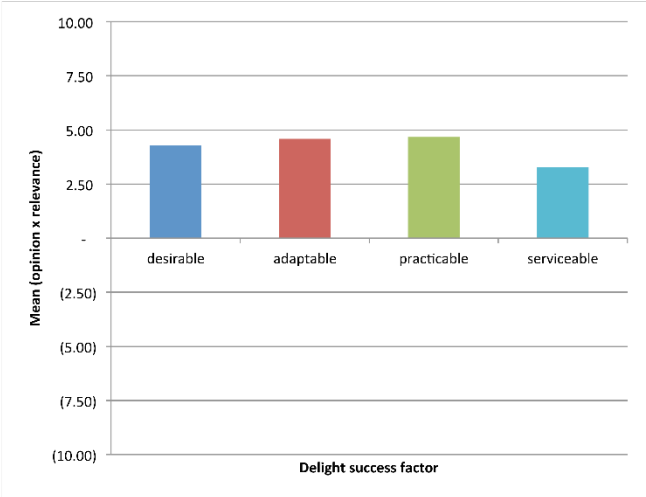
	mean
Functional?	4.53
Appropriate?	4.30
Robust?	4.31
Safe?	4.68
Healthy?	4.32
Problem-solving?	4.00
Easy to use?	4.17
Affordable?	5.11
Comfortable?	4.66
Ethical?	4.13
User-defined ...	6.00
User-defined ...	5.86
	4.67	27.78%
	23.49	

Enduring:

	mean
Low maintenance?	1.32
Easily cleaned?	2.69
Recyclable?	3.59
Non-toxic?	2.66
Repairable?	4.32
Energy efficient?	3.51
Reliable?	3.82
Accessible?	3.31
Regenerative?	2.81
Habitat-safe?	2.10
User-defined ...	4.75
User-defined ...	4.57
	3.29	19.54%
	28.05	100.00%



percent Q1	82.52	%
total responses	103	



sample		N/A
return rate		0%
expected delight (LPS)		41%
actual delight (EUS)	✔	65%

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Instructions

Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Further Information

https://bond.edu.au/cccr
(including latest updates)

Disclaimer

Every attempt has been made to use unbiased evidence-based data (cells with light grey shading) in this study where possible.

i3d3 model: Copyright © 2020, Centre for Comparative Construction Research, Bond University

i3d3 RANKING	50	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

CONSEQUENCES	Project Initiate	Project Implement	Project Influence	Score (%)
Financial (long life)	100	18	88	**69**
Social (loose fit)	50	-75	89	**21**
Ethical (least pain)	83	0	88	**57**
Environmental (low energy)	83	-10	88	**54**
Score (%)	**79**	**-17**	**88**	**50**

The Government of Bangladesh has identified electricity supply as a major constraint on GDP growth and overall economic development. To address these challenges, it has adopted a multipronged plan involving substantial sector investments, regional power trade and sector reforms. The Government has an ambitious target to achieve affordable electricity for all by 2021. To realize this target, new generation capacity must be complemented by upgrading transmission and distribution networks, as well as establishing connections for new consumers. The Government requested the Asian Infrastructure Investment Bank provide financial support for the BEUE project. This funding will: (i) expand electricity coverage by providing 2.5 million new service connections in rural areas and (ii) upgrade two grid substations (250 MVA to 480 MVA) and convert overhead distribution lines into 85 km of underground cables in northern Dhaka. BEUE will supplement other development partner efforts by providing additional financial resources to connect more rural and urban consumers, further reduce distribution losses, and improve the quality and reliability of power supply in Bangladesh. Upon completion it is expected to benefit about 12.5 million people in rural areas. Some delays to the underground cabling were experienced due to inclement weather.

i3d3 ranking
Success is measured on a scale of -100 to +100, where the border of success and fail is set at zero. The above table shows success according to project phases and consequences. Each value in this table is assigned equal weight. Light red shaded cells are problems. Success can be a surrogate for wider project 'quality'.

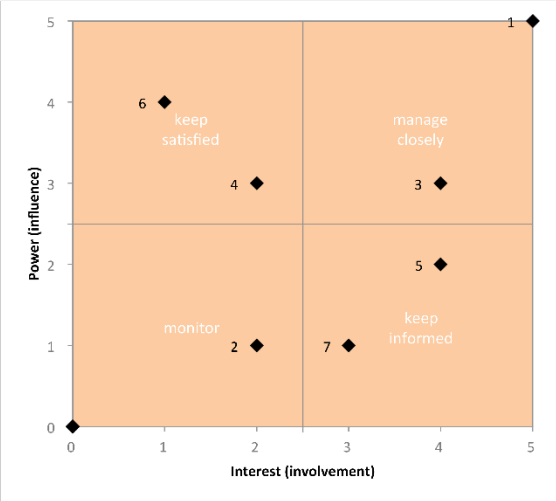
NET BENEFIT	67	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

BENEFIT REALIZATION	winners	6	losers	1

Stakeholders:

	stakeholder ID#	power 1-5	interest 1-5	expected value (%)
Owner/sponsor	1	5.0	5.0	100
Local community	2	1.0	2.0	50
Shareholders/authorities	3	3.0	4.0	83
Environmentalists	4	3.0	2.0	83
Project team	5	2.0	4.0	-17
Client/end-user	6	4.0	1.0	88
Wider society	7	1.0	3.0	80
	8			
	9			
	10			
	11			
	12			

key: 1=minimal 2=low 3=moderate 4=high 5=extreme

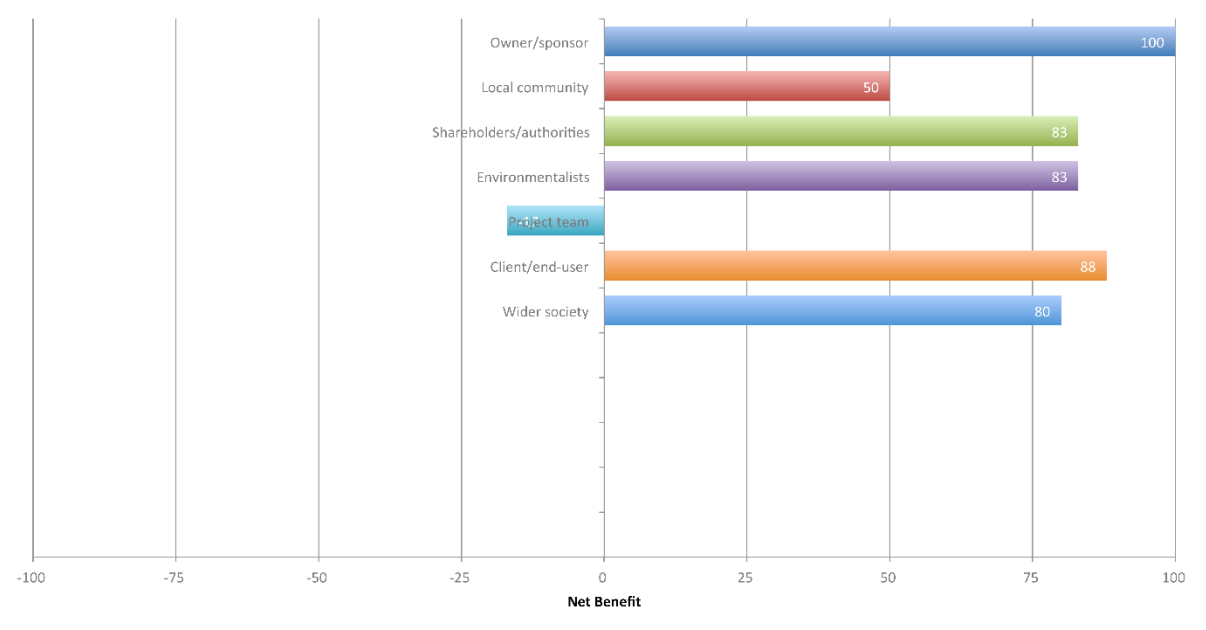


Benefit Register:

	benefit ID#	T/I	D/I	P/E	S/M/L	stakeholder ID#	expected value (%)	realized? Y/N	comments
BCR success score (design) > 0	1	T	D	P	M	1	100	Y	
LPS success score (design) > 0	2	I	I	P	S/M/L	2	50	Y	
RAR success score (design) > 0	3	T/I	D/I	P	M/L	3	83	Y	
EFP success score (design) > 0	4	I	I	E	L	4	83	Y	
PDS success score (deliver) > 0	5	T	D	P	S	5	-17	Y	Project delivery was considerably delayed
EUS success score (delight) > 0	6	T	D/I	P	S/M/L	6	88	Y	
SDG humanity index > 0	7	I	I	P/E	L	7	80	Y	
	8								
	9								
	10								
	11								
	12								

key: tangible / intangible; direct / indirect; planned / emergent; short term / medium term / long term

mean = 67%



HUMANITY INDEX	80	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOAL (SDG) CONTRIBUTIONS	benefit justification

Financial: 20

investments in infrastructure are crucial to achieving sustainable development

enter primary SDG# here > 9

BEUE is intended to provide reliable electricity provision to 2.5 million households in rural Bangladesh for the first time.

Social: 0

economic growth must be inclusive to provide sustainable jobs and promote quality

not eligible 1

The intention is to help lift 12.5 million people out of poverty by providing electrical power, however, the delay in delivering this project has minimized the potential benefit.

Ethical: 20

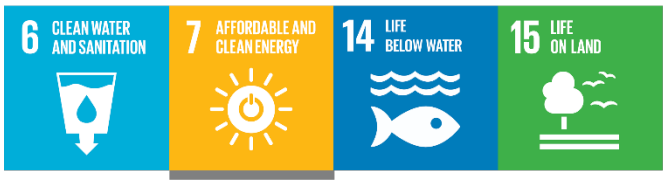
to reduce inequalities, policies should be universal in principle, paying attention to the needs of disadvantaged and marginalized populations

enter primary SDG# here > 10

Targeted existing households do not currently have access to electricity, and instead use fossil fuels for heating, cooking and other basic household needs.

Environmental: 40

energy is central to nearly every major challenge and opportunity



enter primary SDG# here > 7 20

While the provision of electrical power is not 100% clean, it is planned to build a new nuclear power plant to service the increased demand. Existing gas fired power plants are nevertheless cleaner than burning charcoal and wood.

revitalize the global partnership for sustainable development

enter SDG#17* here > 17 20 *this SDG is only available when the complexity score (delivery) is 12 or more

BEUE was a partnership between the Bangladesh government and the Asian Infrastructure Investment Bank to provide basic infrastructure to rural areas of the country and, in the process, reduce pollution caused by the burning of fossil fuels.

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DESIGN (DSS)	79	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

SUCCESS FACTOR	feasible	100	useable	50	achievable	83	sustainable	83

Profit:

Benefit-cost ratio (BCR) **2.0502**

year	benefit	discounted benefit	cost	discounted cost
0		-	23	23
1		-	6,272	6,149
2		-	7,997	7,686
3		-	6,272	5,910
4	5,335	4,929	267	246
5	5,335	4,832	267	242
6	5,335	4,737	267	237
7	5,335	4,644	267	232
8	5,335	4,553	267	228
9	5,335	4,464	267	223
10	5,335	4,377	267	219
11	5,335	4,291	267	215
12	5,335	4,207	267	210
13	5,335	4,124	267	206
14		-		-
15		-		-
16		-		-
17		-		-
18		-		-
19		-		-
20		-		-
21		-		-
22		-		-
23		-		-
24		-		-
25		-		-
26		-		-
27		-		-
28		-		-
29		-		-
30		-		-
		45,158		22,026

discount	2.00 %
currency	BDT (million)
assume BCR	(override)

Notes

Benefits and costs should exclude intangible cash flows
Discount rate is net of inflation (i.e. real discount rate)
Cash flows are expressed in Year 0 terms
BCR can be entered directly using 'assume BCR' cell
Original feasibility study not avaiable
Income = 2.5m households x 400KWh/year x BDT 5.335/KWh
Maintenance and repair costs assumed at 5% of income
Marginal cost of energy generation is excluded
Usage cost based on residential consumer
Average household size = 5 people
BCR = 2 threshold reached after 10 years of operation
New Russian-built Rooppur nuclear power plant online by 2024

People:

Statement: *I support this proposed project*

Local project support (LPS) **1.0000**

strongly disagree	disagree	no opinion	agree	strongly agree	responses	sample return rate	N/A 0%
2	8	-	72	22	104		

Politics:

Risk and reward (RAR) **1.8286**

ID	reward (opportunities) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Affordable electricity for all by 2021	1	3	3
B*	Replace more polluting current energy sources	3	3	9
C*	Improve essential infrastructure and grow GDP	3	2	6
D*	Increase the number of rural and urban consumers	3	1	3
E*	Make existing distribution networks more resilient	2	2	4
F	Reduce poverty	1	3	3
G	Minimize electricity distribution losses	2	2	4
			mean	4.57

ID	risk (threats) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Undertake Environmental and Social Review (ESR)	3	1	3
B*	Undertake Initial Environmental Examination (IEE)	3	1	3
C*	Unable to obtain sufficient finance for construction	1	3	3
D*	Affordable consumer pricing	1	3	3
E*	Increased risks of blackouts due to greater demand	1	1	1
F	Disruption during construction	1	2	2
G				
			mean	2.50

Planet:

Ecological footprint (EFP) **22.0000**

environmental categories (impacts)	extreme (0 stars)	high (1 star)	moderate (2 stars)	low (3 stars)	minimal (4 stars)	regenerative (5 stars)
non-renewable energy demand (embodied carbon)			Y			
water quality impacts					Y	
air pollution					Y	
natural resource depletion					Y	
biodiversity loss					Y	
non-degradable or non-recyclable waste to landfill					Y	
	0	0	1	0	5	0

DELIVER (PDS)	-17	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

SUCCESS FACTOR	within budget	18	on schedule	-75	as specified	0	no surprises	-10

Cost:

	planned	actual		change
Construction (BDT million)	20,563.54	19,669.78	✔	-4.35%

Time:

Onsite activity (calendar month)	36.00	54.00		50.00%

Scope:

New service connections (million)	2.50	2.50	✔	0.00%

Risk:

√ mean risk level (1-3)	2.00	2.07		3.51%

KPIs

-100 ≤ PDS ≤ 100

		change
value (scope/cost)	✔	4.54%
efficiency (cost/time)		-36.23%
speed (scope/time)		-33.33%
innovation (risk/cost)	✔	8.21%
complication (time/risk)	✔	44.91%
impact (scope/risk)		-3.39%
profit (scope²/cost²)	✔	9.29%
people (scope²/time²)		-55.56%
planet (scope²/risk²)		-6.67%
progress (TBL mean)		-17.64%

COMPLEXITY **12** high

	1-3
X: scale	2
Y: uncertainty	2
Z: stakeholders	3

Planned risk events	ID	risk event - * must complete 5	planned probability 1-3	planned consequence 1-3	planned risk level 1-9
Probability and consequence are assessed after any mitigation strategies have been included in scope, cost and time estimates	A*	Delays due to cyclone flooding (May-November)	3	3	9
	B*	Seismic activity causing damage to completed work	1	3	3
	C*	Price increase for equipment resulting in project cost overruns	2	2	4
	D*	Inadequate measures to mitigate local transportation disruption	2	2	4
	E*	Procurement failure and/or improper tendering procedures	1	2	2
	F	Inadequate record-keeping leading to potential corruption	1	3	3
	G	Misuse of loan proceeds	1	3	3
	H				
	I				
	J				
	K				
	L				
	M				
	N				
	O				
	P				
	Q				
	R				
	S				
	T				
				√ mean	2.00

Actual risk events	ID	risk event - * must complete 5	actual probability 1-3	actual consequence 1-3	actual risk level 1-9
Consequence is determined based on final project outcomes, and should include any unanticipated risk events	A*	Delays due to cyclone flooding (May-November)	3	3	9
	B*	Seismic activity causing damage to completed work	3	1	3
	C*	Price increase for equipment resulting in project cost overruns	3	2	6
	D*	Inadequate measures to mitigate local transportation disruption	3	1	3
	E*	Procurement failure and/or improper tendering procedures	3	1	3
	F	Inadequate record-keeping leading to potential corruption	3	1	3
	G	Misuse of loan proceeds	3	1	3
	H		-		
	I		-		
	J		-		
	K		-		
	L		-		
	M		-		
	N		-		
	O		-		
	P		-		
	Q		-		
	R		-		
	S		-		
	T		-		
				√ mean	2.07

DELIGHT (EUS)	88	Bangladesh Electricity Upgrade and Expansion (BEUE) Project

SUCCESS FACTOR	desirable	88	adaptable	89	practicable	88	serviceable	88

Attractiveness:

	mean	influence
Nice to look at?	3.75	
High quality?	5.46	
Profitable?	3.51	
Well-designed?	4.55	
Valuable?	3.67	
Prestigious?	4.60	
Durable?	5.15	
Popular?	4.61	
Joyful?	4.02	
Unique?	3.48	
User-defined ...		
User-defined ...		
	4.28	24.74%
	24.96	

Flexibility:

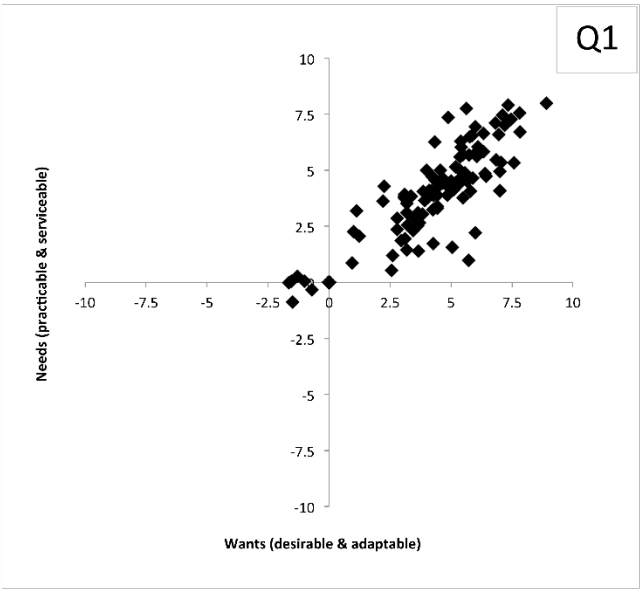
	mean
Versatile?	5.45
Easily modified?	4.96
Able to be customized?	5.11
Multi-use?	2.11
Transportable?	4.68
Better with age?	5.14
Modular?	4.18
Scalable?	4.35
Technically clever?	5.49
Timeless?	4.35
User-defined ...	
User-defined ...	
	4.58	26.50%
	25.09	

Fit for Purpose:

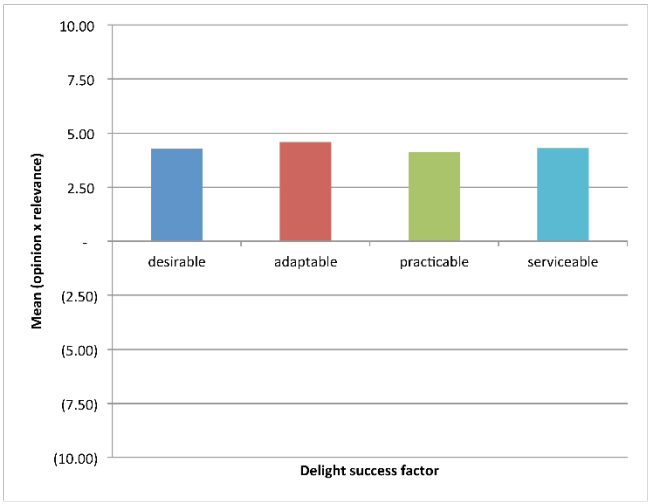
	mean
Functional?	4.29
Appropriate?	4.21
Robust?	3.67
Safe?	6.50
Healthy?	5.09
Problem-solving?	4.00
Easy to use?	4.90
Affordable?	1.95
Comfortable?	3.58
Ethical?	3.12
User-defined ...	
User-defined ...	
	4.13	23.89%
	24.94	

Enduring:

	mean
Low maintenance?	0.44
Easily cleaned?	4.13
Recyclable?	4.43
Non-toxic?	5.32
Repairable?	5.39
Energy efficient?	4.77
Reliable?	3.99
Accessible?	5.25
Regenerative?	3.38
Habitat-safe?	5.94
User-defined ...	
User-defined ...	
	4.30	24.88%
	24.99	100.00%



percent Q1	94.23	%
total responses	104	



sample		N/A
return rate		0%
expected delight (LPS)		50%
actual delight (EUS)	✔	88%

Proudly Endorsed By

GAPPS Global Alliance for the Project Professions

Instructions

Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Further Information

https://bond.edu.au/cccr
(including latest updates)

Disclaimer

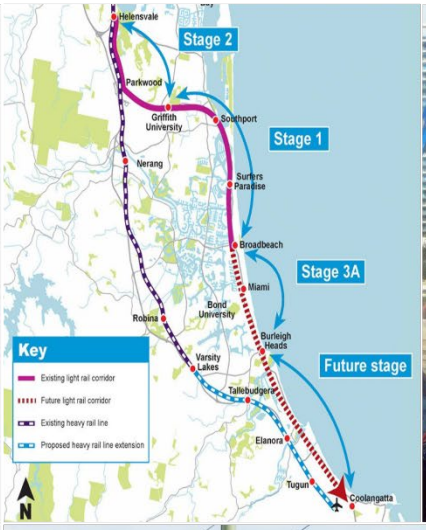
Every attempt has been made to use unbiased evidence-based data (cells with light grey shading) in this study where possible.

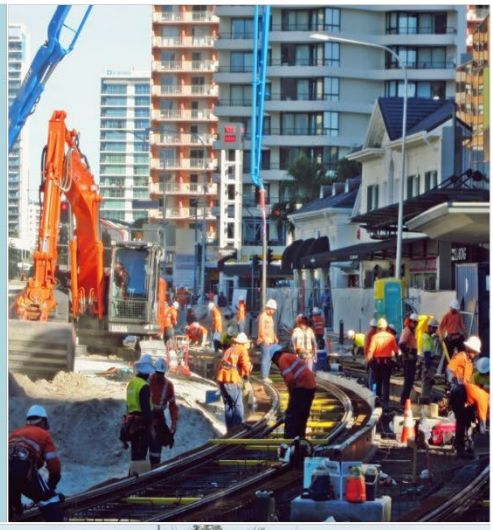
i3d3 model: Copyright © 2020, Centre for Comparative Construction Research, Bond University

i3d3 RANKING	23	Gold Coast Light Rail (GCLR) Stage 1 and 2

CONSEQUENCES	Project Initiate	Project Implement	Project Influence	Score (%)
Financial (long life)	10	0	31	**14**
Social (loose fit)	43	0	25	**23**
Ethical (least pain)	32	0	45	**26**
Environmental (low energy)	25	22	38	**28**
Score (%)	**28**	**5**	**35**	**23**

The Gold Coast Light Rail (GCLR) project comprises at least four stages of dual track connecting Helensvale in the north to Coolangatta in the south. Stage 1 and 2 are complete and in operation. Stage 3A will commence construction in 2021 and Stage 3B is likely to follow immediately after. The total distance of dual track is expected to be 42 kilometres (km). The length of each stage is 13km, 7.3km, 6.7km and 15km respectively. The likely cost of these four stages is around $4 billion. There are also plans to construct some east-west spur lines including services to Nerang and Robina heavy rail stations. Stage 1 was designed to carry 50,000 passengers per day with a capacity up to 75,000 passengers per day, with 16 stations and an initial budget of $1.6 billion. The method of procurement is Operator Franchise Public Private Partnership, involving collaboration of the Commonwealth, State and Municipal governments. Different design consultants and main contractors have been selected for each stage, but it has been a deliberate strategy to focus on local workers and suppliers as much as possible. Stage 1 pre-works commenced in 2010 and this stage was handed over in July 2014. Stage 2 had its business case approved in August 2015 and was open to the public in December 2017. Stage 3A is expected to begin construction in January 2021 and be completed 40 months later. Stage 3B may be finished in 2024, although it is the more difficult stage and likely to be a higher cost/km than earlier work. GCLR is serviced by Keolis Downer and managed by GoldlinQ Pty Ltd on behalf of government. The project is recognized as a world class public transport system and its patronage has grown by 47% since July 2014. Stage 2 had to be finished before the 2018 Commonwealth Games held in April 2018.





i3d3 ranking

Success is measured on a scale of -100 to +100, where the border of success and fail is set at zero. The above table shows success according to project phases and consequences. Each value in this table is assigned equal weight. Light red shaded cells are problems. Success can be a surrogate for wider project 'quality'.

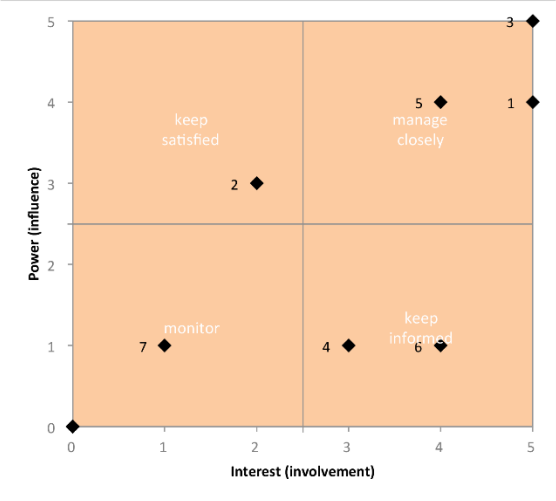
NET BENEFIT	24	Gold Coast Light Rail (GCLR) Stage 1 and 2

BENEFIT REALIZATION	winners 7	losers 0

Stakeholders:

	stakeholder ID#	power 1-5	interest 1-5	expected value (%)
Owner/sponsor	1	4.0	5.0	10
Local community	2	3.0	2.0	43
Shareholders/authorities	3	5.0	5.0	32
Environmentalists	4	1.0	3.0	25
Project team	5	4.0	4.0	5
Client/end-user	6	1.0	4.0	35
Wider society	7	1.0	1.0	20
	8			
	9			
	10			
	11			
	12			

key: 1=minimal 2=low 3=moderate 4=high 5=extreme

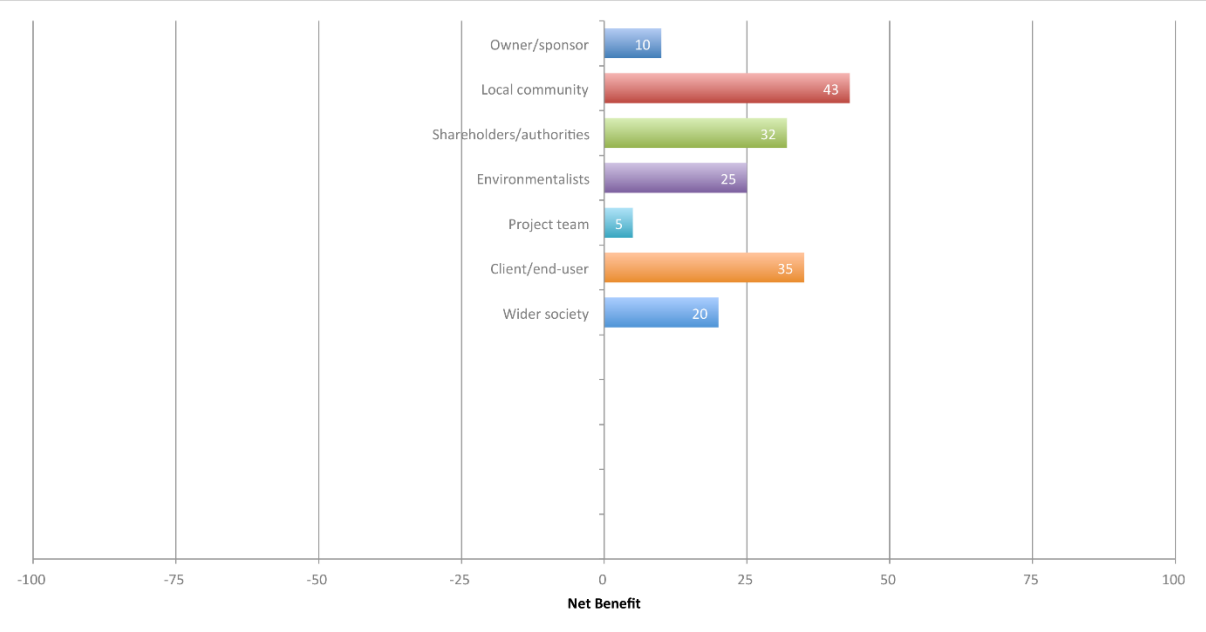


Benefit Register:

	benefit ID#	T/I	D/I	P/E	S/M/L	stakeholder ID#	expected value (%)	realized? Y/N	comments
BCR success score (design) > 0	1	T	D	P	L	1	10	Y	
LPS success score (design) > 0	2	T	D	P	L	2	43	Y	Support inferred from Stage 3A survey data
RAR success score (design) > 0	3	T/I	I	P/E	L	3	32	Y	
EFP success score (design) > 0	4	T/I	I	P	L	4	25	Y	
PDS success score (deliver) > 0	5	T	D	P	M	5	5	Y	All risks were borne by the contractors
EUS success score (delight) > 0	6	T	I	E	S	6	35	Y	
SDG humanity index > 0	7	I	I	E	L	7	20	Y	
	8								
	9								
	10								
	11								
	12								

key: tangible / intangible; direct / indirect; planned / emergent; short term / medium term / long term

mean = 24%



HUMANITY INDEX	20	Gold Coast Light Rail (GCLR) Stage 1 and 2

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOAL (SDG) CONTRIBUTIONS	benefit justification

Financial: 0

investments in infrastructure are crucial to achieving sustainable development

Not applicable.

not eligible 9

Social: 0

Not applicable.

not eligible

Ethical: 0

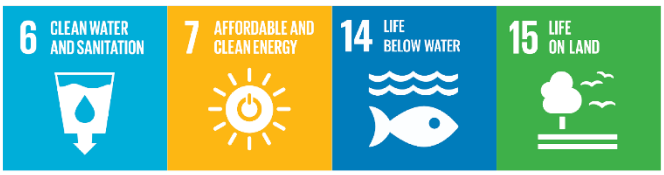
climate change is a global challenge that affects everyone, everywhere

Not applicable.

not eligible 13

Environmental: 20

sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss



Not applicable.

not eligible 15

revitalize the global partnership for sustainable development

This project relies on continuing community patronage as well as financial support from all levels of government

enter SDG#17* here > 17 *this SDG is only available when the complexity score (delivery) is 12 or more

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DESIGN (DSS)	28	Gold Coast Light Rail (GCLR) Stage 1 and 2

SUCCESS FACTOR	feasible	10	useable	43	achievable	32	sustainable	25

Profit:

Benefit-cost ratio (BCR) **1.0997**

year	benefit	discounted benefit	cost	discounted cost
0		-	170	170
1		-	250	240
2		-	300	277
3		-	300	267
4	75	64	100	85
5	80	66	5	4
6	85	67	210	166
7	90	68	210	160
8	95	69	5	4
9	100	70	5	4
10	105	71	5	3
11	110	71	5	3
12	115	72	5	3
13	120	72	5	3
14	120	69	5	3
15	120	67	5	3
16	120	64	5	3
17	120	62	5	3
18	120	59	5	2
19	120	57	5	2
20	120	55	5	2
21	120	53	5	2
22	120	51	5	2
23	120	49	5	2
24	120	47	5	2
25	120	45	5	2
26	120	43	5	2
27	120	42	5	2
28	120	40	5	2
29	120	38	5	2
30	120	37	5	2
		1,568		1,426

discount	4.00 %
currency	AUD million
assume BCR	(override)

Notes
Benefits and costs should exclude intangible cash flows
Discount rate is net of inflation (i.e. real discount rate)
Cash flows are expressed in Year 0 terms
BCR can be entered directly using 'assume BCR' cell
BCR modelled on Stage 3A business case (BCR=1.1)
AUD170 million in pre-construction works (Year 0)
Operation and maintenance contract for 15 years is part of PPP agreement
Passenger growth assumed for 10 years

People:

Statement: *I support this proposed project*

Local project support (LPS) **0.8690**

strongly disagree	disagree	no opinion	agree	strongly agree	responses
229	163	221	576	953	2,142

sample	2,142
return rate	100%

Politics:

Risk and reward (RAR) **1.3226**

ID	reward (opportunities) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Prioritize local jobs and local workers	3	2	6
B*	Contribute to sustainable and liveable urban areas	3	3	9
C*	Critical 2018 Commonwealth Games infrastructure	3	2	6
D*	Reduce traffic congestion	2	2	4
E*	Encourage greater public transport patronage	2	3	6
F	Improved air quality	3	2	6
G	Consolidated land use for future population growth	2	2	4
			mean	5.86

ID	risk (threats) - * must complete 5	probability 1-3	consequence 1-3	risk level 1-9
A*	Loss of on-street parking in some areas	2	1	2
B*	Major disruption during construction period	2	3	6
C*	Relocation of underground services	3	2	6
D*	Contaminated ground remediation works	2	2	4
E*	Danger to construction workers from local traffic	2	3	6
F	Land acquisition costs	2	2	4
G	Noise and dust pollution	3	1	3
			mean	4.43

Planet:

Ecological footprint (EFP) **15.0000**

environmental categories (impacts)	extreme (0 stars)	high (1 star)	moderate (2 stars)	low (3 stars)	minimal (4 stars)	regenerative (5 stars)
non-renewable energy demand (embodied carbon)		Y				
water quality impacts				Y		
air pollution				Y		
natural resource depletion				Y		
biodiversity loss				Y		
non-degradable or non-recyclable waste to landfill			Y			
	0	1	1	4	0	0

DELIVER (PDS)	5	Gold Coast Light Rail (GCLR) Stage 1 and 2

SUCCESS FACTOR	within budget	0	on schedule	0	as specified	0	no surprises	22

Cost:

	planned	actual		change
Construction cost (AUD millions)	1,620.00	1,620.00	✔	0.00%

Time:

Work on site (months)	48.00	48.00	✔	0.00%

Scope:

Length of dual track (km)	20.30	20.30	✔	0.00%

Risk:

√ mean risk level (1-3)	2.45	2.32	✔	-5.13%

KPIs

-100 ≤ PDS ≤ 100

		change
value (scope/cost)	✔	0.00%
efficiency (cost/time)	✔	0.00%
speed (scope/time)	✔	0.00%
innovation (risk/cost)		-5.13%
complication (time/risk)	✔	5.41%
impact (scope/risk)	✔	5.41%
profit (scope²/cost²)	✔	0.00%
people (scope²/time²)	✔	0.00%
planet (scope²/risk²)	✔	11.11%
progress (TBL mean)	✔	3.70%

COMPLEXITY **12** high

	1-3
X: scale	2
Y: uncertainty	2
Z: stakeholders	3

Planned risk events	ID	risk event - * must complete 5	planned probability 1-3	planned consequence 1-3	planned risk level 1-9
Probability and consequence are assessed after any mitigation strategies have been included in scope, cost and time estimates	A*	Discovery of unidentified underground services	3	2	6
	B*	Unexpected latent ground conditions requiring remediation	3	2	6
	C*	Danger to workers from road users	2	3	6
	D*	Noise and dust complaints	3	1	3
	E*	Contractual risk (cost, time, reputation, weather)	3	3	9
	F				
	G				
	H				
	I				
	J				
	K				
	L				
	M				
	N				
	O				
	P				
	Q				
	R				
	S				
	T				
				√ mean	2.45

Actual risk events	ID	risk event - * must complete 5	actual probability 1-3	actual consequence 1-3	actual risk level 1-9
Consequence is determined based on final project outcomes, and should include any unanticipated risk events	A*	Discovery of unidentified underground services	3	3	9
	B*	Unexpected latent ground conditions requiring remediation	3	2	6
	C*	Danger to workers from road users	3	1	3
	D*	Noise and dust complaints	3	1	3
	E*	Contractual risk (cost, time, reputation, weather)	3	2	6
	F		-		
	G		-		
	H		-		
	I		-		
	J		-		
	K		-		
	L		-		
	M		-		
	N		-		
	O		-		
	P		-		
	Q		-		
	R		-		
	S		-		
	T		-		
				√ mean	2.32

DELIGHT (EUS)	35	Gold Coast Light Rail (GCLR) Stage 1 and 2

SUCCESS FACTOR	desirable	31	adaptable	25	practicable	45	serviceable	38

Attractiveness:

	mean	influence
Nice to look at?	2.84	
High quality?	3.73	
Profitable?	2.01	
Well-designed?	2.41	
Valuable?	3.20	
Prestigious?	1.76	
Durable?	3.18	
Popular?	3.22	
Joyful?	1.95	
Unique?	1.07	
User-defined ...	1.40	
User-defined ...	1.17	
	2.33	20.85%
	22.65	

Flexibility:

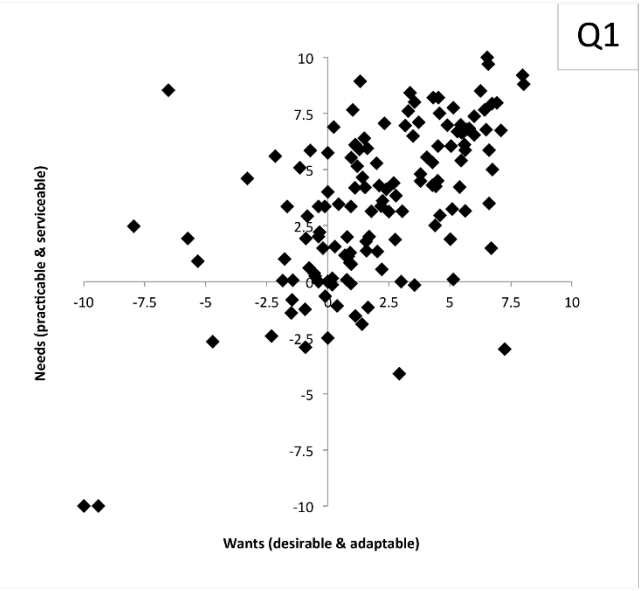
	mean	
Versatile?	2.29	
Easily modified?	1.37	
Able to be customized?	1.48	
Multi-use?	1.67	
Transportable?	1.72	
Better with age?	1.16	
Modular?	1.30	
Scalable?	2.08	
Technically clever?	1.87	
Timeless?	0.97	
User-defined ...		
User-defined ...		
	1.59	14.25%
	21.49	

Fit for Purpose:

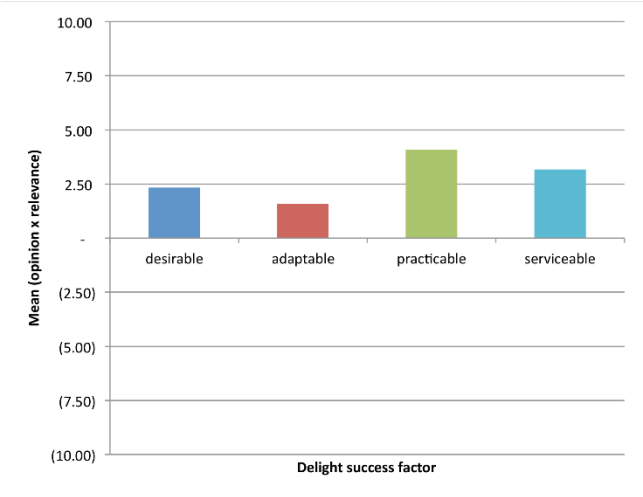
	mean	
Functional?	5.46	
Appropriate?	4.20	
Robust?	4.01	
Safe?	4.55	
Healthy?	3.71	
Problem-solving?	3.77	
Easy to use?	4.05	
Affordable?	3.33	
Comfortable?	4.07	
Ethical?	3.63	
User-defined ...		
User-defined ...		
	4.08	36.52%
	28.76	

Enduring:

	mean	
Low maintenance?	2.99	
Easily cleaned?	2.73	
Recyclable?	2.44	
Non-toxic?	2.87	
Repairable?	3.84	
Energy efficient?	3.03	
Reliable?	4.12	
Accessible?	3.83	
Regenerative?	3.00	
Habitat-safe?	2.83	
User-defined ...		
User-defined ...		
	3.17	28.38%
	25.10	100.00%



percent Q1	67.39	%
total responses	138	



sample	413
return rate	33%
expected delight (LPS)	43%
actual delight (EUS)	35%

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Instructions

Enter survey responses to the right of this page. Responses are computed as opinion multiplied by relevance, and are in the range -10 to +10. There is provision for 1,000 responses to be entered against each question. Specify the total responses in Cell K38.

Further Information

https://bond.edu.au/cccr
(including latest updates)

Disclaimer

Every attempt has been made to use unbiased evidence-based data (cells with light grey shading) in this study where possible.

i3d3 model: Copyright © 2020, Centre for Comparative Construction Research, Bond University