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Service development process: an integrated perspective in developing a service process for e-commerce

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Abstract: The prime inspiration of this study is the strategic selection and integration of design methods for a service development process. Technological advancement and competitive business environments increased the selling of products and services over the internet. Thus, it is essential to build up knowledge of design-led approaches for academic and business organisers. In addition, to develop a service process for obtaining new customer value and service innovation, a multi-perspective approach is required. Only a few existing researchers discussed this topic in the field of e-commerce. Aiming to bridge the gap, strategic management and engineering, design thinking, service design, and information system were adapted for developing a service process model in e-commerce. The proposed service development process model includes three phases, namely, the input phase, intermediate phase, and output phase. A practical case of domestic plumbing services in e-commerce was considered to demonstrate the effectiveness of the proposed service development process model. This study helps service providers, designers, developers, and project managers for developing service processes in e-commerce.

Keywords: service development process; design thinking; design management; e-commerce; domestic plumbing.

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1 Introduction

Business organisers and manufacturing companies have shifted their focus from product orientation towards service orientation. The trend of servitisation has increased exponentially in the last couple of decades. Servitisation refers to adding services to the traditional products to increase value addition and new offerings to customers. Therefore, developing a service process has become essential for academic and business organisers. The transformative approach of service design as a user-centric and design-led approach leads to service innovation (Yu and Sangiorgi, 2018b). Service innovation is more about improved customer experiences, processes and actions (Fließ and Kleinaltenkamp, 2004; Lee et al., 2019; Chen and Cheng, 2012; Costa et al., 2018). The study on the new service development process by Froehle and Roth (2009) includes a resources-oriented and a process-oriented framework. Resources-oriented new service development practices emphasise developing intellectual, organisational, and physical resources. In contrast, process-oriented new service development emphasises ideation of concepts, customer experience analysis, service sequence development, in-field service experiments, test and market launch. Yu and Sangiorgi (2018a) argues that design implications for product innovation are related to technical or functional performance, aesthetics, forms, manufacturing efficiency and logistics. On the other hand, design implications for service innovation are related to the attributes of service experiences, processes, organisational performances, human resources and actions. Service design has been studied as an integrative and multi-disciplinary approach for service innovation (Patrício et al., 2011; Wetter-Edman et al., 2014).

Initially, design thinking had a limited application to architecture but later applied in business practices by innovation consulting firm IDEO. Design thinking emphasises a customer-centric approach as a principal attribute (Chou, 2018). In a customer-centric approach, end-users play a cohesive role in developing the organisation's products or services (Vetterli et al., 2016). The design toolkit developed by IDEO emphasised a human-centred perspective for public sector organisations to adapt and employ to their problem-solving activities (Trischler et al., 2019). Liedtka (2011) identified essential tools and practices of the design thinking approach and demonstrated with the two cases of managers. Managers who are, in effect, successful design thinkers. The design thinking models developed by IDEO, Stanford Design School and IBM are the most cited, influential and emphasised models (Micheli et al., 2019). These models explore and clarify the problem through tools and methods, such as ethnography, personas or journey maps. Then, iterate into ideation and conceptualisation through brainstorming, mind

maps, or visualisation. In conclusion, these models move into developing prototypes and conducting field experiments. Inspiration, ideation and implementation are the stages considered in the design thinking model of IDEO. Stanford Design School's design thinking model comprises five stages: empathy, define, ideate, prototype, and test. The design thinking model comprised of understanding, exploring, prototyping and evaluating are the stages proposed by IBM.

On-demand services have grown significantly and are driven by technological advancements and changing customer requirements. On the other hand, online businesses have grown exponentially due to internet penetration and smartphones among customers (Laudon and Traver, 2017; Lee and Han, 2009). Moreover, to sustain in the competitive business environments, the service development process models should integrate perspectives such as strategic management, design thinking, service design, and information system. In India, there is a niche market of on-demand home services. There are on-demand home services for installation and repair works in the domestic market. In addition, start-ups for various services, viz., shifting furniture, events organisation, health and wellness services are running online businesses. The fast adoption of online services during the COVID-19 lockdown and post-lockdown significantly drove the country's e-commerce sector. According to the India Brand Equity Foundation, the digital economy may reach the US\$800 billion by 2030 from 85–95 billion in 2020 (IBEF, 2021). Therefore, there is a need to develop an integrated approach for developing a service process in e-commerce. This paper proposes integrating design-led approaches that guide and provide a systematic design method toward achieving a service development process. It also discusses methods/tools such as user behaviour study, rough group analytic hierarchy process (AHP), scenario planning, design brief, stakeholder mapping, service blueprint, data flow diagram (DFD), and wireframe/prototype. A case example of domestic plumbing services was considered to demonstrate the effectiveness of the proposed service development process model.

2 Literature and theoretical foundations

A systematic literature review on methods, tools and approaches has been conducted to understand service design approaches in design methods. A brief description of the methods, tools and approaches described as follows.

2.1 User behaviour study

User behaviour data are essential in the early stages of design activities, viz., identifying target customers, generating concepts, personas and contexts (Kim et al., 2018). Various user behaviour attributes can be studied through the demographic profiles for the market launch of products or services (Rust and Huang, 2014). It enhances the customers' experience, contexts, requirements and customisation in a specific market segment. Customers are more connected, informed and active through networking and social media about products and services (Blazevic and Lievens, 2008). The factors of potential user behaviour comprise, viz., gender, occupation, age, cultural background and location (Zhao et al., 2010). These factors determine uncertainty and could be analysed to target potential customers. Therefore, it is essential to understand user behaviour to fulfil

customer needs and achieve organisation strategies and goals. There are various methods and tools to collect user behaviour, viz., focus groups, interviews, personas and surveys.

2.2 Rough group AHP

Design requirements prioritisation and elicitation make decision-making effective in developing products, services, and systems (Liedtka, 2011). The integration of methods such as the AHP and rough group aid in prioritising subjective and uncertain requirements (Song et al., 2013). The AHP method has two phases, viz., modelling and evaluation (Prasad and Kim, 2018). The modelling phase emphasises criteria, goals or alternatives into a hierarchical structure. The evaluation phase enables the pairwise comparison of components in a hierarchical structure. An ordinal scale is used for pairwise comparison. The rough group originated from the rough set theory (Yang et al., 2017). Pawlak proposed the rough set theory. This tool is used in handling vagueness and imprecision of information from decision-makers. It deals with imprecise and subjective concepts.

2.3 Scenario planning

Scenario planning is considered for strategic planning and policymaking in descriptions, scripts and contents. Besides, developing scenarios is essential for plausibly exploring future uncertainties. It is considered a management technology profoundly utilised by decision-makers and managers of an organisation to analyse future possibilities. Scenario planning is a form of exploration but not forecasting, and analysis of scenarios highlights plausible prospects (Derbyshire and Giovannetti, 2017; Bradfield et al., 2005). Herman Khan is a founder of scenarios and applied scenario planning techniques for strategic solutions in business predictions. Scenario planning could be developed for different purposes for an organisation. The different kinds of scenario planning might be for: risk consciousness or a need of renewal on old business; a paradigm shift on new business, business/concept development, and strategy development/organisational development (Lindgren and Bandhold, 2009). There are different approaches to planning, generating, and analysing scenarios (Page et al., 2010; Bishop et al., 2007). However, the intuitive logics (ILs) approach is generally employed in developing scenarios (Derbyshire and Giovannetti, 2017). It is a qualitative and narrative approach to make plausible decisions about a problem or concern. It considers the influences and perspectives of political, economic, social and technological factors. Scenario planning has the potential of providing various benefits. Multiple examples of scenario planning from practitioners worldwide suggest that scenarios are helpful for strategic thinking. Scenario planning aid in future challenges about the political, economic, social and technological factors involved in the business environment.

2.4 Design brief

Design brief is recognised to clarify the design problem, design opportunity and design direction (Blyth and Worthington, 2001). In literature, design briefing is referred to as creative brief, marketing brief, project brief, or innovation brief (Dewulf et al., 2012; Phillips, 2004; Parkman, 2010). Designers outline the briefing to clarify and communicate the design problem, timeline, constraints, strategies and outcomes (Dewulf

et al., 2012). Phillips (2004) defined design briefs as “a document that outlines the strategic direction for creative development, covering the specific task at hand, the communication objectives and strategy, and any elements that the executions must contain.” Ryd (2004) discusses the importance of a design brief during the production phase for a construction project. However, designers and design managers should make an effort to study design briefs. It is a combination of a business plan and a creative design strategy (Phillips, 2004). The successful briefing shows the design team’s experience, skills, and knowledge. Design briefing is about comprehensive communication and strategic objectives for all the stakeholders involved in the project.

2.5 Stakeholder mapping

A stake is an authority, right, responsibility, ownership, knowledge, capacity, interest, influence or contribution. A stakeholder is an individual or group having a stake. Stakeholder analysis or mapping has evolved to identify and analyse stakeholders’ interests and actions. Assessing stakeholders for any project of an organisation is an essential step in strategic analysis (Freeman, 2015). The quality of a system is improved by selecting and involving appropriate stakeholders. Stakeholder mapping benefits the visualisation of all internal and external stakeholders involved in the project and emphasises interrelations (Ginige et al., 2018). Stakeholder mapping determines who have a positive and negative influence on an effort. In addition, who is most affected by an effort. To summarise the characteristics of stakeholders, Ginige et al. (2018) mentioned that tables or charts aid in the group or prioritise the stakeholders. Stakeholder analysis is conducted employing power versus interest or influence versus importance matrix. Stakeholder management researchers used the power versus interest matrix for several objectives. For example, Bryson (2004) used a power versus interest matrix to determine the stakeholders’ interest and power to address the issue, stakeholders’ coalition encouragement or discouragement, and information on how to convince stakeholders’ perspectives (Bryson, 2004).

2.6 Service blueprint

The service blueprinting approach originated from the service design, firstly introduced by Shostack in 1982 (Costa et al., 2018). The service blueprint is a picture or a flow of human resources, processes, tangible and intangible service systems (Fließ and Kleinaltenkamp, 2004). Service blueprints could be adopted for a new service design and an existing service for improvement (Wang et al., 2017). The service concept incorporated with the design concept is emerging. Besides, the service practitioners or designers conceptualise the design process by utilising a service blueprint. Service blueprint enables them to explore, visualise and analyse customer service activities and experiences. These are identified in the service blueprint by tracking the customer’s interactions with service staff. The studies on applications of service blueprint are, viz., hospital management, courier delivery services, room service in a hotel, restaurant management and smart parking services (Geum and Park, 2011; Lee et al., 2019). The service blueprint design is composed of regions and boundaries (Chen and Cheng, 2012; Go and Kim, 2018). The regions and boundaries are shown on the vertical axis. The regions of the service blueprint are physical resources, customer actions area, the onstage

interaction area, the backstage interaction area and the support processes. The boundaries of the service blueprint are the line of interaction, line of visibility and internal interaction. The service process is viewed, understood and shown on the horizontal axis. The arrows in the service blueprint design represent the trail of connected and related activities.

2.7 *Data flow diagram*

DFDs enable designing software or web-based applications and information flow in a structured system design and analysis (Al Ashry, 2017). DFDs allow decomposition and represent a system's visualisation through four elements, viz., processes, data stores, data flow, and external entities (Ii et al., 2003). DFDs are utilised in organisations for the information flow, i.e., logical view of a system and representing the actual flow, i.e., physical view of a system (Zhang et al., 2018). In DFD, a single diagram is drawn, named a context diagram. A context diagram of DFD is decomposed into processes, data stores, data flow and external entities describing all the activities and information flow of a system. In recent developments, the data flow diagram process has been utilised in widespread domains. Meesang et al. (2016) discussed an assessment process in decision making through DFDs and concluded that it could act as a decision support screening system for healthcare professionals to improve their services. Zhang et al. (2018) presents a visualisation system to help software developers to develop and analyse a system through DFD. Al Ashry (2017) presents the significance and relationships of data flow diagrams and entity relationships diagrams in designing a software application for managing the grocery store process.

2.8 *Wireframe/prototype*

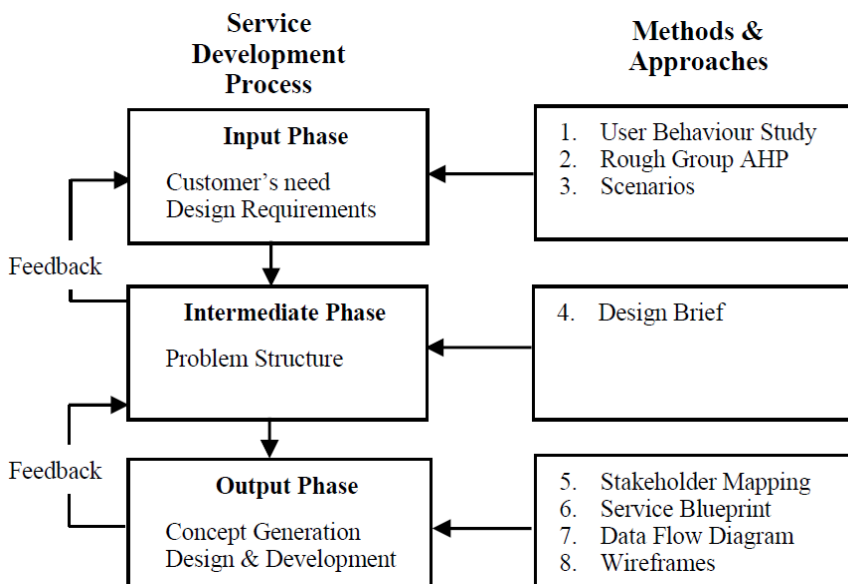
The design and execution of usability could play a significant factor in e-commerce websites' success. User interface is a visual representation technique to depict end-user interactions with a system (Jitnupong and Jirachiefpattana, 2018). User-centred design approaches have been employed to develop user interfaces (Kikuchi et al., 2010). The user-centred design methodology is utilised in e-commerce for increasing customers' trust, user satisfaction, purchase intention, and decision to buy (Pfeiffer et al., 2016). Sharma and Lijuan (2015) examined five elements for service quality of e-commerce websites and their effects on e-business promotion through an online-based questionnaire. The five elements considered in their study are, viz., information quality, e-service quality, usefulness, e-satisfaction and trust. As a result, information and online service quality are the two elements that help achieve user satisfaction and e-commerce sustainability. Hasan and Morris (2017) investigated usability of e-commerce websites. Their study identified design problems and usability requirements through heuristic evaluation, user testing, and Google Analytics. They identified usability problems that may affect user experiences on e-commerce are, viz., navigation, organisation, content, communication, design, and purchasing processes are the usability problems. Further, their study recommends overcoming usability problems such as displaying product availability information, accurate shipping details, products booking options without user credentials, ease in an online order, alternative delivery options, and display of company information on the website (Hasan and Morris, 2017). Varela et al. (2017) proposed a conceptual model of key factors for online shopping. In their study, usability is one of the

critical success factors to consider in designing the website, and it is a one-dimensional property of a user interface. The first step in formally establishing a website's visual design is wireframes (Garrett, 2011).

3 Service development process methodology

The service development process involves communication, needs identification, and empathy with customers (Beltagui, 2018). In addition, the designer's skills in integrating multi-perspective approaches into concepts generation, analysis and identifying alternative solutions. Therefore, the methodology of the proposed service development process integrates strategic management, design thinking, service design, and information system perspectives. The proposed service development process model includes the input, intermediate, and output phases. Figure 1 illustrates the proposed service development process model. The reasons for adopting an integrated perspective of methods and approaches in the proposed service development process model are explained in Table 1.

Figure 1 Proposed service development process model



The proposed model provides a continuing mechanism, and the description of each phase is presented below,

- *Input phase:* This phase aims to study tools and methods for requirements identification and analysis. Various tools and methods were explored and experimented, viz., user behaviour study through structured questionnaire and interview, rough group AHP approach for prioritising design requirements, scenario planning to understand plausible futuristic situations. The experiment of the methods was conducted in the design of domestic plumbing in the Indian context. A synthesis

of the combined outcome of the methods has been proposed. The findings of the input phase were considered in defining the design brief for service development.

- *Intermediate phase:* In the input phase, customer's requirements, design requirements, and plausible futuristic scenarios are created and identified. Findings from the input phase were utilised as insights for the design brief. The design brief provides a structured statement that outlines problem definition, goals, constraints, budgets, and timeline.
- *Output phase:* This phase primarily concentrates on the design thinking approach to illustrate stakeholders mapping, service process visualisation, data flow and wireframes. To serve this purpose, all the stakeholders were initially identified through primary data. Then, the mapping of all stakeholders in power versus interest matrix shows the future strategic management of stakeholders. Furthermore, the service blueprint approach illustrates the touchpoints of multiple stakeholders, customer journey, and interaction between technology with supporting staff, tangible products, and intangible services. The data flow diagram was carried out to decompose a process into sub-processes. DFDs clarify activities from the service provider's perspective and depict data flow between various actors for smooth operations. Lastly, wireframes act as a carrier for designers to develop and establish a visual design for the website.

Table 1 Reasons for adapting methods and approaches in the proposed service development process model

<i>Methods and approaches</i>	<i>Remarks</i>
User behaviour study	To understand the life-cycle of the customer using the product or service.
Rough group AHP	The integration of the analytic hierarchy process (AHP) and rough group methods aid in prioritisation and ranking of uncertain, subjective and fuzzy requirements (Song et al., 2013).
Scenarios	Scenario planning is utilised for strategic planning and policymaking in descriptions, scripts and contents. It explores plausible future uncertainties that aid in decision-making through drivers of change or trends (Derbyshire and Giovannetti, 2017).
Stakeholder mapping	Stakeholder mapping benefits the visualisation of all the actors involved in the project or organisation. It emphasises how stakeholders are connected and interact (Ginige et al., 2018).
Service blueprint	Service blueprint enables service designers to explore, understand, and analyse customer service activities and experiences (Wang et al., 2017).
Data flow diagram	DFDs are used for process modelling to represent the system under development through connections of sources, sinks, processes and data stores (Ii et al., 2003; Zhang et al., 2018).
Wireframes	Wireframes enable visual design for the websites.

4 Case example of the proposed model for domestic plumbing services

4.1 Input phase: identifying customer needs and design requirements

Customers' requirements were collected through the structured questionnaire based on the survey method in this phase. Statistical analysis has been conducted to observe significant relations and variations between variables. The design requirements for the plumbing service system were identified based upon user behaviour study, plumbers, and retailers. In addition, the design requirements were grouped and categorised into the hierarchical structure under product, service and system. A questionnaire of pairwise comparison of product-related, service-related and system-related design requirements were developed. Then, a structured interview and interactions were conducted with experts for collecting importance ratings on design requirements. The integration of the AHP and rough group method (Song et al., 2013) has been utilised to prioritise domestic plumbing design requirements and product service components. Scenario planning considered the narrative approach for concerns of plumbing services by setting a scenario timescale. The effects and driving forces for plumbing services were identified through secondary data. Two scenarios were framed based upon grouping the effects and driving forces of change into impacts versus uncertainty matrix.

4.1.1 User behaviour study

Data concerning the customer's opinions about the service aspects in domestic plumbing is collected through a questionnaire. A total of 160 respondents' opinions were collected and the duration spent with each respondent was around 25–30 minutes. Among the respondents, 128 are males, and 32 are females. The questionnaire consists of domestic plumbing service aspects. It comprises, viz., how many times called for corrective and preventive maintenance, the duration of a plumber to fix the plumbing issue, agree or disagree with the plumber's responsiveness, and what mode of contact is made with the plumber. The other essential variables considered were the frequency of domestic plumbing issues, the user's expectations/needs towards plumbing services and demographic data. Non-parametric and parametric statistical analyses of domestic plumbing services were conducted concerning the demographic profile of the respondents.

Chi-square test of independence study reveals a significant difference between the domestic plumbing service aspect of preventive maintenance and respondents' residential typology. Respondents were less likely to agree with the plumber's responsiveness. In addition, there is a significant difference between the duration of a plumber to fix the plumbing issue with the demographic profile of the respondents' occupation and age group. A significance level of 0.05 was observed in the one-way ANOVA test between the frequency of domestic plumbing issues and the demographic profile of the respondents. The study reveals that dripping faucets plumbing issues vary significantly with the respondents' occupation and residential typology. In addition, running toilet issues vary significantly with respondents' locality and leaked pipes issue with respondents' residential typology.

4.1.2 *Rough group AHP*

The elicitation and prioritisation of design requirements for domestic plumbing service were conducted through the integrated approach of the AHP and rough group (Song et al., 2013). In this study, design requirements of domestic plumbing were identified from the secondary data and various stakeholders (plumbers, vendors and retailers). Thirty-four design requirements were classified and grouped into a hierarchical structure of product, service and system-related domestic plumbing. The first hierarchy of product-related design requirements consists of technical function, economic, and quality. The first hierarchy of service-related design requirements includes process, interaction, timing and reliability. The first hierarchy of system-related design requirements comprises human resources, facility, material, information, and capital. Five experts were identified with areas of expertise in design, maintenance and technician to obtain priority weights. Pairwise comparison was conducted between design requirements to collect expert's judgments and calculated eigenvalue, consistency index and consistency ratio. Then, calculated average rough interval and formed a rough group decision matrix. The rough group method resulted in rough weights and crisp values to prioritise and rank design requirements for domestic plumbing. As a result, the design requirements for the product-related ranking show, viz., products' efficiency to execute a job, flexibility or provision of alternate products, and the reusability of products. The design requirements for the service-related ranking exhibit, viz., response and delivery of the service, availability of plumber, and minimal processing time to execute plumbing issues. The design requirements for the system-related ranking exhibit, viz., plumber skills, communication and location.

4.1.3 *Scenario planning*

The scenario planning has been conducted for domestic plumbing services, and the scenario timescale is set to ten years. The driving forces were identified through secondary data and clustered. The driving forces of political factors for domestic plumbing are, viz., Skill India, Digital India, Pradhan Mantri Kaushal Vikas Yojana, and National Skill Development Corporation. Similarly, the gig economy, family income, demand, and supply were the economic factors. Buying habits, lifestyle, education and online shopping were considered under the social drivers of trends. The technological factors are the video in real-time, mixed reality, and drone delivery was emphasised. The influence of each driving force was mapped through the impact versus uncertainty matrix for plumbing services. Then, defined the possible outcomes for domestic plumbing service system, and two scenarios were created and visualised.

- Scenario 1: In India, on-demand services are operational in urban cities. There is an opportunity and business expansion for on-demand services in semi-urban and rural cities of India. In this scenario, the existing on-demand service process is visualised through stakeholders, geographical presence, infrastructure, tangible products and intangible services. In addition, the benefits and advantages of utilising on-demand services for customers.
- Scenario 2: The customers may solve minor plumbing issues through instructions from the app/websites in the era of DIY. In addition, the customer journey and strategies for service providers were outlined.

4.2 Intermediate phase: design brief

In this section, findings from the input phase were utilised to draw problem structure. The design brief enables the clarification of the project's scope, aim, and objectives for the stakeholders involved in the development process. Three design briefs were outlined. Design brief-1 for designing a plumbing toolkit. Design brief-2 for designing a mobile-based app for plumbing services. Design brief-3 for designing and developing an e-commerce website for domestic plumbing services, as shown in Table 2. All three design briefs were shared with a small focus group of designers. Design briefs were explained, and their probable design outcome was envisaged. Design brief-3 was selected based on the general feedback received for the output phase.

Table 2 Design brief

<i>Design brief title: e-commerce website</i>	
We are designing	E-commerce website for domestic plumbing services
That	Provide guidelines (images + videos) to resolve minor plumbing issues, purchase tools/spare parts and hire a nearby plumber
For	<ul style="list-style-type: none"> • Residential typology of detached houses • 25–34; 35–44 age-group • Respondents with attached house to avoid the delay of servicemen response towards resolving issues
So that	<ul style="list-style-type: none"> • The consumer no need to go through the process of searching plumber online for a minor plumbing problem • The consumer gets online professional support • The consumer can enhance the skill set of do-it-yourself

4.3 Output phase: concept, design and development

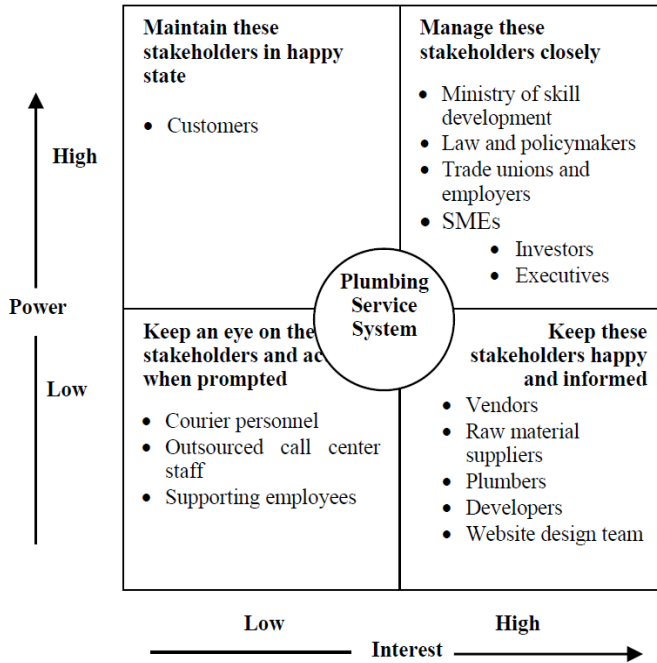
This section applies the design thinking approach for concepts, design and development of e-commerce for domestic plumbing. Stakeholder mapping emphasises the role of actors involved in developing e-commerce for domestic plumbing. The service blueprint approach is utilised to define and ideate the touchpoints of actors, tangible products, and intangible services. DFDs to identify the activities, processes, and data flow between the actors. Wireframes were created for user navigation, content, organisation, and purchasing services.

4.3.1 Stakeholder mapping

Multiple stakeholders were mapped in the power versus interest matrix for the plumbing service system, as shown in Figure 2. The essential stakeholders who might have a stake or are influential for the plumbing service system are the government, investors, service providers, vendors, plumbers, and customers. As a key stakeholder, the government can influence and play the role of a regulator in the adoption process or governing of e-commerce. The investor is an individual or an organisation with the agenda of financial returns to fund money/capital and develop e-commerce. Service providers are companies or organisations that can provide operational activities for the service processes between

all the stakeholders. Vendors, an organisation that owns independent outlets and provides the plumbing tools/spares parts. Plumbers are qualified individuals with vocational skills who specialise in fixing/repairing domestic plumbing systems. Customers are end-users who access the e-commerce platform for instructions to resolve minor plumbing issues, buy plumbing tools/spare parts, and hire plumbers for on-demand major plumbing services.

Figure 2 Power versus interest matrix



4.3.2 Service blueprint

As depicted in Figure 3, the service blueprint illustrates the two horizontal lines from the customer’s perspective, viz., line of interactions and line of visibility. The line of interactions is divided between customer actions and onstage contact. The touchpoints and customers’ journey for accessing the website for resolving minor plumbing issues are shown under customer actions. This design may resolve the customer waiting period for the plumbers and can be self-dependent. The line of visibility is divided into onstage and backstage contacts with customers.

As depicted in Figure 4, the service blueprint represents the touchpoints and customer journey for online ordering of plumbing tools/spares. It also represents plumber requests for on-demand major plumbing issues through the website. It delivers plumber availability for major plumbing issues and tools/spares for customers. In addition, ease of online order, multiple payment options, reviews and ratings on service delivery. To enhance the competitive advantage, the service provider must include, viz., website maintenance and update, plumbing products inventory, plumbers’ availability, easy payment process, and data security.

Figure 3 Service blueprint of plumbing services for do-it-yourself tutorials (see online version for colours)

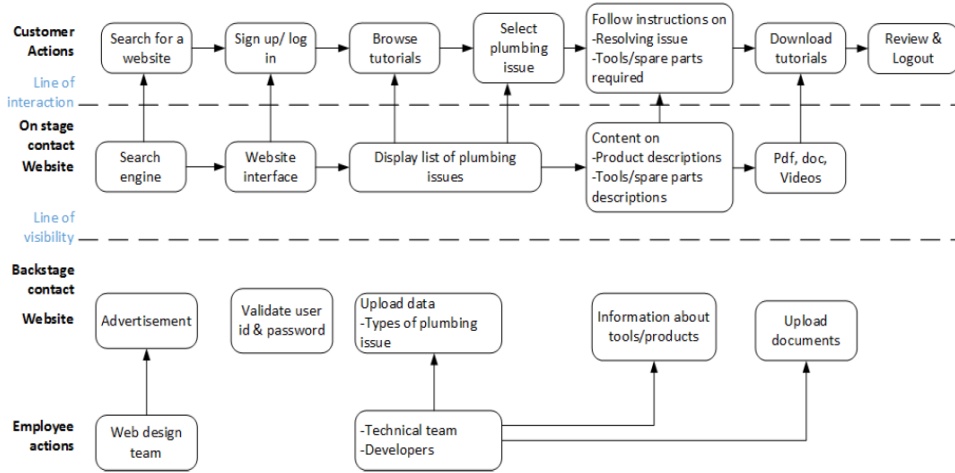
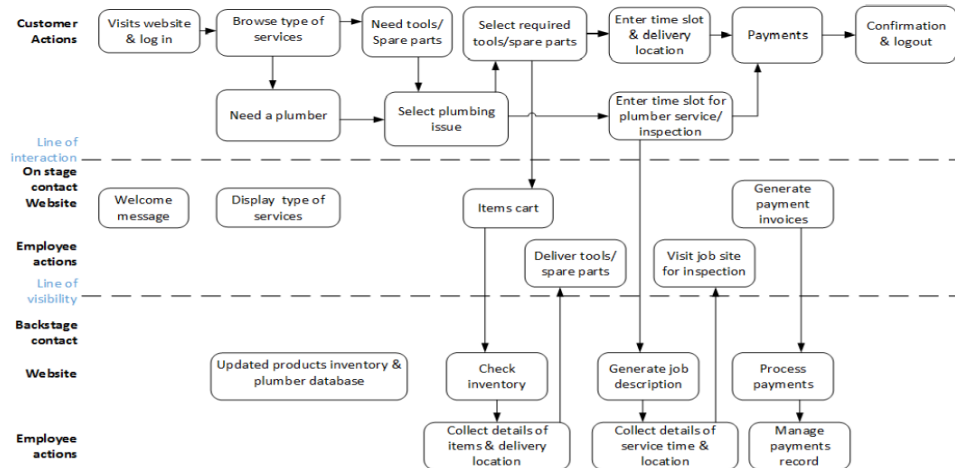


Figure 4 Service blueprint of plumbing services for on-demand services (see online version for colours)

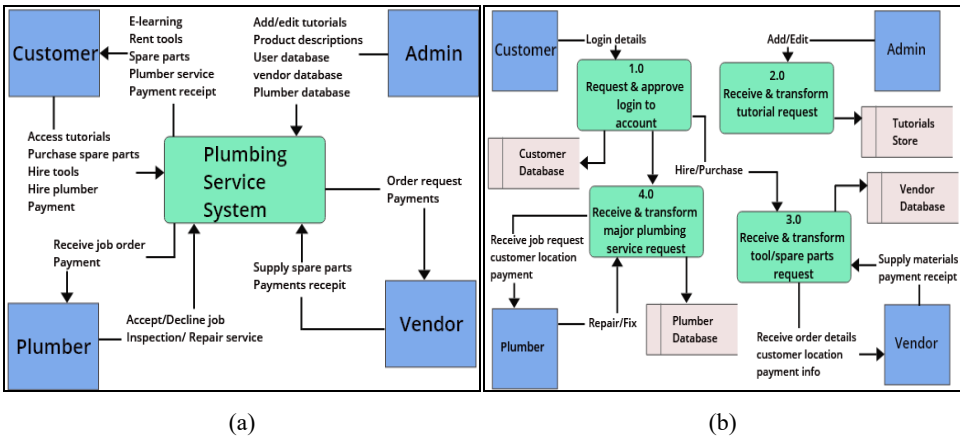


4.3.3 Data flow diagram

In this study, Gane and Sarson symbols of DFDs are employed to visualise the information system of a domestic plumbing system. Figure 5(a) is the context diagram of the system. The process in the context diagram is named a plumbing service system. The four sources/sinks of the plumbing service system are customer, plumber, vendor and admin. The customer provides input to the plumbing service system to access DIY tutorials, purchase tools/spares, hire plumbers and make payments. Then, the customer receives e-learning, tools on rent, spare parts, plumber service and payment receipt. The plumbing service system provides input to the plumber for job order requests and

payment details. The plumbing service system receives information from plumber about job acceptance/decline and inspection/repair service. The plumbing service system provides vendors' input for order requests and payment details. The plumbing service system receives information from the vendor about the supply of spare parts and payment receipts. Admin provides input to the plumbing service system about add/tutorials, product descriptions, and user/vendor/plumber databases.

Figure 5 DFDs of plumbing service system, (a) context diagram (b) level-0 diagram (see online version for colours)



A level-0 DFD has been developed based on the context diagram, as illustrated in Figure 5(b). Level-0 DFD of plumbing service system has four processes, viz.,

- 1 request and approve login to an account
- 2 receive and transform tutorial request
- 3 receive and transform tools/spare parts request
- 4 receive and transform plumber service request.

Data stores in this DFD are

- D1 customer database
- D2 plumber database
- D3 vendor database
- D4 tutorial store.

4.3.4 Wireframes

Wireframes were designed to establish a visual design for the e-commerce platform of a domestic plumbing service system. Designers execute wireframes/prototypes with the aid of pencil and paper sketches, computer drawn images and in-built software tools. Figure 6 illustrates the layout of the plumbing service system, viz., home screen, DIY screen, tools/spares and retailer's screen. The home screen represents end-user interfaces requesting on-demand plumber services, online orders of plumbing tools and spares,

access to DIY tutorials on minor plumbing issues, and the plumbing retailer's information. On the DIY tutorials page, customers can navigate to the tutorial for accessing the information on resolving minor plumbing issues.

Figure 6 Wireframes of plumbing service system – home screen, DIY screen, tools/spares screen and retailers screen (see online version for colours)

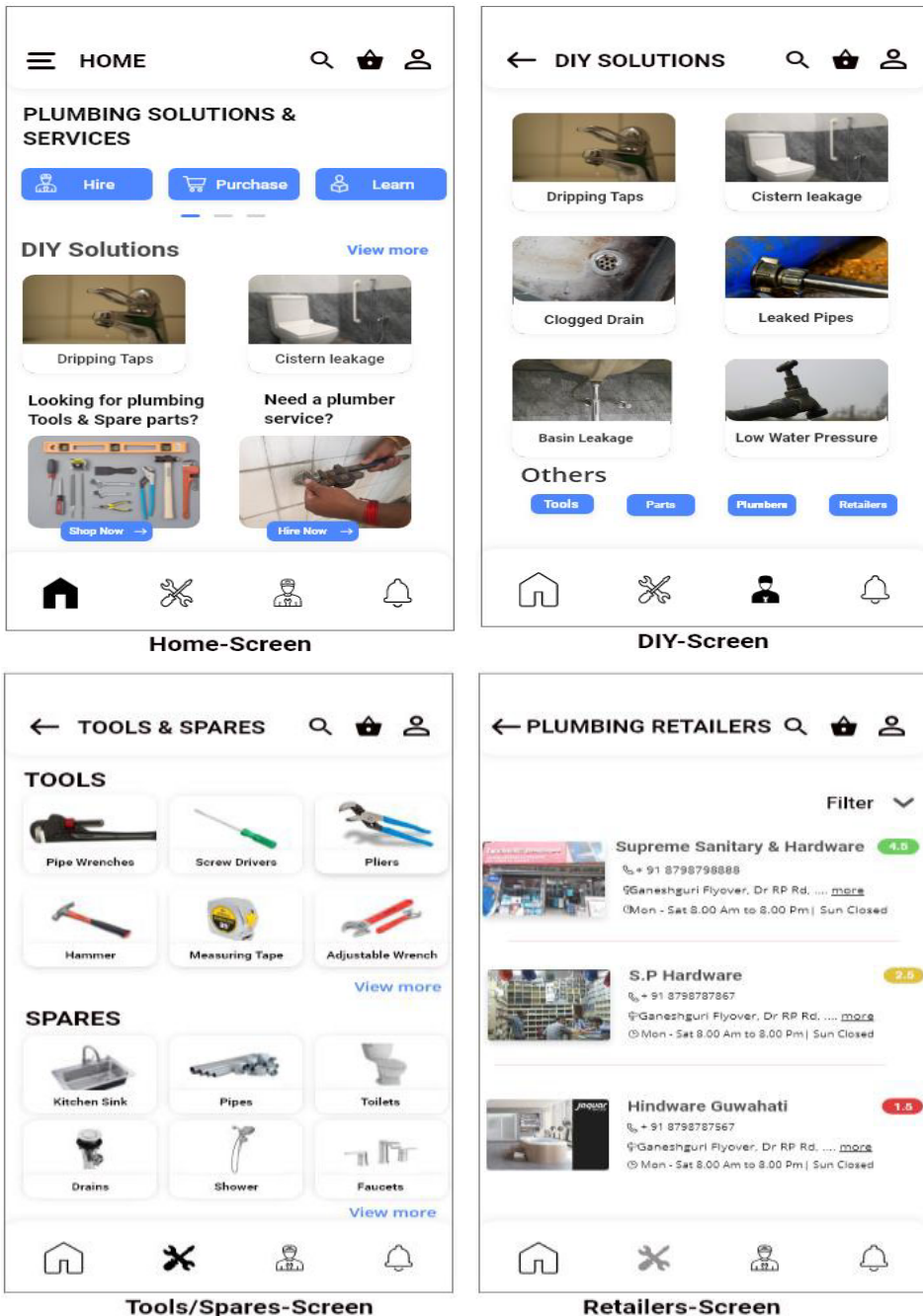


Figure 7 Wireframes of plumbing service system – plumbing service for kitchen faucets/taps and sinks (see online version for colours)

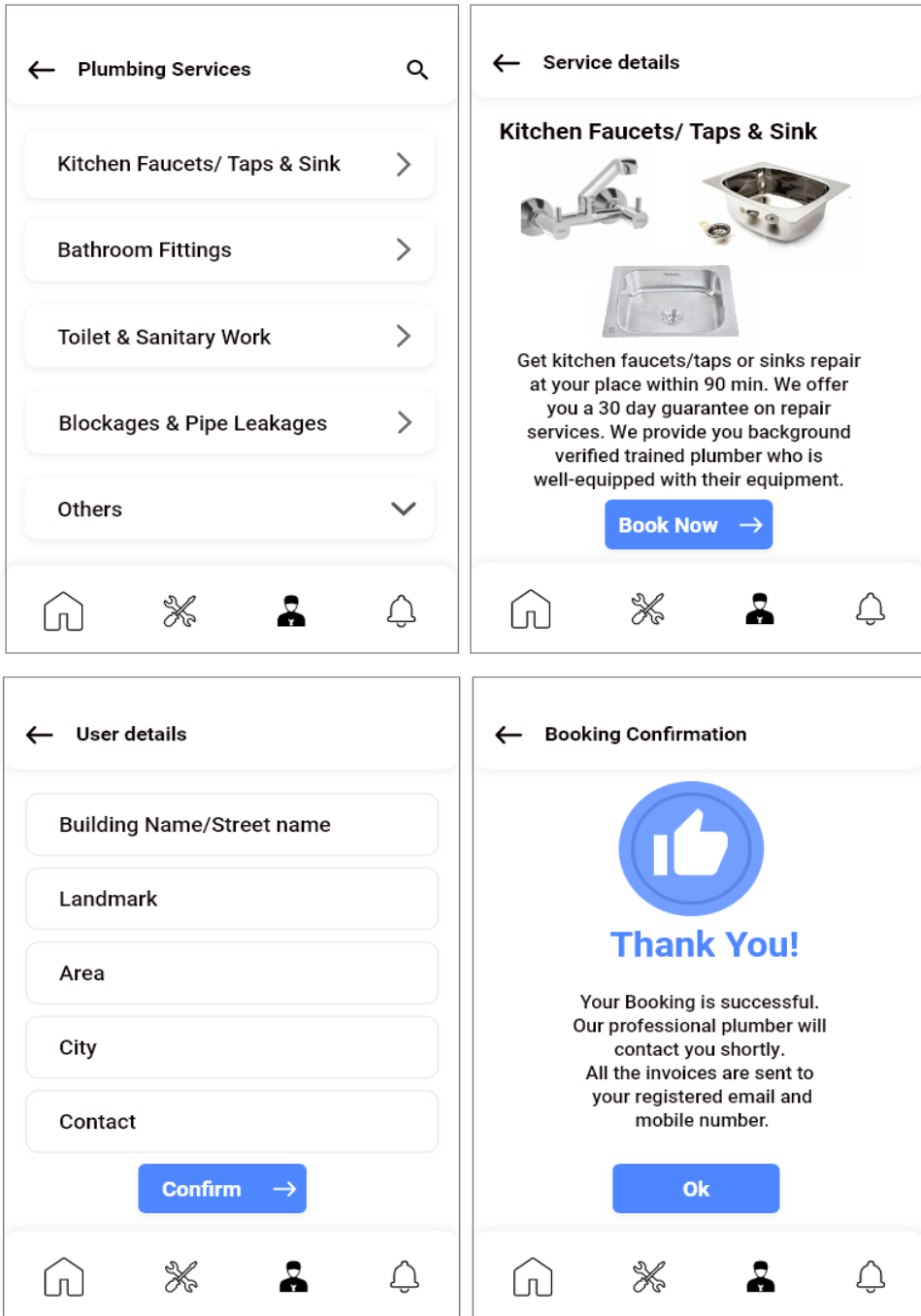


Figure 7 illustrates the process of requesting a plumber service for kitchen faucets/taps and sinks. It depicts three steps to complete the process of plumber service requests.

Here, the customer selects the plumbing issue and reviews the particulars of inspection and service charges. Then, the customer inputs the date, time and location for the plumber service. After the review, the customer confirms the plumber service request. In response, the plumbing service system confirms plumber service booking confirmation to the customer through the contact details and registered mail.

5 Conclusions

This study proposed integrated perspectives in developing a service process through a reference of domestic plumbing in the Indian context. This proposed service process provides a structural approach for business organisers, designers and service practitioners. The proposed methodology for a service development process identifies customers' requirements, prioritises design requirements, outlines problem structure, and visualises a service process. Therefore, designers and project managers could design and develop a service process for business in e-commerce, which brings new customer experiences with the usage of digital technology.

For the case study, the most frequent plumbing issues found in the research are dripping faucets, running toilets and leaked pipes. The result of integrating AHP and rough group methods shows the priority of product-related, service-related and system-related design requirements. The scenario planning exercise revealed the opportunity for innovation in on-demand domestic plumbing services considering recent and future trends. Design briefs outline the problem structure, target audience, website features, navigation, and layout. The concept design and development illustrate the visualisation of a service process for a domestic plumbing system. It includes stakeholder mapping, service blueprint, data flow and wireframes/prototypes.

The limitations of this study were the implementation and validation of the service process. The future research trajectories may include more case studies of home services to generalise the proposed service process and implementation of the plumbing service system. Future work may be extended to optimise service operations management, particularly from the perspective of after-sales service issues and maintenance.

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