UTS UNIVERSITY OF TECHNOLOGY SYDNEY

# Leveraging Digital Platform-based Intermediation to Facilitate Knowledge and Technology Transfer Activities through University-Industry Collaboration: A Design Science Research Approach

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**Doctor of Philosophy**

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# CERTIFICATE OF ORIGINAL AUTHORSHIP

I, *Maram*, declare that this thesis is submitted in fulfilment of the requirements for the award of *Doctor of Philosophy*, in the *School of Professional Practice and Leadership / Faculty of Engineering and IT* at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

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Ultimately, a doctoral degree is simply a key- its true value lies in applying the knowledge and skills acquired to drive innovation, expand understanding, and create a profound impact on society.

# ABSTRACT

Universities play a crucial role in developing human capital for the knowledge-based economy (KBE) by fostering the creation, application, and spread of knowledge. Collaboration between universities and industry is paramount for deriving and enhancing innovation. Through such collaborative arrangements, referred to as University-Industry Collaboration (UIC), both universities and the industry access resources and transfer knowledge to each other. University technology transfer offices (UTTOs) and knowledge transfer offices (UKTOs) are examples of UIC facilitation mechanisms (intermediation).

A comprehensive literature review highlights shortcomings in some geographical areas, including developing regions/countries, particularly in the Middle East and North Africa (MENA) region, which have received limited attention in UIC research. Notably, there is a significant lack of studies focusing on the socio-technical applications of UIC in the MENA region that has recently demonstrated economic strengthening and an emphasis on knowledge-based activities. A closer look at the literature reveals several research gaps, including how different types of intermediaries manage knowledge-based activities.

This study aims to develop and validate a socio-technical facilitation mechanism, specifically a digital platform-based intermediary, to enhance knowledge and technology transfer (KT/TT) activities within the UIC setting. A comprehensive framework that integrates UIC mechanisms with concepts from Social Capital (SC) theory is applied from a socio-technical perspective. It employs the Design Science Research (DSR) methodology to develop a platform-based intermediary. It is organised into five iterative phases, each aimed at progressively refining and validating the research outcomes, including problem identification, solution suggestions, development, evaluation, and conclusions based on reflection on the DSR process.

Data collection includes primary and secondary methods. Secondary data comprises a comprehensive literature review and two targeted systematic reviews: one examining 60 journal articles on UIC in the MENA region and another focusing on theoretical and contextual insights from 23 studies on UIC. Primary data was collected in one of the leading countries in the MENA Region, Saudi Arabia, through 40 semi-structured expert interviews, additional iterative follow-up interviews, and a focus group for prototype feedback.

A thematic analysis of the interview data is employed to discuss common themes and utilise SC theory to understand inter-organisational relationships and the role of embedded resources like trust and common understanding in facilitating UIC activities. This analysis helped identify key drivers and barriers to practical KT/TT-UIC activities, which informed developing a structured guidance model that defines essential design criteria for creating efficient intermediation tools, including design requirements, principles, and features.

The significance of this research lies in its potential to enhance the efficiency and productivity of KT/TT activities within the UIC setting, thereby fostering innovation, industry advancement, and economic growth. By integrating social and technical aspects, it provides a comprehensive analysis of the phenomena, challenges, and potential solutions, offering valuable insights for stakeholders involved in UIC activities. The outcomes are also expected to benefit academics, industry professionals, and policymakers focused on enhancing UIC collaborations and could serve as a valuable reference for other regions facing similar challenges.

In summary, this study contributes to the UIC literature by highlighting critical insights into drivers and barriers and demonstrating how digital intermediation mechanisms can help overcome existing barriers and improve collaborative inter-organisational relationships.

# LIST OF PUBLICATIONS

**The research undertaken for this thesis has resulted in the following publications.**

| Publication Title | Publication Avenue |
|---|---|
| Knowledge Transfer in University-Private Research Partnership in Saudi Arabia: A Review | ACIS 2020<br>Wellington, New Zealand |
| The Role of Social Capital, Communication, Knowledge Transfer, and Intermediary Companies in the University-Private Partnership in Saudi Arabia: A Theoretical View | MENACIS 2020<br>Casablanca, Morocco |
| "Who You Know Affects What You Know": Knowledge Transfer in the University Private Partnership- A Social Capital Perspective | Industry and Higher Education Journal<br>SAGE Publications |
| University-Industry Collaboration in the Middle East and North Africa Region: Current Trends and Future Perspectives<br>***This paper received the "Best Doctoral Paper Award".*** | MENACIS 2021<br>Agadir, Morocco |
| Investigating the Social Capital Theory in the University-Private Partnership: A Systematic Review | HICSS 2022<br>Maui, Hawaii, USA |
| Learning from Intermediaries to Overcome Cognitive-Related Barriers in the University-Industry Collaboration | ACIS 2022<br>Melbourne, VIC, Australia |
| Insights into Key Barriers and Drivers of University-Industry Collaboration in the Middle East and North Africa (MENA) Region | The DATABASE for Advances in Information Systems Journal<br>ACM SIGMIS |

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# LIST OF ABBREVIATIONS

| Abbreviation | Term |
|---|---|
| FEDS | Framework for Evaluation in Design Science |
| GDP | Gross Domestic Product |
| DFs | Design Features |
| DPs | Design Principles |
| DRs | Design Requirements |
| DSR | Design Science Research |
| HEIs | Higher Education Institutions |
| IP | Intellectual Property |
| IS | Information Systems |
| Joint R&D | Joint Research and Development |
| KBE | Knowledge-based Economy |
| KT | Knowledge Transfer |
| KT/TT-UIC | Knowledge Transfer and Technology Transfer through the University-Industry Collaboration |
| MENA | The Middle East and North Africa |
| R&D | Research and Development |
| SC | Social Capital |
| SC-UIC | Social Capital Theory in the University-Industry Collaboration |
| TT | Technology Transfer |
| UIC | University-Industry Collaboration |

# PART I- RESEARCH BACKGROUND

## Chapter 1: Introduction

## Chapter 2: Literature Review

# 1 INTRODUCTION

Chapter 1 serves as an introduction to the research conducted and provides an overview of the research topic, background, research purpose, research questions, methodology, scope, significance, and its structure. The chapter introduces the research background (Section 1.1), shedding light on the existing knowledge and the problem being addressed, and identifying the gaps this study seeks to fill. Following this, the study purpose (Section 1.2) is articulated, commencing with a statement of purpose (Section 1.2.1) that clarifies the rationale behind the research. This section further unfolds into the research aims and objectives (Section 1.2.2), which outline the goals and anticipated outcomes, and the research questions (Section 1.2.3) which define the investigative queries guiding this research. An overview of the research approach (Section 1.4) details the methodologies utilised, includes an explanation of the data collection and analysis methods (Section 1.4.1) employed, and a summary of the DSR project (Section 1.4.2), providing insights into the methodological framework and execution. The discussion of the scope (Section 1.4) sets the boundaries and limitations within which the research is conducted; this ensures a focused approach to the subject matter. The significance and expected contributions (Section 1.5) discusses the potential impacts, and the degree to which the research aims make substantial contributions to the body of knowledge. An outline (Section 1.6) is then presented, offering a chapter-by-chapter breakdown that maps out the thesis structure and content. The chapter concludes with a summary (Section 1.7) that recaps and outlines the essential elements introduced and then used in the in-depth discussions in subsequent chapters.

## 1.1 RESEARCH BACKGROUND

This section provides a foundation for understanding the existing knowledge relevant to the study to outline the broader context within which the research is situated. Knowledge-based economy (KBE) refers to economies that are impacted by the production, distribution and use of knowledge and have at least one characteristic of “applications of information and communication technologies (ICT) would be the drivers of the new economy” (Godin, 2006, p. 20). As an umbrella concept, the KBE influences researchers from many disciplines to investigate and explore what drives robust economic growth through innovation ecosystems.

An innovation ecosystem is referred to as "the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors; [where this definition often emphasises on] collaboration/complements and actors" (Granstrand & Holgersson, 2020, pp. 2-3). Actors are presumed to pursue economic goals and leverage the collective configuration of resources, knowledge, and skills to achieve them collaboratively within a given setting or ecosystem (Vargo & Lusch, 2016; Burkhalter et al., 2021). According to Williamson and De Meyer (2012), ecosystems or business-related ecosystems refer to networks of different organisations that work together to create value by leveraging their skills and capabilities. They emphasise the critical role that individual actors play within these ecosystems and highlight the potential benefits of collaborations among actors. Resources can also be defined as anything that actors draw upon to correspond to their particular explicit or latent needs; it is essential to consider how actors strategically manage and allocate these resources (Burkhalter et al., 2021).

Previous literature has examined collaborations between universities and the industry, with more attention paid to knowledge-based activities or transferred knowledge and technology through such collaborations. A university is an organisation/institution that performs “a key role within contemporary societies by educating large proportions of the population and generating knowledge” (Perkmann et al., 2013, p. 423). In addition to the two primary missions of generating and disseminating knowledge from teaching and research, universities contribute to society via their so-called ‘third mission’. Molas-Gallart et al. (2002, p. iii) refer to this ‘third mission’ as "all activities concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments". On the other hand, industry is broadly referred to as public, private, and not-for-profit organisations.

In the literature, the term ‘university-industry collaboration (UIC)’ is widely used to describe the phenomenon of such a collaboration/relation between a university and an industry organisation. UIC is defined here as the inter-organisational arrangements between universities and industry to access each other’s resources. Furthermore, from the organisation's standpoint, several actors (pillars) form the UIC ecosystem. A standard UIC ecosystem consists of a university and its private sector partner as a university-private collaboration, and some may refer to it as an academia-business collaboration. However, it can also evolve to include multiple partners (sometimes referred to in this paper as actors or stakeholders). In open innovation, the government is involved in these collaborations as a third actor, in which collaboration can advance to a 'triple-helix' model (i.e. university-private-government, i.e. university-industry-government (U-I-G) collaboration’) or even a 'quadruple-helix' model (i.e. university-private-government-public/society collaboration) (Etzkowitz, 2003, 2014; Miller et al., 2016; Chen & Lin, 2017).

Universities are major players in preparing human capital for knowledge creation, use and dissemination in the knowledge-based economy. Collaboration between universities and the industry is paramount to generating and enhancing innovation. Through such collaborative arrangements, both universities and the industry access resources and transfer knowledge to each other. Knowledge is considered embedded in individuals’ minds and institutions' documents, practices, relationships, and norms. Knowledge-based activities, including knowledge transfer (KT) and technology transfer (TT) channels such as joint research and development (R&D) projects, consulting, patents, etc., take place. These activities are crucial in promoting innovation, entrepreneurship, and KT/TT, which are vital for economic development (The World Bank, 2021).

Previous literature related to UIC has addressed the collaboration from different aspects, such as presenting general UIC channels (Perkmann & Walsh, 2007), addressing KT within formal academic engagement channels, e.g., contract research and consultations (Perkmann et al., 2013; de Wit-de Vries et al., 2019), or even comparing UIC context in the developed and some selected developing countries (Nsanzumuhire & Groot, 2020).

Intermediaries, such as university technology transfer offices (UTTOs) and knowledge transfer offices (UKTOs), play a crucial role in facilitating KT/TT-UIC. These entities help bridge cognitive and cultural gaps among diverse partners, enhancing communication, building trust, and aligning objectives between academic and non-academic stakeholders (Alexander & Miller, 2017; Villani, Rasmussen & Grimaldi, 2017; de Wit-de Vries et al., 2019). Effective intermediation addresses barriers in the KT/TT-UIC process by leveraging embedded resources and expertise to mediate differing academic and industrial cultures, thus fostering a more collaborative innovation ecosystem. Considering the variety of the KT/TT-UIC activities (Bekkers & Bodas Freitas, 2008; Perkmann et al., 2021), the wide range of heterogeneous UIC ecosystems and the complexity of the contexts (Howells, 2006;

Alexander & Martin, 2013; Schaeffer, Öcalan-Özel & Pénin, 2020), and the inconsistency in the KT/TT-UIC literature (Al-Tabbaa & Ankrah, 2019; de Wit-de Vries et al., 2019), the scholarly debate is continuing regarding the roles/forms of intermediaries in the KT/TT-UIC (Villani, Rasmussen & Grimaldi, 2017; Albats, Alexander & Cunningham, 2022)

The role and forms of these intermediaries continue to evolve, with newer models like digital platforms emerging alongside traditional physical offices, reflecting the complex and varied nature of UIC ecosystems and the ongoing scholarly debate on their optimal structures and strategies. Consequently, several forms/strategies of intermediation have emerged as a significant trend in the KT/TT-UIC phenomenon, ranging from a traditional form of intermediation (e.g. UTTOs/UKTOs) that have been investigated in the literature to other intermediation forms and types (e.g., crowdsourcing platforms) that remain unexplored in the KT/TT-UIC context (Howells, 2006; Alexander & Martin, 2013; Villani, Rasmussen & Grimaldi, 2017; Al-Tabbaa & Ankrah, 2019; Albats, Alexander & Cunningham, 2022). For example, several forms of intermediaries based on their architectures have been proposed in the work of Alexander and Miller (2017), including the following: (a) an intermediary organisation that is located within their host institutions (e.g. within universities), (b) located within arms-length institutions, based outside of the host institutions, or (c) based on a virtual/digital platform. Similarly, different structures/strategies of intermediaries as physical or virtual organisations were also introduced by Albats, Alexander, & Cunningham (2022); This was also discussed in Hakami, Pradhan & Mastio (2022b). Physical intermediaries are categorised as traditional intermediaries (located physically within the host institution as in-house/arms-length) or regional clusters (located remotely). In contrast, virtual entities are divided into two categories: virtual communities, which operate remotely without relying on a dedicated digital platform, and digital intermediaries, which manage fully virtual activities through a digital platform (Hakami, Pradhan & Mastio, 2022b).

## 1.2 PURPOSE OF THE STUDY

### 1.2.1 Statement of Purpose

The purpose of this research is to develop and validate a socio-technical facilitation mechanism, specifically a digital platform-based intermediary, as a suggested solution to enhance KT/TT activities and improve practices within the UIC setting, effectively bridging existing gaps. It also systematically identifies critical drivers and barriers, establishing a foundation for developing a structured guidance model. This model will define essential design criteria for effective and efficient development of such intermediation tools. By employing the Social Capital (SC) theoretical lens and adopting a socio-technical perspective, the framework will integrate both social dynamics and technical requirements to optimise outcomes in such collaboration practices.

### 1.2.2 Research Aims and Objectives

This section presents the research aims and objectives, which define the primary goals and specific milestones. Aims and objectives are designed to guide the investigation to ensure that the research process remains focused and aligned with the overarching research questions.

**Aim 1: Investigate the current dynamics of KT/TT activities within the UIC setting through the following objectives:**

**Objective 1.1:** Identify and analyse current trends that facilitate KT/TT activities by systematically reviewing the relevant knowledge to understand underlying patterns and influences.

**Objective 1.2:** Explore emerging practices that could potentially enhance the effectiveness of these activities, guided by a relevant theoretical lens in such a context.

**Aim 2: Identify and analyse factors influencing KT/TT activities within the UIC setting through the following objectives:**

**Objective 2.1:** Examine both drivers and barriers that enable or constrain KT/TT activities by applying a theoretical lens considering the perspectives of various key stakeholders within the UIC ecosystem to gain a comprehensive understanding and analysis.

**Objective 2.2:** Propose a type of facilitation intermediation mechanism based on identified factors designed to optimise the flow of knowledge and technology between university and industry partners.

**Aim 3: Facilitate and enhance KT/TT activities through a socio-technical digital platform-based intermediary within the UIC setting through the following objectives:**

**Objective 3.1:** Investigate design strategies for socio-technical facilitation mechanisms that effectively integrate SC dynamics dimensions and technical capabilities, which leads to creating a digital platform-based intermediary for KT/TT activities within the UIC setting.

**Objective 3.2:** Examine critical drivers and barriers within the UIC ecosystem to ensure their alignment with the technical and SC requirements of the digital platform-based intermediary.

**Objective 3.3:** Derive design requirements (DRs) that address user requirements/needs guided by a theoretical lens and technological functionalities to ensure the digital platform-based intermediary effectively supports such collaborations.

**Objective 3.4:** Formulate a set of design principles (DPs) that guide the creation of the digital platform-based intermediary within the UIC setting.

**Objective 3.5:** Instantiate design principles by specifying actionable design features (DFs) of the platform to facilitate such collaborations.

**Objective 3.6:** Prototype, implement, and evaluate the digital platform-based intermediary to demonstrate its capability to address current gaps and integrate and optimise such collaborations.

### 1.2.3 Research Questions

Based on the defined research aim and objectives, overarching research questions are designed and formulated to guide the exploration of the current practices, challenges, and opportunities within the UIC setting. Furthermore, they are intended to inform the development of a digital platform-based intermediary. The ultimate goal is to facilitate KT/TT activities within the UIC setting. It is worth mentioning that RQ3 was developed and updated

throughout the study due to the iterative nature of the research approach, as outlined in Section 1.3 and described in Table 1.1; more details are in Chapter 3.

**To Address Aim 1:** Investigate the current dynamics of KT/TT activities within the UIC Setting, RQ1 is formulated as follows:

***RQ1:*** *What are the current trends and emerging practices in facilitating KT/TT activities within the UIC setting?*

**To Address Aim 2:** Identify and analyse factors influencing KT/TT activities within the UIC setting, RQ2 is formulated as follows:

***RQ2:*** *How are KT/TT activities enabled and constrained within a UIC setting?*

**To address Aim 3:** Facilitate and enhance KT/TT activities through a socio-technical digital platform-based intermediary within the UIC setting, RQ3 is formulated as follows:

***RQ3:*** *How would such a digital platform-based intermediary be designed to facilitate KT/TT activities within the UIC setting?*

## 1.3 RESEARCH APPROACH OVERVIEW

This section introduces the Design Science Research (DSR) methodology adopted in this study. DSR approach, a well-established paradigm within Information Systems (IS) research, which is recognisable in numerous literature (Hevner et al., 2004; Vaishnavi & Kuechler, 2004; Gregor et al., 2007; Peffers et al., 2007; Hevner & Chatterjee, 2010). Due to the DSR iterative nature, the RQs were developed progressively as the study unfolded, in particular, RQ3 was formulated after RQ2 identified an improved basis for the suggested solution (i.e., the artifact). DSR is dedicated to creating socio-technical artifacts that address organisational problems and generate prescriptive design knowledge, making it ideal for developing and validating a digital platform-based intermediary (Hevner & Chatterjee, 2010; Venable, Pries-Heje & Baskerville, 2012; Vaishnavi & Kuechler, 2015). This intermediary is intended to enhance KT/TT activities and improve practices within the UIC setting, which contribute to effectively bridging existing gaps. Given the complexity and innovative nature of this research, along with the limited knowledge available in this context, the DSR approach is critical in providing the insights necessary for constructing such a platform. The methodology suggested by Vaishnavi and Kuechler (2015) is followed, which includes five structured phases with potential iterations for artifact development, as illustrated in Table 1.1.

Data collection methodologies are structured to underpin the research from both theoretical and contextual perspectives (Maxwell, 2012). The approach to secondary data collection includes an extensive literature review and two detailed systematic reviews aiming to enhance the study's essential theoretical and contextual comprehension. This combination of data collection approach enriches research by contextualising findings and trends and establishing a foundation for analysis that contributes uniquely to its depth and breadth (Myers & Avison, 2002; Maxwell, 2012; Myers, 2013).

Primary data collection is conducted within the context of Saudi Arabia, a significant contributor and leading country within the MENA region. It involves conducting qualitative expert interviews within the UIC ecosystem and engaging stakeholders from universities, industry, and intermediary organisations. Follow-up interviews

further complement these during the DSR process in the design of the artifact. In the evaluation phase, a focus group is implemented alongside additional expert interviews and feedback on the prototype demonstration, all of which evaluate the artifact's effectiveness and practicality (Hevner & Chatterjee, 2010). *Further details are provided in Chapter 3.*

Table 1.1: The DSR Process (DSR Cycle)
Source: (Vaishnavi & Kuechler, 2015)

| DSR Phase | DSR Activities | DSR Outcomes |
|---|---|---|
| **Phase 1:**<br><br>**Problem Awareness** | - Conduct a general literature review.<br>- Perform two systematic literature reviews.<br>- Conduct exploratory semi-structured expert interviews.<br>- Interpret qualitative data through the lens of SC Theory. | - A comprehensive overview of the existing literature.<br>- A detailed analysis of relevant literature focusing on the MENA region and SC insights within the UIC context.<br>- A data structure mapping the qualitative data highlights key drivers and barriers within the UIC setting, guided by the SC Theory lens. |
| By completing DSR Phase 1, RQ1 will be fully answered by achieving Aim 1 (Objectives 1.1 and 1.2), while RQ2 will be partially addressed, achieving Aim 2 and only (Objective 2.1). | | |
| **Phase 2:**<br><br>**Solution Suggestion** | - Deepen the analysis of qualitative insights to develop a solution, exploring both existing and proposed forms of intermediation.<br>- Derive DRs from the empirical qualitative findings (meta-user requirements), guided by the theoretical lens, to ensure alignment with the solution's objectives and emphasise the socio-technical perspective.<br>- In parallel, follow-up expert interviews (ex-ante evaluation) are conducted, and feedback on the proposed solution and DRs is obtained.<br>- Building on this foundation, a set of tentative DPs is formulated. | - A list of DRs and tentative DPs for the proposed solution.<br>- A structured framework that aligns DRs with their respective DPs within the UIC setting. |
| By completing DSR Phase 2, RQ2 will be fully addressed by achieving the remainder of Aim 2 (Objective 2.2), while RQ3 will be partially addressed by achieving Aim 3 and only the following objectives (3.1, 3.2, 3.3, and 3.4). | | |
| **Phase 3:**<br><br>**Development** | - Instantiated DPs are integrated directly as DFs to ensure that theoretical foundations are practically applied in the prototype.<br>- The IT artifact prototype, a digital-based platform intermediary, is then comprehensively developed to be demonstrated to the UIC ecosystem in the next phase. | - A mapping model that correlates DRs and DPs with DFs.<br>- A prototype serving as a proof-of-concept instantiation to demonstrate DPs in real-world scenarios, highlighting their functionality and impact. |
| By completing DSR Phase 3, RQ3 will also be partially addressed, achieving Aim 3 and only (Objective 3.5). | | |
| **Phase 4:**<br><br>**Evaluation** | - While demonstrating the artifact prototype, an ex-post summative evaluation is conducted, via qualitative methods, including expert interviews and focus group to:<br>- Validate the theoretical DPs and assess whether the IT artifact meets the specified DRs and achieves the expected DPs. This is done by | - A collection of feedback and practical recommendations.<br>- An update to the DPs and artifact design based on the feedback received. |

| DSR Phase | DSR Activities | DSR Outcomes |
|---|---|---|
| | applying a light reusability evaluation framework and conducting a targeted feedback questionnaire (qualitative).<br>- Assess the design framework by evaluating the logic flow and features within the artifact, thus confirming the consistency and coherence of the tangible DFs. | |
| By completing DSR Phase 4, RQ3 will be fully answered, achieving Aim 3 and (Objective 3.6). | | |
| **Phase 5:**<br><br>**Conclusion** | - Reflect on and summarise the research findings.<br>- Discuss the implications and provide recommendations for future research and practice.<br>- Highlight the limitations and identify areas for future research and practice. | - A detailed reflection and summary of the research findings, including relevant publications. |
| Final reflections on all Aims, their related Objectives, and RQs will be conducted. | | |

### 1.3.1 Summary of the DSR Project

The DSR Grid, developed by vom Brocke and Maedche (2019), provides a structured and clear framework for visualising the six core dimensions of a DSR research project. These dimensions include Problem Description, Input Knowledge, Research Process, Key Concepts, Solution Description, and Output Knowledge.

This grid is designed to support diverse perspectives to meet the specific needs of each project. Table 1.2 illustrates the DSR Grid, showcasing how it facilitates effective communication and providing a comprehensive description.

Table 1.2: A Summary of the DSR Project
Source: vom Brocke and Maedche (2019)

| Problem | Research Process | Solution |
|---|---|---|
| Research on the UIC often overlooks the diverse roles of industry practitioners and the effectiveness of various types of intermediaries, including digital-based platform types. This leads to a limited understanding of the extended UIC ecosystem and models and the ability of these different intermediaries to overcome such collaboration barriers. Additionally, there is a notable lack of studies on how UIC settings are developed in various regional contexts, especially in underexplored areas like the MENA region (focused on the Saudi Arabia context), which | A staged research process is proposed, adhering to the DSR framework by Vaishnavi and Kuechler (2015). This process includes five iterative phases of problem identification and solution suggestion, followed by developing and evaluating the suggested solution. The process concludes by reflecting on the DSR journey and lessons learned to capture insights and enhancements for future research endeavours. | An IT artifact, in the form of a digital platform prototype serving as a socio-technical UIC intermediary, is proposed to enhance and facilitate such collaboration. |

| | | |
|---|---|---|
| impedes the effective KT/TT activities within the UIC setting. | | |
| **Input Knowledge** | **Concepts** | **Output Knowledge** |
| The input knowledge for this research was derived from a combination of mechanisms and concepts within the UIC setting, underpinned by the theoretical foundations of SC and socio-technical perspectives. The approach to data collection was designed to support this research both theoretically and contextually. Secondary data collection comprises a general literature review alongside two targeted systematic reviews, each specifically designed to enrich the theoretical and contextual understanding necessary for this research. The primary data collection includes expert interviews conducted within the UIC ecosystem, involving representatives from universities, industries, and intermediary organisations. These were supplemented by follow-up interviews across various stages of the Design Science Research (DSR) process. The evaluation phase further incorporated a focus group, additional expert interviews, and expert feedback on the prototype demonstration. | University-Industry Collaboration (UIC), UIC Ecosystem, Knowledge Transfer (KT), Technology Transfer (TT), Intermediary, Digital Platform, Social Capital (SC) Theory, Socio-Technical Perspectives, Design Science Research (DSR) Approach, Design Requirements (DRs), Design Principles (DPs), and Design Features (DFs). | A digital platform prototype is developed, serving as a socio-technical intermediary specifically designed to optimise and improve the UIC ecosystem and support effective KT/TT-UIC activities. This platform is supported by a comprehensive framework, developed based on findings from expert interviews, which identifies and addresses critical key factors influencing UIC through the SC theory lens. It also integrates customised DRs, DPs, and DFs, offering a structured guidance model for designing similar systems within a collaborative inter-organisational context. Thoroughly evaluated and validated within the UIC setting, it effectively and adaptively merges social dynamics with technical requirements to optimise outcomes in such collaborations. |

## 1.4 SCOPE OF THE STUDY

The scope of this study defines the research boundaries and focuses on specific aspects of the investigation. It examines the dynamics, challenges, and opportunities related to KT/TT within the UIC setting. The study assesses current practices and trends, besides factors that either enable or impede KT/TT-UIC activities and analyses the perspectives and roles of various stakeholders within the UIC ecosystem. The UIC ecosystem in this study includes various stakeholders within the UIC setting in Saudi Arabia, encompassing representatives from universities, industry sectors, and intermediary organisations. This approach ensures a comprehensive understanding of the ecosystem and captures diverse perspectives. Further research is essential to understand the complexities and nature of these stakeholder interactions holistically. Additionally, it explores the conceptualisation and design implications of a socio-technical digital platform intended to enhance such collaborations and practices. The findings from this research are anticipated to provide a profound understanding

of how KT/TT-UIC activities can be optimised. It aims to propose actionable design criteria for developing digital platform-based intermediaries that could effectively facilitate these activities within the UIC setting. Considering this, data collection is specifically conducted within the context of KSA, driven by the country's ongoing transition into KBE. As a leading country within the MENA region, Saudi Arabia offers a unique and promising environment for such collaborations with national and international R&D initiatives. Furthermore, a closer look at the literature reveals several gaps and shortcomings in studying digital-based platform intermediation. While recognised as an area of inquiry, it still lacks substantial investigation in the broader literature. It remains remarkably underexplored in specific contexts such as the MENA region, especially in Saudi Arabia.

## 1.5 SIGNIFICANCE OF THE STUDY AND EXPECTED CONTRIBUTIONS

This research is motivated by significant shortcomings in understanding and improving the effectiveness of the UIC ecosystems. The current literature lacks a comprehensive exploration of the broader UIC environment, the role of intermediaries and the challenges specific to developing regions.

The significance of this research lies in its potential to improve knowledge transfer (KT) and technology transfer (TT) activities within the UIC setting. By identifying and analysing current drivers and barriers and proposing a digital platform-based intermediation solution, the study seeks to enhance the efficiency and productivity of collaborations. This has broader implications, including fostering innovation, advancing industries, and driving economic growth. Integrating social and technical aspects into the design of a digital platform-based intermediary provides a socio-technical perspective that aligns technical functionality with the social dynamics of users. This ensures the platform not only addresses technical needs but also supports effective collaboration by fostering trust and improving interactions among stakeholders.

The study contributes to UIC literature by offering a comprehensive analysis of challenges and solutions, both generally and specific to regional contexts like Saudi Arabia. The application of SC theory within the UIC setting provides a structured framework to understand the complex dynamics of collaboration while extending the theory’s operational use. For policymakers, this research identifies key drivers and barriers in UIC activities and offers actionable strategies to build supportive environments for collaboration. For academics and industry professionals, the design and evaluation of a prototype platform yield valuable insights into improving UIC practices through innovative digital intermediation. This socio-technical perspective bridges theoretical insights with practical applications, offering a replicable model for other regions facing similar challenges. By addressing these shortcomings, the study contributes to advancing UIC ecosystems and their role in fostering sustainable innovation and economic development.

## 1.6 THESIS OUTLINE

This thesis is organised into six main parts, as shown in Figure 1.1. Part I, "research background," provides foundational context with an introduction and literature review chapters. Part II, "research approach," details the methodologies and primary and secondary data collection methods. Part III, "research findings & discussion," covers the DSR phases from problem awareness to solution evaluation. Part IV, "final reflections," summarises

the research, offering key insights and recommendations and concluding the DSR cycle. Part V, "appendices," includes additional materials. Finally, Part VI, "References," lists all sources used to enable further exploration.

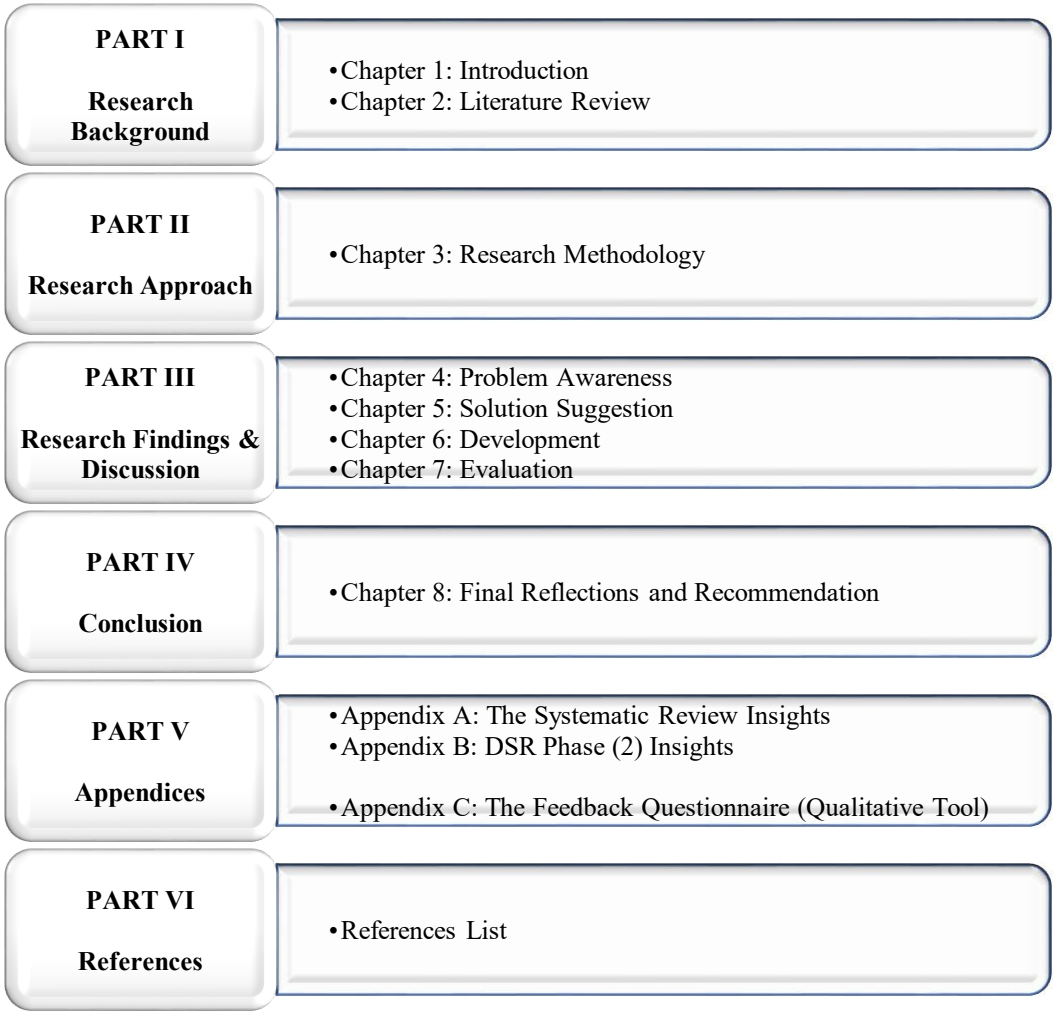



Figure 1.1: Thesis Layout

## 1.7 CHAPTER SUMMARY

In conclusion, this chapter has laid the groundwork for the PhD thesis by introducing the research topic and its contextual background of the UIC context. This chapter has delineated the aims and objectives and presented the key research questions that will guide the investigation. Within the UIC setting, the study aim was to investigate the current dynamics of KT/TT-UIC activities, identify and analyse factors influencing these such activities and collaborations, and facilitate and enhance KT/TT-UIC activities through a socio-technical digital platform-based intermediary. The DSR methodological approach has been outlined, along with the specific data collection and analysis methods to be employed. The scope of the research has been defined, setting clear study boundaries. Furthermore, the chapter has highlighted the significance of this research and its potential contributions to the fields of UIC and KT/TT. Chapter 1 has set the stage for the in-depth exploration and analysis that will follow in subsequent thesis chapters

# 2 LITERATURE REVIEW

Chapter 2 provides an extensive literature review, which is foundational for examining the various dimensions and dynamics of the UIC aspects. This is crucial for advancing research and innovation in contemporary academic and industrial settings. The concept of UIC is defined, its developmental phases explored, and the supportive innovation ecosystems discussed, offering a detailed perspective on the collaborative process (Section 2.1). Specific channels/activities through which UIC operates are analysed and discussed with particular emphasis on KT/TT (Section 2.2). Key factors influencing UIC are identified and categorised into motivation, roles, barriers, and driving forces that facilitate or hinder these collaborations (Section 2.3). Mechanisms that facilitate UIC are further explored, especially focusing on the role of intermediaries and the integration of digital platforms that combine socio-technical perspectives to enhance collaboration effectiveness (Section 2.4).

A substantial part of the chapter is dedicated to the theoretical framework of SC Theory. The structural, relational, and cognitive dimensions are identified, and their influence within the KT/TT-UIC framework is explored. This theoretical exploration helps identify existing research gaps, setting the stage for addressing these gaps in subsequent parts of the thesis (Section 2.5).

The literature review identifies critical research gaps in the relevant UIC literature that are essential for guiding this thesis's focus and furthering the field's development (Section 2.6). The chapter concludes with a summary that recaps the important themes discussed and precisely sets the framework for navigating through the intricacies of the UIC phenomena, thereby preparing for the detailed analyses in the following chapters (Section 2.7).

## 2.1 UNIVERSITY-INDUSTRY COLLABORATION (UIC)

In the literature, the term ‘university-industry collaboration (UIC)’ is widely used to describe the collaboration/relation between a university and an industry organisation. This study defines UIC as inter-organisational arrangements between universities and industry to access each other’s resources. A university is an organisation/institution that performs “a key role within contemporary societies by educating large proportions of the population and generating knowledge” (Perkmann et al., 2013, p. 423). In addition to the two primary missions of generating and disseminating knowledge from teaching and research, universities contribute to society via their so-called ‘third mission’. Molas-Gallart et al. (2002, p. iii) refer to this ‘third mission’ as "all activities concerned with the generation, use, application and exploitation of knowledge and other university capabilities outside academic environments".

The industry in this study broadly contains public, private, and not-for-profit organisations. While public, private, and not-for-profit sectors are essential parts of the ecosystem, the private sector has received greater attention in the academic literature as a key collaborator with higher education institutions (Perkmann et al., 2021). This is likely due to the private sector's recognised role as an engine of economic growth, as well as its capacity to serve as an invaluable source and driver of knowledge generation and innovation (OECD, 2016). The dynamic interaction and knowledge-sharing between private enterprises and academic research centres is seen as crucial for advancing technological progress and spurring entrepreneurial activity; thus, the OECD (2016, p. 7) defined

the private sector as “a diverse group of financial institutions, intermediaries, multinational companies, micro, small and medium-sized enterprises and cooperatives who operate in the formal and informal sectors engaging in profit-seeking activities with a majority of private ownership– is widely recognised as an engine of growth and ingenious source and driver of knowledge generation and innovation”.

### 2.1.1 The Innovation Ecosystem of University-Industry Collaboration

UIC is widely used in the literature to refer to this type/model of collaborative ecosystem. An innovation ecosystem can be characterised as " the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors; [where this definition often emphasises on] collaboration/complements and actors" (Granstrand & Holgersson, 2020, pp. 2-3). Actors are understood to pursue economic goals and leverage the collective configuration of resources, knowledge, and skills to achieve them collaboratively within a given setting or ecosystem (Vargo & Lusch, 2016; Burkhalter et al., 2021). According to Williamson and De Meyer (2012), ecosystems or business-related ecosystems refers to networks of different organisations that work together to create value by leveraging their skills and capabilities. They emphasise the critical role that individual actors play within these ecosystems and highlight the potential benefits of interactions and collaborations between actors operating within such a structure. Resources can also be defined as anything that actors draw upon to correspond to their particular explicit or latent needs; it is essential to consider how actors strategically manage and allocate these resources (Burkhalter et al., 2021).

From the organisation's perspective, the UIC ecosystem comprises several key pillars. A university and its private sector partner are at the core of a standard UIC ecosystem, forming a university-private collaboration, which can also be referred to as an academia-business collaboration. This collaboration between academia and industry is a fundamental aspect of the UIC model. However, the UIC ecosystem can evolve beyond this basic structure to include multiple partners. These additional partners may be referred to as actors or stakeholders within the ecosystem. Including these diverse partners helps broaden the scope and potential of the UIC model.

In the context of open innovation, the government can also become a third actor within these collaborative arrangements. This leads to the development of a 'triple-helix' model, which encompasses the university, the private sector, and the government - often referred to as a university-industry-government (U-I-G) collaboration. The UIC ecosystem can expand further by incorporating an additional element- the public. This collaborative model, known as the 'quadruple-helix', includes the university, private sector, government, and the broader public. This expanded ecosystem aims to foster even greater innovation and societal impact by integrating diverse stakeholders (Etzkowitz & Leydesdorff, 2000; Etzkowitz, 2003, 2014; Miller et al., 2016).

The evolution of the UIC ecosystem, progressing from a standard university-industry collaboration to the more sophisticated triple-helix and quadruple-helix configurations or even more complex multi-stakeholder arrangements, reflects the growing recognition of the immense value that such multi-stakeholder partnerships can offer in driving innovation, facilitating knowledge transfer, and fostering economic development.

### 2.1.2 The Phases of University-Industry Collaboration

The UIC process can be divided into three phases: pre-collaboration, collaboration, and post-collaboration. However, these phases do not necessarily progress chronologically, as the nature and circumstances of the partnership can influence their sequence. According to Plewa, Korff, Johnson, et al. (2013), the success factors for measuring the outcomes differ across these phases, as shown in Figure 2.1. In the pre-collaboration or pre-linkage phase, the focus is on identifying potential partners and reaching an agreement to work together, which is the critical success factor for this stage (Plewa, Korff, Baaken & Macpherson, 2013; Plewa, Korff, Johnson, et al., 2013). Collaboration typically involves three key phases: establishment, engagement, and advancement. In the establishment phase, the collaborating parties often engage in lengthy, frequent face-to-face discussions to identify each other's strengths, needs, interests, expectations, and the likely deliverables for the initial project. This leads to a contract that formalises the collaboration. The engagement phase involves discussing and mutually agreeing on the scope of the collaborative work, leading to the successful delivery of the initial project. Finally, in the advancement phase, the collaboration creates value beyond the initially defined project, leading to an ongoing, mutually beneficial partnership and positive word-of-mouth referrals. The key success factors throughout this process are establishing a formal contract, delivering the initial project, and cultivating a lasting, productive partnership with positive feedback from those involved (Bansal, Irving & Taylor, 2004; Plewa, Korff, Johnson, et al., 2013).

In the post-collaboration or latent phase, the success may be evaluated based on the potential for future collaboration should a suitable project arise and the continuation of personal linkages between the partners, even in the absence of an active project. This latent phase allows for the preservation of the relationship, facilitating the resumption of collaboration should a suitable opportunity present itself in the future (Plewa, Korff, Baaken & Macpherson, 2013; Plewa, Korff, Johnson, et al., 2013).

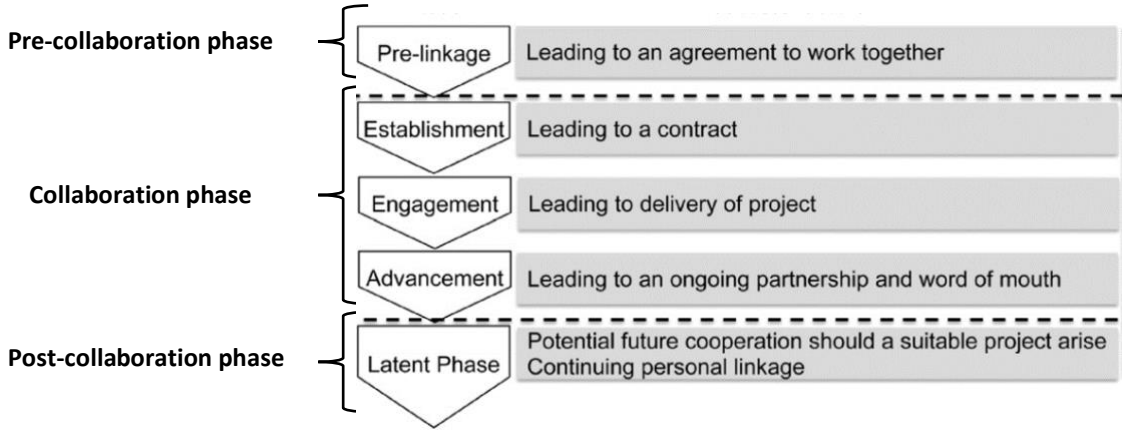



Figure 2.1: Evolution of Collaboration Phases

Source: (Plewa, Korff, Baaken & Macpherson, 2013; Plewa, Korff, Johnson, et al., 2013).

## 2.2 THE CHANNELS/ACTIVITIES OF UNIVERSITY-INDUSTRY COLLABORATION (UIC)

When two organisations collaborate, they endeavour to acquire embedded resources from one another, such as embedded knowledge and technology. This exchange leads to transferring crucial assets - knowledge and technology - which are essential for organisations. These vital assets are embedded within the members of the organisations, their skill sets, tools, technologies, tasks, and internal and external relationships, in which partners can leverage each other's strengths, foster innovation, and enhance their overall competitiveness within their respective fields. The collaboration allows organisations to gain access to knowledge and technologies that may be deeply integrated and difficult to access independently, presenting opportunities for mutual growth and development.

### 2.2.1 Knowledge Transfer and Technology Transfer (KT/TT)

Explicit knowledge is "words and numbers and shared in the form of data, scientific formulae, specifications and manuals" (Alexander & Childe, 2012, p. 538). Explicit knowledge can be clearly codified, documented and accessed in tangible formats, whereas, in the implicit mode, it can be hard to obtain/codify the knowledge embedded in the intangible resources (e.g. organisation's social norms, rules, or routines) (Argote et al., 2000). In the context of UIC, knowledge is embedded in an organisation's assets, including members, skill sets, tools, technology, tasks, and internal/external relationships. So, when knowledge is transferred between two organisations, they mainly seek to acquire the embedded knowledge from each other. Thus, knowledge transfer (KT) is defined as "the process through which one unit (department, group, or division) is affected by the experience of another" (Argote & Ingram, 2000, p. 151), in which KT can take place either explicitly or implicitly within the UIC ecosystem (Argote & Ingram, 2000; Alexander & Childe, 2012; Alexander, Bessant & Wood, 2013). Besides, technology transfer (TT) refers to the process of transferring technological knowledge and technology-related organisational know-how from one organisation to another. This can involve the sharing of patents, licences, expertise, and best practices to enable the adoption and application of new technologies and processes inter-organisationally (Bozeman, 2000).

KT/TT are viewed as influential contributors to the economy's growth through the facilitation of innovation and successful collaborations. They have been identified as the most significant characteristic of UIC (de Wit-de Vries et al., 2019; Perkmann et al., 2021). According to Gopalakrishnan and Santoro (2004), KT is a more widespread and inclusive construct, while TT is a narrower and more precise construct. KT is related to 'why', strategic matters, and cause-effect relationships at the inter-organisational interactions, whereas TT is associated with 'how' and operational matters. However, In the literature, KT and TT terms are frequently stated interchangeably (Perkmann & Walsh, 2007; de Wit-de Vries et al., 2019), in the sense that KT and TT are inseparable (Bozeman, 2000). Likewise, both terms KT and TT are stated interchangeably. Also, knowledge transfer (KT) and technology transfer (TT) through the UIC phenomenon are abbreviated to ‘KT/TT-UIC’.

### 2.2.2 Exploring the Diverse Range of KT/TT-UIC Activities

KT/TT occur through various UIC activities (i.e. knowledge-based activities) (Michael D. Santoro & Gopalakrishnan, 2000; Perkmann & Walsh, 2007; Bekkers & Bodas Freitas, 2008; Azagra-Caro et al., 2017), such as joint research (R&D), publications, consulting works, and licensing to commercialise patents. KT/TT-UIC activities refer to the various activities (i.e., mechanisms or channels) that enable the sharing and co-creation of tangible and intangible resources within the UIC setting. These activities involve different modes of interaction that facilitate varying levels of relational involvement, ranging from low to highly collaborative relationships. These activities serve as informational and social bridges connecting the UIC ecosystem, facilitating the KT/TT across these realms. Previous studies have categorised and prioritised the KT/TT-UIC activities due to their dynamic nature, encompassing the extent of engagement and involvement levels, contractual nature, importance and preference to the UIC actors, as well as the frequency and intensity of engagement, thereby providing a comprehensive view to understand the vital dynamics underpinning these activities.

A typology of activities, classified based on the varying degrees of involvement and interaction between university and industry stakeholders, has been revised, summarised, and presented by the author in Table 2.1. This typology ranges from high to medium and low levels of engagement, drawing from the work of Perkmann and Walsh (2007); Perkmann et al. (2013); Perkmann et al. (2021). High relational involvement activities include research partnerships and research services. Medium relational involvement activities include academic entrepreneurship and human resource transfer. Low relational involvement activities include the commercialisation of property rights. Additionally, informal interaction and scientific publications activities can improve and support all forms of relational involvement- high, medium, or low- within the UIC setting, offering valuable opportunities for building relationships and sharing knowledge. Table 2.1 has precisely organised these activities into a comprehensive framework, providing a clear and concise overview of the diverse ways in which these key stakeholders can engage with one another, facilitating a deeper understanding of the dynamic nature of such collaborations.

Table 2.1: Classification and Description of KT/TT-UIC Activities with Levels Of Involvement
Source: (Perkmann & Walsh, 2007; Perkmann et al., 2013; Perkmann et al., 2021)

| **KT/TT-UIC Activities** | **Activities Category** | **Level of Relational Involvement** | **Description** |
|---|---|---|---|
| - Collaborative R&D within the UIC setting. | Research Partnerships | High Relational Involvement | These arrangements may be characterised as ***'Relationships***.' They arise when university and industry actors collaborate intensively on specific projects, leading to shared outcomes. Such collaboration entails close interactions among actors within the UIC ecosystem (i.e. face-to-face interaction involvement).<br>- *Essential for fostering and maintaining the UIC ecosystem over time, especially in the context of 'open innovation'.* |
| - Contract research and consulting commissioned by industrial clients. | Research Services | | |

| KT/TT-UIC Activities | Activities Category | Level of Relational Involvement | Description |
|---|---|---|---|
| - Academic-led development and commercialisation of technologies via (partly) company ownership (e.g., academic spin-offs). | Academic Entrepreneurship | Medium Relational Involvement | These arrangements are based on ***'Mobility***,' where individuals transitioning between academic and industrial settings can be classified as having intermediate relational involvement, often maintaining some relations with previous colleagues after the move, and such mobility can be permanent or temporary. |
| - Industry employee training as a multi-context learning mechanism.<br>- Postgraduate industry training.<br>- Integration of graduate trainees into industry roles.<br>- Industry secondments for hands-on experience.<br>- Industry professionals serving as adjunct faculty at universities.<br>- Graduates transitioning to industrial positions.<br>- Academics managing their academic spin-offs.<br>- Industrial scientists temporarily working in university labs. | Human Resource Transfer | | |
| - Transferring university patents to firms.<br>- Licensing university IP to industry partners.<br>- Commercialisation or turning university Ips into market-ready products. | Commercialisation of Property Rights | Low Relational Involvement | These ***'Transfer'*** arrangements do not necessarily require direct or ongoing relationships within the UIC ecosystem. The transactions are typically transactional in nature, involving a low level of relational engagement between the parties.<br>- *Recent research has shed light on such activities and their influence on research and commercialisation.*<br>- *Recent research highlights the critical role of intermediaries in UIC commercialisation and the need for policy focus despite lower academic participation.* |
| - Building social connections and establishing professional networks at conferences and industry events.<br>- Engaging with peers and fostering collaborations through seminars, symposiums, and workshops.<br>- Expanding industry contacts and developing collaborations at trade shows and panel discussions. | Informal Interaction | These activities can improve and support all forms of relational involvement- high, medium, or low- within the UIC ecosystem, offering valuable opportunities for building relationships and sharing knowledge. | |
| Use of codified scientific knowledge within industry, including:<br>- Leveraging scientific publications to advance industry practices and product development.<br>- Applying research and evidence from academic journals to address technological and process challenges in industry. | Scientific Publications | | |

Moreover, Schaeffer, Öcalan-Özel, and Pénin (2020) developed a framework that distinguishes between formal and informal KT activities, considering the level of face-to-face interaction. This categorisation helps to identify the different modes of knowledge and technology transfer within the UIC context. The formal KT activities involve structured and planned interactions, such as contract research, joint research projects, and licensing agreements. These types of activities are often associated with explicit knowledge sharing. In contrast, informal KT activities are more spontaneous and unstructured, including networking, conferences, and informal meetings, which are more aligned with transferring tacit knowledge. This framework provides a useful tool for understanding the diverse range of such activities within the UIC setting, presented in further detail in Table 2.2.

Table 2.2: Classification of KT/TT-UIC Activities Distinguished by Contractual Basis and Interaction Mode
**Source:** Adopted from Schaeffer, Öcalan-Özel, and Pénin (2020, p. 35)

| | **Contract-based KT/TT-UIC Activities** | **Non-Contract-based KT/TT-UIC Activities** |
|---|---|---|
| **KT/TT-UIC Activities Without face-to-face interactions** | **Purely Formal Activities**<br>Licensing (patents, software) | **Informal Non-Interactive Activities**<br>Scientific publications |
| **KT/TT-UIC Activities With face-to-face interactions** | **Formal Interactive Activities**<br>R&D projects<br>Contract research<br>Academic spin-offs<br>U–I doctoral theses<br>Contractual consultancy | **Purely Informal Activities**<br>Teaching activities<br>Academic conferences and workshops<br>General public conferences<br>Non-contractual consultancy |

Likewise, Bekkers and Bodas Freitas (2008) have classified KT/TT-UIC activities from the most to the least preferred in developing the best KT/TT-UIC practices. The commercialisation of intellectual property (IP) rights activities, such as licensing, patenting, and spin-off companies, were university actors' least preferred activities, while private sector actors most preferred patents and licensing. Measuring such activities involves assessing the frequency and intensity of engagement across multiple channels (D'Este & Patel, 2007; Bekkers & Bodas Freitas, 2008). These channels encompass various activities, from collaborative research to consultancy and licensing agreements, facilitating the bi-directional flow of knowledge within the UIC setting. Activities such as joint R&D, consulting, training, scientific publications, and conferences were valued by both partners (Perkmann & Walsh, 2007). However, preferences for KT/TT-UIC activities might have changed as the university and the industry evolved. Recently, Perkmann et al. (2021) have reported that significant progress has been made in understanding this phenomenon since then, most notably in terms of KT/TT-UIC activities and their impacts on research and, to a degree, commercialisation outcomes.

Maintaining a diverse range of KT/TT-UIC activities is crucial for fostering mutually beneficial collaborations between academic institutions and industry partners. According to D'Este and Patel (2007), the availability of various activities plays a pivotal role in enhancing individual researchers' skills and engagement in collaborative research engagement. Furthermore, Arza (2010) argues that varied KT/TT-UIC activities provide substantial intellectual and economic advantages for universities. On the one hand, these channels enable universities to leverage their research expertise and facilitate knowledge exchange, thereby contributing to advancing academic

disciplines. On the other hand, they offer opportunities to generate additional revenue streams through licensing, consultancy, or other commercialisation activities. From the industry perspective, a diverse set of such activities allows them to address production challenges more effectively to gain access to cutting-edge research, innovative solutions, and fresh perspectives, ultimately supporting their innovation strategies and enhancing their competitiveness.

Several other studies have underscored the importance of variety in KT/TT-UIC activities/channels. Cohen, Nelson, and Walsh (2002) highlight the role of these channels in bridging the gap between academic disciplines and industry sectors, facilitating cross-pollination of ideas and fostering interdisciplinary collaborations. D'Este and Patel (2007) further emphasise the influence of individual and institutional characteristics on the effectiveness of KT/TT-UIC activities, suggesting that a diverse range of channels can cater to the unique needs and contexts of different actors. Moreover, Bekkers and Bodas Freitas (2008) explore the relationship between KT/TT-UIC activities and the knowledge characteristics of scientific disciplines. Their findings suggest that certain channels may be more suitable for specific disciplines, highlighting the need for a diverse portfolio of channels to accommodate the varying knowledge transfer requirements across different fields of study.

The existing body of research examines the barriers and challenges that arise within the UIC setting (Alexander et al., 2020). For example, cognitive differences within the UIC ecosystem and a lack of mutual trust exist. Furthermore, the literature highlights additional barriers rooted in divergent organisational cultures, misaligned partner expectations, funding practices that impede the acquisition of knowledge, and policy and regulatory frameworks that govern permissions and access to knowledge (D'Este & Patel, 2007; Bekkers & Bodas Freitas, 2008; Battistella, De Toni & Pillon, 2016; de Wit-de Vries et al., 2019). These multifaceted barriers challenge the effective transfer of knowledge and technology within the UIC setting.

## 2.3 KEY FACTORS INFLUENCING ACTIVITIES THROUGH UNIVERSITY-INDUSTRY COLLABORATION

### 2.3.1 Critical Role and Motivation Factors

Knowledge-based economy (KBE) refers to economies that are impacted by the production, distribution and use of knowledge and has at least one characteristic of "applications of information and communication technologies (ICT) would be the drivers of the new economy" (Godin, 2006, p. 20). As an umbrella concept, the KBE influences researchers from many disciplines to investigate and explore what drives robust economic growth through innovation ecosystems. Considering this, this research project centres around the collaborative framework, setting, or ecosystem between universities and industry organisations. Historically, collaborations between universities and the industry received much attention during the economic crisis of the 1970s (i.e. petroleum shortages) when universities and the private sector were forced to collaborate to grow and diversify their sources of income (Cooper, 2009).

Previous literature has examined collaborations between universities and industry, paying more attention to knowledge-based activities or transferred knowledge and technology through such arrangements (Perkmann et al., 2013; de Wit-de Vries et al., 2019; Perkmann et al., 2021). Universities are significant players in preparing human capital and are involved in knowledge creation, use, and dissemination in the knowledge-based economy.

Collaboration between universities and industry is crucial to enhancing innovation. Through these collaborative relationships, both universities and industry can access resources and transfer knowledge to one another, creating mutually beneficial outcomes (de Wit-de Vries et al., 2019). Therefore, UIC is envisioned as a mutually beneficial partnership that fosters developing and applying new ideas, technologies, and solutions to address real-world challenges.

Furthermore, Ankrah and Al-Tabbaa (2015) discussed the potential outcomes of UIC, where it can provide significant benefits, such as increased innovation, access to resources, and impact on society. However, it also carries potential drawbacks, including when universities or companies stray from their core goals and priorities, concerns about quality and academic integrity, conflicts due to differing interests, and risks like losing control of intellectual property. While the advantages of UIC often outweigh the disadvantages, universities and industry partners must be aware of these possible issues, especially regarding the susceptible position of universities due to their solid financial motivations for engaging in UIC.

### 2.3.2 Impeding Factors

Barriers to UIC have been thoroughly discussed within literature over the years (Perkmann & Walsh, 2010; Perkmann, King & Pavelin, 2011; Perkmann et al., 2013; Ankrah & Al-Tabbaa, 2015; Alexander et al., 2020; Tootell et al., 2020; Perkmann et al., 2021; Kleiner-Schaefer & Schaefer, 2022), providing a foundation of knowledge that highlights the diverse challenges affecting these collaborative activities across different sectors and regions. According to the comprehensive systematic literature review conducted by Nsanzumuhire and Groot (2020), such barriers were summarised into five principal groups: Misalignment barriers involve conflicting objectives and operational discrepancies between academic institutions and industry sectors. Motivation-related barriers highlight the need for more perceived personal and professional gains from such collaborations, exacerbating disinterest and resistance within the academic setting. Capability-related barriers reflect deficits in the skills, knowledge, and resources needed to initiate and sustain effective partnerships. Governance-related barriers stem from institutional and administrative challenges, including unclear roles and cumbersome bureaucratic processes. Finally, context-related barriers encompass regional and systemic limitations such as insufficient local industry presence, lack of governmental support, and inadequate infrastructural connections. These categories underscore the complexity of the heterogeneous UIC ecosystem, as Klofsten et al. (2019) highlighted, which impedes productive collaborations between universities and industries. This requires implementing comprehensive strategies to address these obstacles and fully unlock the potential of such collaborations.

### 2.3.3 Drivers and Success Factors

Research on UIC reveals that drivers and success factors vary throughout the relationship lifecycle (i.e., UIC phases), highlighting the dynamic nature of the UIC ecosystem (Rottman, 2008; Williamson & De Meyer, 2012; Plewa, Korff, Baaken & Macpherson, 2013; Hossinger, Chen & Werner, 2020). This understanding offers complementary perspectives on the factors influencing successful UICs and emphasises the importance of adaptability in fostering long-term collaboration. Accordingly, Plewa, Korff, Johnson, et al. (2013) identified vital drivers, including communication, understanding, trust, and individual relationships. These factors contribute to

success across different UIC phases: pre-linkage (agreement to collaborate), establishment (contract signing), engagement (project delivery), advancement (ongoing partnership), and latent phase (continued personal connections). In alignment with these findings, Tootell et al. (2020) examined drivers for complex inter-organisational cooperation, similarly emphasising communication (personal connection and mutual understanding), shared values (understanding partner and community values, communicating value propositions), trust (built on experience and reputation), and commitment (involving intermediaries, genuine interest in partner success).

On the other hand, Hossinger, Chen, and Werner (2020) proposed a multi-level framework that comprehensively views factors influencing academic entrepreneurship. They emphasise a resource-based perspective, highlighting the role of the UIC ecosystem, particularly academics' human and social capital, in shaping UIC likelihood and performance. They identify the drivers of UIC in academic spin-off activity across three levels of analysis: micro (individual academic factors such as motivations, capital, demographics, and research characteristics), meso (university-level elements including characteristics, research orientations, and support mechanisms), and macro (regional and national contexts like economic development, location, and governmental policies).

## 2.4 FACILITATION MECHANISMS FOR UNIVERSITY-INDUSTRY COLLABORATION

Previous literature has shown that mechanisms facilitating UIC can be categorised into two groups: those that focus on trust-building and those that incorporate boundary-spanning processes. A recent systematic literature review by Nsanzumuhire and Groot (2020) stated that trust-building mechanisms involve leveraging existing relationships or building trust from scratch through open communication and collaborative work. At the same time, the boundary-spanning mechanism is facilitated by organisations (e.g., Technology Transfer Offices TTOs), as well as individual boundary-spanners. While trust evolves from reciprocal communication to decision-making similarity as relationships mature (Plewa, Korff, Johnson, et al., 2013; de Wit-de Vries et al., 2019; Nsanzumuhire & Groot, 2020). Boundary-spanning mechanisms include organisational alignment of needs and capabilities, enlarging social networks, and creating boundary objects for communities of practice (Howells, 2006; Nsanzumuhire & Groot, 2020; Albats, Alexander & Cunningham, 2022). Both trust-building and boundary-spanning mechanisms aim to overcome cultural differences, reduce barriers, and foster effective collaboration between academic and industrial partners.

### 2.4.1 Intermediation in the UIC Context

Regarding mechanisms to facilitate KT/TT-UIC activities, intermediation as a process and intermediaries as organisations/entities help to manage inter-organisation relationships by crossing boundaries among heterogeneous partners/stakeholders, including both university actors (academics) and industry actors (non-academics) (Alexander & Martin, 2013; Miller, McAdam & McAdam, 2014; Alexander & Miller, 2017; Villani, Rasmussen & Grimaldi, 2017; Al-Tabbaa & Ankrah, 2019; de Wit-de Vries et al., 2019; Takanashi & Lee, 2019; O'Kane et al., 2020; Albats, Alexander & Cunningham, 2022). Intermediaries are agents/brokers/boundary organisations between universities and industry organisations (Howells, 2006). Prior studies of the KT-UIC have revealed and discussed several examples of intermediaries, including university technology transfer offices

(UTTOs), university knowledge transfer offices (UKTOs), technology licensing organisations (TLO), university incubators (UIs), intellectual property headquarters (IPHQs), and university-industry cooperative research centres (UICRCs) (Trune & Goslin, 1998; Howells, 2006; Villani, Rasmussen & Grimaldi, 2017; Takanashi & Lee, 2019).

Previous studies have highlighted the challenge of successful collaboration in the innovation ecosystem, particularly in the context of the UIC setting (Klofsten et al., 2019; Granstrand & Holgersson, 2020; Hossinger, Chen & Werner, 2020). Various enablers and barriers to KT/TT activities in UIC have been discussed across different contexts. For instance, cognitive differences among partners have frequently been identified as a barrier, negatively impacting the frequency of interactions (M. D. Santoro & Bierly, 2006; Muscio & Pozzali, 2013; Lopes & Lussuamo, 2020). However, there is a research gap when it comes to understanding how these barriers can be mitigated (de Wit-de Vries et al., 2019). One suggested approach is to involve intermediaries in expanding the UIC ecosystem to overcome potential barriers among heterogeneous partners (Villani, Rasmussen & Grimaldi, 2017; Al-Tabbaa & Ankrah, 2019; de Wit-de Vries et al., 2019; Klofsten et al., 2019). Nevertheless, studies have shown a lack of clarity on how intermediaries contribute to reducing these barriers, particularly in the case of long-term UIC involving knowledge transfer and technology transfer (Villani, Rasmussen & Grimaldi, 2017; de Wit-de Vries et al., 2019). Furthermore, developing a holistic perspective on the UIC ecosystem is important, which has been neglected in past literature. Most existing studies have focused primarily on academics, with limited attention given to industry actors (de Wit-de Vries et al., 2019). Additionally, the role of intermediaries as an essential part of the UIC ecosystem has often been overlooked (Al-Tabbaa & Ankrah, 2019; Tootell et al., 2020).

The UIC ecosystem depends on the industry's crucial role in supporting universities with resource acquisition and the commercialisation of academic research. In return, universities are expected to offer industry partners their expertise in specific domains and access to their infrastructure, such as buildings and laboratory facilities. These resources are influential in facilitating collaborative research and development activities, providing industry partners with the resources to carry out their projects effectively. However, bridging the gap between academic and industrial cultures can be challenging; this is where intermediaries come into play as valuable entities within the UIC ecosystem (Muscio & Pozzali, 2013; Villani, Rasmussen & Grimaldi, 2017; de Wit-de Vries et al., 2019; Lopes & Lussuamo, 2020; Tootell et al., 2020). The role of Intermediaries is summarised as “bringing people together, helping to build links, identifying gaps and needs, and sharing ideas” (Bielak et al., 2008, p. 220). Intermediaries possess embedded resources and experts who specialise in mediating between academic and industrial partners. By leveraging their expertise and resources, intermediaries help reduce cognitive differences and foster a better understanding of the needs and expectations of both academic and industrial stakeholders (Alexander & Miller, 2017; Villani, Rasmussen & Grimaldi, 2017; de Wit-de Vries et al., 2019). Integrating intermediary organisations within the UIC ecosystem enriches such collaborations to build a successful long-term KT/TT-UIC by facilitating effective communication and dealing with inter-organisational barriers among partners who differ in their capability to absorb the transferred knowledge (Trune & Goslin, 1998; Howells, 2006; Alexander & Martin, 2013; Plewa, Korff, Johnson, et al., 2013; Villani, Rasmussen & Grimaldi, 2017; Takanashi & Lee, 2019; Tootell et al., 2020).

A complex interplay of knowledge-based activities characterises the landscape of UIC. This complexity is further amplified by the heterogeneous nature of UIC ecosystems and the diverse contexts and industry fields in which they operate (Alexander & Martin, 2013; de Wit-de Vries et al., 2019; Perkmann et al., 2021). The Complications of these ecosystems, coupled with inconsistencies in UIC literature, have sparked ongoing scholarly debates regarding the roles and forms of intermediaries within the UIC setting (Al-Tabbaa & Ankrah, 2019; Perkmann et al., 2021; Albats, Alexander & Cunningham, 2022). While research has been conducted on intermediation in KT/TT-UIC contexts, there remains a significant gap in our understanding of how intermediaries can address potential barriers and what specific forms or roles they might adopt in these collaborations (Villani, Rasmussen & Grimaldi, 2017; Takanashi & Lee, 2019). This knowledge gap has led to the emergence of various intermediary forms within the UIC settings, each with unique roles, types, and strategies.

### 2.4.2 Exploring Diverse Intermediary Forms

This section delves into the potential arrangements, types of intermediaries, and integration strategies that can be implemented within the UIC ecosystem to overcome existing obstacles. Given the wide range of knowledge-based activities in terms of KT/TT-UIC activities (Michael D. Santoro & Gopalakrishnan, 2000; Perkmann & Walsh, 2007; Bekkers & Bodas Freitas, 2008; Azagra-Caro et al., 2017), the heterogeneity of UIC ecosystems (Bekkers & Bodas Freitas, 2008; Perkmann et al., 2021), the heterogeneity of UIC ecosystems, and the complexity of different contexts (Howells, 2006; Alexander & Martin, 2013; Schaeffer, Öcalan-Özel & Pénin, 2020), as well as the inconsistencies in the UIC literature (Al-Tabbaa & Ankrah, 2019; de Wit-de Vries et al., 2019), ongoing scholarly debate continues regarding the roles and forms of intermediaries in the UIC ecosystem (Alexander & Miller, 2017; Albats, Alexander & Cunningham, 2022). While various authors have conducted studies on intermediation within the KT/TT-UIC context, the involvement of intermediaries as a mechanism to address potential barriers and their specific forms/roles in such collaborations remain insufficiently explored (Alexander & Martin, 2013; Alexander & Miller, 2017; Villani, Rasmussen & Grimaldi, 2017; de Wit-de Vries et al., 2019; Takanashi & Lee, 2019).

As a result, the UIC setting has witnessed the emergence of a diverse array of intermediary forms, each with distinct roles, types, and strategies, representing significant trends in the field. Among these forms are traditional intermediaries, such as UTTOs/UKTOs, which can take the shape of internal departments located centrally or embedded within faculties (Alexander & Miller, 2017), or as arms-length subsidiaries wholly owned by the host university (e.g., the in-house intermediaries examined here). However, even within the category of traditional intermediaries, variations exist in their functions, strategies, and the KT/TT-UIC channels they utilise, depending on their objectives within the affiliated university (Alexander & Miller, 2017).

Literature investigates the role of these intermediaries, shedding light on how UIC ecosystems can benefit from their presence. These intermediaries foster collaboration and bridge the gap within the UIC setting. Their role lies in connecting different stakeholders and facilitating the exchange of resources. Furthermore, there are other forms of intermediaries, such as separate organisations linked by policy and/or constitution or virtual organisations that provide specialised sector skills as outlined by regional policy and/or institutional agreements. Additionally, exploring crowdsourcing platforms as intermediaries within the KT/TT-UIC context remains unexplored, mainly (Howells, 2006; Alexander & Martin, 2013; Alexander & Miller, 2017; Al-Tabbaa & Ankrah, 2019). By delving

into these alternative intermediaries, we can better understand their impact on UIC ecosystems. As a result, various intermediary forms with different roles, types, and strategies have emerged as significant trends in the UIC setting.

Moreover, Alexander and Miller (2017) proposed several forms of intermediaries based on their architectures, including (a) intermediary organisations located within their host institutions (e.g., universities), (b) those located within arms-length institutions external to the host institutions, or (c) those based on virtual/digital platforms. Similarly, Albats, Alexander, and Cunningham (2022) introduced different structures/strategies of intermediaries as physical or virtual organisations. Physical intermediaries are categorised as traditional intermediaries (physically located within the host institution or at arm's length) or regional clusters (located remotely). On the other hand, virtual intermediaries are classified as virtual communities (operating virtually without a permanent digital platform) or digital intermediaries (conducting entirely virtual activities through a digital platform) (Hakami, Pradhan & Mastio, 2022b).

Notably, there is an essential distinction between digital platforms and virtual network-based intermediaries. Digital platforms are typically characterised by a lasting digital infrastructure, commonly manifested as web-based platforms. Conversely, virtual network-based intermediaries, like virtual scientific communities, lack a permanent physical or digital presence. Instead, they exist solely as peer-to-peer connections within a network (Albats, Alexander & Cunningham, 2022).

### 2.4.3 Integrating Socio-Technical Perspectives with the Digital Platform in the UIC Context

A platform can be described as a foundational product, service, or technology utilised by innovators within an ecosystem to develop and refine complementary products, services, or technologies (Gawer & Cusumano, 2014). While a digital platform, as described by Constantinides, Henfridsson, and Parker (2018), can be referred to as a collection of digital resources, including services and content, that facilitates value-adding interactions between providers and users; they also emphasised that such platforms do not necessarily have physical assets like infrastructure resources nor generate value through direct product sales. Digitalisation in business process refers to the integration of digital technologies into various business operations, such as data collection, analysis, communication, and decision-making, to increase efficiency, reduce costs, and enhance an organisation's ability to deliver products and services to customers quickly and agilely (Adomako & Nguyen, 2023), allowing organisations to stay competitive and adapt to the rapidly changing business environment by adopting digitalisation. This transformative shift has empowered organisations to streamline their workflows (Williamson & De Meyer, 2012; Adomako & Nguyen, 2023). Alongside, digital platforms have emerged as game-changers, revolutionising value creation across numerous industries.

The concepts of digital platforms within an ecosystem have been the subject of academic debate for over two decades, highlighting the evolving understanding and significance of these frameworks in contemporary digital strategy (Hossain & Lassen, 2017; de Reuver, Sørensen & Basole, 2018; Brechtel & Altmann, 2021; Kapoor et al., 2021; Reim, Andersson & Eckerwall, 2023); however, when it comes to applying such digital platforms within a heterogeneous ecosystem, some additional complexities and challenges need to be addressed to leverage their potential fully. Many studies predominantly concentrate on the technical facets of platform firms, often

overlooking the crucial social factors within these environments (Kapoor et al., 2021). To bridge this gap, this study examines both the social and technical dimensions of platform ecosystems, aiming to understand the intricate interdependencies that arise from the interactions among various actors within these platforms. Building on this foundational understanding, it adopts the socio-technical perspective in exploring the complexities and challenges of implementing digital platforms within such an ecosystem (i.e., the UIC ecosystem).

The socio-technical perspective views the mutual constitution of people's relationships (i.e., social factors) and digital technologies as integral. Socio-technical research highlights the diverse networks of institutions, individuals, and technological artifacts that collectively contribute to the design, development, adoption, and usage of IS (Sawyer & Jarrahi, 2015). Leavitt (2013) provides a comprehensive lens on organisational and technological change, particularly in IS studies, to explore how organisations manage social and technical dimensions, ensuring smoother transitions into socio-technical systems. His diamond framework addresses the complex, interdependent relationships between actors, technology, tasks, and structures. However, this study does not adopt the diamond framework by Leavitt (2013); instead, it embraces the socio-technical perspective as a dynamic interplay between people and digital technologies. This perspective reveals that such digital platforms encompass two key components: (1) technical elements, such as software, hardware infrastructures, and other technologies, and (2) social elements, including organisational processes that enable interactions between diverse user groups and stakeholders (de Reuver, Sørensen & Basole, 2018), within the UIC setting.

Notably, multi-sided platforms have garnered significant attention as they function as virtual marketplaces, fostering direct interaction between two or more independent groups of actors or organisations, with each group connected to the platform, providing opportunities for increased efficiency and flexibility through a streamlined exchange of information while reducing communication interfaces (Wallbach et al., 2019). For organisations, multi-sided platforms improve efficiency and agility by facilitating seamless information exchange and collaboration among diverse stakeholders. This, in turn, leverages mutual resource sharing to drive innovation and enhance their competitive edge in the global marketplace (Pousttchi & Gleiss, 2019; Wallbach et al., 2019).

Digital platforms as novel socio-technical artifacts drive scholars in the field of IS to pursue conceptual and methodological advancements actively (de Reuver, Sørensen & Basole, 2018), introducing new market opportunities, as evidenced in studies by Burkhalter et al. (2021) and de Reuver, Sørensen, and Basole (2018). The emergence of digital UKTOs/UTTOs as intermediaries suggests a significant shift from the traditional model, although the full extent of their impact is not yet fully understood (Alexander & Miller, 2017; Albats, Alexander & Cunningham, 2022). In the dynamic ecosystem of academia and industry, there is a growing need for research to understand the impact of digital transformation on knowledge exchange. These emerging collaborations and intermediaries create a collaborative environment where all actors are recognised as value co-creators rather than passive recipients (Burkhalter et al., 2021). Moreover, Adomako and Nguyen (2023) concluded that digitalisation within the UIC setting serves as a driving force for inter-organisational collaboration, which directly intensifies transferring the technology (i.e. intensity refers to the degree to which organisations are involved in the KT/TT-UIC activities). They also noted that this relationship within the ecosystem is strengthened when the technology's commercial potential is high.

## 2.5 THEORETICAL FOUNDATION: SOCIAL CAPITAL (SC) THEORY

The concept of SC originated in the fields of sociology and political science. It appeared early on in The Death and Life of Great American Cities, in which Jane Jacobs (1961) studied diverse relationships and how relational action within city neighbourhoods formulated social trust. Häuberer (2011) credited Bourdieu (1983) and Coleman (1988) as key figures in systematically introducing and shaping the concept of social capital. Since then, SC has been widely adopted in the literature across various academic disciplines, including intellectual capital (Nahapiet & Ghoshal, 1998), economic development (Woolcock, 1998), academic research performance (Zhang & Wang, 2017) and KT (Inkpen & Tsang, 2005; Jiang & Mei, 2016). The influence of SC has been studied at various levels of analysis, including the individual, the group, intra- or inter-organisational, and community.

SC theory can be used to explore the role of relational networks in facilitating KT/TT-UIC (Nahapiet & Ghoshal, 1998; Adler & Kwon, 2002; de Wit-de Vries et al., 2019; Thomas & Paul, 2019). SC has been widely defined based on its applicability to a variety of situations (Granovetter, 1973; Coleman, 1988; Bourdieu & Wacquant, 1992; Putnam, 1995; Nahapiet & Ghoshal, 1998; Portes, 1998; Woolcock, 1998; Adler & Kwon, 2002). Coleman (1988, p. S98) views it as "a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors, whether persons or corporate actors within the structure". Bourdieu and Wacquant (1992, p. 119) define SC as "the sum of the resources, actual or virtual, that accrue to an individual or a group by possessing a durable network of more or less institutionalised relationships of mutual acquaintance and recognition". Similarly, Nahapiet and Ghoshal (1998, p. 243) define SC as "the sum of the actual and potential resources embedded within, available through and derived from the network of relationships possessed by an individual or social unit". However, Adler and Kwon (2002) argue that SC is an "umbrella concept" with no single affirmed definition, thus allowing for various interpretations. In this respect, Putnam (1995) refers to SC as a multidimensional concept. Furthermore, Woolcock and Narayan (2000) examined SC from different perspectives, including the community, networks, institutional, and synergy views. Differentiation is also made between bonded SC, where resources are held internally, and bridging SC, where resources are held externally, where access to internal and external resources may be sought depending on the situation. Nahapiet and Ghoshal (1998) emphasised three dimensions of SC (structural, relational and cognitive) that underpin the creation of intellectual capital. This was also discussed in Hakami, Pradhan & Mastio (2022c).

### 2.5.1 The Social Capital (SC) Dimensions

Based on the emerging rich body of literature, the SC dimensions proposed by Nahapiet and Ghoshal (1998) received wide acceptance and were adopted in many studies that applied them extensively from different perspectives. This helped to measure the influence and integration of SC in KT/TT-UIC more precisely (Inkpen & Tsang, 2005; de Wit-de Vries et al., 2019). Every SC dimension focuses on a cluster of aspects (Nahapiet & Ghoshal, 1998; Inkpen & Tsang, 2005). For example, the structural dimension is associated with the structural nature of an organisation and the configuration of its social networks, while the relational dimension relates to the quality of relationships concerning the ease of access to relationally embedded resources, such as trust. Finally, the cognitive dimension refers to actors' shared frames of reference and absorptive capacity (Nahapiet & Ghoshal, 1998). This was also discussed in Hakami, Pradhan & Mastio (2022c).

#### 2.5.1.1 The Structural Dimension

As Nahapiet and Ghoshal (1998, p. 252) stated, “who you know affects what you know”. The structural dimension comprises a pattern of interconnected relationship networks of inter-organisational entities, including network ties, tie strength, network configurations, and network stability. Network ties influence how organisation actors relate to each other (Inkpen & Tsang, 2005) and are considered a fundamental and crucial aspect of SC. Social ties among network entities foster inter-organisational partnerships (Adler & Kwon, 2002). Tie strength is defined as a "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterise the tie" (Granovetter, 1973, p. 1361). Additionally, network configuration is defined as “the pattern of linkages in terms of such measures as density, connectivity, and hierarchy” (Nahapiet & Ghoshal, 1998, p. 244). It reveals opportunities to develop connections among organisations through which actors are willing to share knowledge and resources (Chow & Chan, 2008). Network stability is also defined as a “change of membership in a network” (Inkpen & Tsang, 2005, p. 153). This was also discussed in Hakami, Pradhan & Mastio (2022c).

#### 2.5.1.2 The Relational Dimension

Concentrating on the characteristics and quality of relationships, relational can be the most critical dimension in facilitating inter-organisational KT/TT-UIC (M. D. Santoro & Saparito, 2003). It involves trust, identification, norms, and mutual obligations. Trust is defined as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer, Davis & Schoorman, 1995, p. 712). It is developed over time and refers to the willingness of organisations and individuals to decrease control over interactivity and review confidentiality policies concerning KT/TT-UIC (Inkpen & Tsang, 2005). It is identified in the literature as the principal influencer in developing relationships towards KT/TT-UIC (Inkpen & Tsang, 2005; de Wit-de Vries et al., 2019). Identification is “the process whereby individuals see themselves as one with another person or group of people” (Nahapiet and Ghoshal (1998, p. 256). Norms (especially norms of reciprocity) are another vital aspect of the quality of relationships, which are defined as “the degree of consensus in the social system" (Nahapiet & Ghoshal, 1998, p. 255). Obligations also represent "a commitment or duty to undertake some activity in the future" (Nahapiet & Ghoshal, 1998, p. 255). This was also discussed in Hakami, Pradhan & Mastio (2022c).

#### 2.5.1.3 The Cognitive Dimension

The cognitive dimension refers to "resources providing shared representations, interpretations, and systems of meaning among parties" (Nahapiet & Ghoshal, 1998, p. 244). It contains common understanding, shared goals, shared language, shared values, and shared cultural assumptions. The degree to which partners align on shared goals and culture is critical to their collective motivation and commitment (Inkpen & Tsang, 2005). Having shared goals and cultural frames of reference facilitates access, when necessary, to the knowledge and experience of each partner (M. D. Santoro & Saparito, 2003; Inkpen & Tsang, 2005; Steinmo & Rasmussen, 2018). Shared language can be defined as “the acronyms, subtleties and underlying assumptions that are the staples of day-to-day interactions” (Lesser & Storck, 2001, p. 836). The collective goals and aspirations of the network members are

referred to as shared goals (Inkpen & Tsang, 2005, p. 157), while shared culture refers to the degree to which norms of behaviour govern relationships (Inkpen & Tsang, 2005, p. 153). This was also discussed in Hakami, Pradhan & Mastio (2022c).

### 2.5.2 The Role of the Social Capital in the Context of KT/TT-UIC

SC dimensions are interrelated and evolve as the relationships develop (Inkpen & Tsang, 2005). There have been numerous studies to investigate the role/influence of SC theory and its dimensions in inter-organisational relationships context, that is, the role of SC dimension in facilitating KT/TT-UIC and accessing embedded resources in these inter-organisational relationships (M. D. Santoro & Bierly, 2006; Rottman, 2008; Al-Tabbaa & Ankrah, 2019; Tootell et al., 2020). As previously reported in the literature, building trust and managing cognitive differences in the organisational goals and culture among partners create reciprocal benefits and assist in overcoming UIC barriers. SC dimensions are shown to increase the frequency of partner interaction and collaboration and the number of KT/TT-UIC activities between them, thereby strengthening the ties that affect KT/TT-UIC (Plewa, Korff, Johnson, et al., 2013; Azagra-Caro et al., 2017). For instance, it has been reported that KT/TT-UIC can be fostered through building SC between partners by (i) strengthening network ties and opportunities to develop further connections, (ii) maintaining mutual trust, degree of social norms, and potential commitment, and (iii) sharing common goals and culture between partners. Accordingly, the lack of SC between partners/actors leads to several potential KT/TT-UIC barriers, such as narrowing collaboration opportunities and inflexibility in transferring knowledge (structural), lack of trust and poor attitude toward KT/TT-UIC (relational), and cognitive differences and difficulties in realising commercial value (cognitive) (Thune, 2007; Philbin, 2008; Filieri et al., 2014; Steinmo & Rasmussen, 2018; de Wit-de Vries et al., 2019; Leonchuk & Gray, 2019; Robertson, McCarthy & Pitt, 2019; Abdulai, Murphy & Thomas, 2020; Gerbin & Drnovsek, 2020). This was also discussed in Hakami, Pradhan & Mastio (2022c).

## 2.6 RESEARCH GAP

The current literature on KT/TT-UIC has identified several significant research gaps. These gaps underscore the need for further investigation to deepen our understanding of UIC dynamics and effectiveness and to deepen our understanding of various aspects within the UIC setting, as follows:

**Research Gap 1: Underrepresentation of UIC Ecosystem**

- **Literature Evidence:** There is a notable limitation in exploring the extended UIC ecosystem, primarily focused on academic perspectives, which limits practitioners' critical insights and contributions. These practitioners have been considerably less explored in existing research, impacting the complete understanding of UIC dynamics (de Wit-de Vries et al., 2019).
- **Addressing the Gap:** This study aims to provide a more holistic understanding of the UIC setting by including various experts from universities, industry, and intermediary organisations. Employing a comprehensive DSR approach that engages in iterative data collection, analysis, and verification cycles. This ensures that the perspectives of industry actors are included and integral to developing a more balanced understanding of UIC dynamics.

**Research Gap 2: Role and Forms of Intermediaries in Facilitating Collaborations**

- **Literature Evidence:** Intermediaries play a crucial role in the heterogeneous UIC ecosystem, yet there remains a clear gap in understanding how intermediaries manage some barriers, including cognitive differences among UIC actors, particularly in knowledge-based activities. The literature also shows an inconsistent focus where studies either focus exclusively on intermediaries or ignore their role, leading to significant oversight. Additionally, emerging types of intermediaries, such as those based on digital platforms, are not explored enough, particularly in terms of their engagement and facilitative collaborations in the UIC context (Alexander & Miller, 2017; Villani, Rasmussen & Grimaldi, 2017; Al-Tabbaa & Ankrah, 2019; de Wit-de Vries et al., 2019; Takanashi & Lee, 2019; Albats, Alexander & Cunningham, 2022).
- **Addressing the Gap:** This study delves into the role of intermediaries within the UIC setting, examining both traditional physical intermediaries and the emerging digital platform-based intermediaries. It iteratively develops and evaluates digital platform-based intermediary artifacts via a DSR approach. Such an artifact meets the UIC ecosystem's specific needs and requirements to ensure a thorough exploration and optimisation for enhancing collaboration effectiveness.

**Research Gap 3: Inconsistent Mechanisms in Social Capital (SC) Application- Theoretical**

- **Literature Evidence:** Significant inconsistency exists in the mechanisms used to address and measure social capital among partners, particularly cognitive differences, during KT/TT-UIC activities. These inconsistencies are mainly due to the challenges associated with measuring the cognitive dimension aspects of SC theory, leading to varied and often conflicting results in empirical research (Nahapiet & Ghoshal, 1998; Chow & Chan, 2008; Zhang & Wang, 2017; de Wit-de Vries et al., 2019; Robertson, McCarthy & Pitt, 2019).
- **Addressing the Gap:** A systematic literature review on SC in a UIC context is conducted to tackle these inconsistencies and establish a solid theoretical foundation. SC is then employed as an interconnected theoretical lens to interpret empirical findings, enriching the understanding of interactions within the UIC ecosystem. Furthermore, insights derived from this theoretical and empirical analysis are used to inform the design requirements of the digital platform artifact. This approach ensures the digital platform incorporates a socio-technical perspective, effectively bridging theoretical concepts with practical implementation needs.

**Research Gap 4: Underexplored Socio-Technical Perspectives within the UIC Setting and Platform Ecosystems**

- **Literature Evidence:** Many studies focus on the technical aspects of platforms, often neglecting critical social dimensions. This oversight is especially apparent in research that ignores the intricate interdependencies emerging from interactions among diverse actors within platform ecosystems (Hossain & Lassen, 2017; Brechtel & Altmann, 2021; Kapoor et al., 2021; Reim, Andersson & Eckerwall, 2023).
- **Addressing the Gap:** The aim is to bridge this gap by adopting a socio-technical perspective to iteratively develop and evaluate a digital platform-based intermediary within the UIC setting. This

approach emphasises social factors shaping collaborations in the UIC ecosystem, interpreted through social capital theory and guided by a DSR methodology. This ensures a holistic and comprehensive understanding of the interplay between social and technical elements to foster effective collaboration and innovation within platform ecosystems while addressing an underexplored but critical research area.

**Research Gap 5: Insufficient Research on UIC in Developing Regions (i.e., MENA Region) with Emphasis on Socio-Technical Applications- Contextual**

- **Literature Evidence:** Despite the MENA region's emerging status as a more robust economic force with a growing emphasis on knowledge-based activities, empirical findings on UIC within this region are limited. Studies indicate that the theoretical and practical understanding level in UIC has been relatively low (Al-Mansoori & Koc, 2019; Elyoussoufi Attou, 2019; Sultan, 2020), with the applications of a socio-technical perspective also notably lacking. Moreover, while there are notable differences in the application of SC dimensions across various contexts and regions, the literature on these applications in developing areas, particularly in the MENA region, is sparse. This is especially true for the UIC ecosystem in the Saudi Arabian context, which represents a significant gap in understanding regional dynamics (Robertson, McCarthy & Pitt, 2019; Nsanzumuhire & Groot, 2020).
- **Addressing the Gap:** A systematic review focusing on the underexplored geographical context to bridge the gaps in understanding the UIC phenomenon within the MENA region is also conducted. As a leading country in the MENA region, Saudi Arabia offers a unique and promising setting for such collaborations. Accordingly, data collection is conducted within Saudi Arabia, which is justified by the nation's transition into a 'knowledge-based economy'. These insights are intended to be relevant and adaptable to similar developing regions. Moreover, a socio-technical perspective is employed through the iterative development and evaluation of a digital platform-based intermediary, influencing such collaborations within the UIC ecosystem in the Saudi Arabian context, focusing on the social dimensions interpreted from SC theory through a DSR approach. By integrating both social and technical aspects, the study ensures a comprehensive understanding of the challenges and opportunities in the MENA region's UIC initiatives and practices.

## 2.7 CHAPTER SUMMARY

To sum up, Chapter 2 has provided a comprehensive literature review on KT/TT-UIC activities. UIC concepts, developmental phases, innovation ecosystems, and operational channels have been explored. This chapter has also analysed key factors influencing such collaborations, including roles, barriers, and driving forces, as well as mechanisms facilitating collaboration, emphasising intermediaries and digital platforms. The SC theory framework has been examined in depth, exploring its structural, relational, and cognitive dimensions within the UIC context. Through this extensive review, several critical research gaps have been identified: (1) underrepresentation of the UIC ecosystem, (2) unclear roles and forms of intermediaries in facilitating collaborations, (3) inconsistent mechanisms in Social Capital application, (4) underexplored socio-technical perspectives within the UIC setting and platform ecosystems, and (5) insufficient research on UIC in the MENA region, particularly regarding socio-technical applications. Chapter 2 highlights research gaps, paving the way for methodologies to enhance KT/TT-UIC activities and address these gaps in later chapters.

# PART II- RESEARCH APPROACH

## Chapter 3: Research Methodology

# 3 RESEARCH METHODOLOGY

Chapter 3 outlines the comprehensive methodology adopted for conducting the research presented in this thesis. The methodology is crucial as it underpins the entire study by providing a structured approach to data collection, analysis, and interpretation. The chapter is organised to reflect the logical progression of the research methods employed, beginning with the foundational research paradigm and advancing through various data collection and analysis techniques. Initially, the chapter outlines the research paradigm that guides the study's philosophical orientation within the IS field, detailed in the research paradigm in the IS (Section 3.1). This section sets the stage for understanding the theoretical underpinnings and methodological choices that inform the subsequent research processes. Following the discussion on the research paradigm, the thesis delves into the design science research (DSR) approach (Section 3.2), which is central to the methodology employed. This approach is particularly relevant to IS research that aims to create and evaluate IT artifacts to solve identified organisational problems. The rationale for selecting the DSR approach (Section 3.2.1) is articulated, highlighting its relevance and suitability for the research questions and objectives. This section justifies the use of DSR in exploring and addressing the complexities of KT/TT activities within the UIC setting. Additionally, the DSR framework (Section 3.2.2) outlines the specific processes and stages of the research, from problem identification to developing and evaluating suggested solutions. It concludes with a phase where reflections on the DSR journey and lessons learned are provided.

Data collection and data analysis (Section 3.3) explains the overarching strategies employed for data collection and analysis. This section ensures that the research adheres to rigorous standards of validity and reliability, which are essential for achieving the research objectives. The secondary data collection methods are comprehensively explored in (Section 3.4). This includes a general literature review (Section 3.4.1), a systematic literature review focused on KT/TT-UIC in the MENA region (Section 3.4.2), and another systematic review investigating the SC-UIC (Section 3.4.3). These systematic reviews provide a critical foundation and context, integrating existing knowledge and identifying gaps where new contributions can be made. The primary data collection methods are described in (Section 3.5). These include the setting of the primary data collection in the Saudi Arabian context (Section 3.5.1), expert interviews (Section 3.5.2), and focus groups (Section 3.5.3). These methods are critical in gathering firsthand insights and empirical data to support the research findings.

Finally, the chapter concludes with a summary (Section 3.6) that synthesises the key points discussed and reiterates the importance of the chosen methodologies in addressing the research objectives. This structured approach ensures that the research is grounded in a solid methodological foundation to enable reliable findings that contribute significantly to the field of IS and UIC.

## 3.1 RESEARCH PARADIGM IN THE INFORMATION SYSTEMS

IS are established within organisations to improve their effectiveness and efficiency. According to Hevner et al. (2004), for IS to be successful in achieving this goal, it is dependent on a combination of certain factors and development and implementation methodologies which refer to the approaches and techniques used to design, develop, and deploy the systems. Such factors can include the capabilities of the systems, which refers to what the system can do, its functionalities, and its operational scope; characteristics of the organisation's structure, culture, and operational processes; work systems as the processes and workflows through which the organisation's activities are carried out; and people as the users, managers, and IT staff who interact with the system. Therefore, the responsibility rests upon researchers and practitioners within the IS field to advance and acquire knowledge that enhances the practical application of information technology in organisational settings. This involves developing and disseminating insights related both to managing the technology itself and to leveraging technology for broader managerial and organisational benefits (Hevner et al., 2004; Peffers et al., 2007; Gregor & Hevner, 2013).

There are two fundamental research paradigms for acquiring knowledge within the IS field: the behavioural science paradigm and the design science paradigm (March & Smith, 1995). The research paradigms impact the analysis, design, implementation, management, and use of such IS applications towards achieving the primary purpose of IS in improving organisational effectiveness and efficiency, which relies on the researcher's experience, creativity, intuition, and problem-solving capabilities (Gregor & Hevner, 2013; Vaishnavi & Kuechler, 2015). Accordingly, this can lead to the potential for IS research to make substantial contributions by leveraging the cycle between design science and behavioural science and focusing on solving fundamental issues in the productive application of information technology.

The behavioural science paradigm is grounded in natural science research methods. It aims to develop and justify theories that explain or predict human and organisational phenomena and provide insights into the interactions among people, technology, and organisations (Hevner et al., 2004; Gregor & Hevner, 2013; Vaishnavi & Kuechler, 2015). On the other hand, the design science paradigm is grounded in engineering and the sciences of the artificial, which is characterised as a problem-solving paradigm and aims to create innovations that redefine ideas, practices, technical capabilities, and products. Such innovations can be demonstrated in designing artifacts to effectively and efficiently accomplish tasks related to IS (Hevner et al., 2004; Gregor & Hevner, 2013; Vaishnavi & Kuechler, 2015).

Literature highlights the differing goals of behavioural science and design science research: the former aims to validate theories through empirical evidence, while the latter values the practical utility of artifacts (Hevner, March, Park & Ram 2004). Despite these differences, both fields prioritise rigour through effective knowledge use and acknowledge the interconnection between truth (justified theory) and utility (effective artifacts) (Aboulafia, 1991; Hevner et al., 2004). Moreover, Markus, Majchrzak, and Les (2002) emphasised the dynamic interaction between theory and practice in artifact creation, as artifacts, despite being human-made, still adhere to behavioural theories. Their development involves the application of existing foundational theories (i.e., “kernel theories”), testing and modification of these theories, and extension of these theories through practical application (Hevner et al., 2004).

Moreover, the philosophical grounding of the design science paradigm is summarised in Table 3.1, which provides a detailed comparison across three distinct research perspectives: positivist, interpretive, and design (Vaishnavi & Kuechler, 2015). Each perspective is described according to four fundamental philosophical dimensions: ontology (addresses the nature of reality), epistemology (concerns the nature of knowledge and how it is acquired), methodology (refers to the methods used to investigate and understand reality), and axiology (the study of values, distinguishes each perspective by its ultimate goals). This structured comparison highlights each perspective's philosophical foundations and approaches to illustrate how they influence the methods and outcomes of research within the DSR.

Table 3.1: Philosophical Assumptions of Three Research Perspectives
Source: Vaishnavi and Kuechler (2015, p. 31)

| Basic Belief | Positivist | Interpretive | Design |
|---|---|---|---|
| **Ontology** | A single reality; knowable, probabilistic | Multiple realities, socially constructed | Multiple, contextually situated alternative world-states. Socio-technologically enabled |
| **Epistemology** | Objective; dispassionate. Detached observer of truth | Subjective, i.e. values and knowledge emerge from the researcher-participant interaction. | Knowing through making an objectively constrained construction within a context. Iterative circumscription reveals meaning. |
| **Methodology** | Observation; quantitative, statistical | Participation; qualitative. Hermeneutical, dialectical. | Developmental. Measure artifactual impacts on the composite system. |
| **Axiology** | Truth: universal and beautiful; prediction | Understanding: situated and description | Control; creation; progress (i.e. improvement); understanding |

## 3.2 DESIGN SCIENCE RESEARCH (DSR) APPROACH

Design has historically been a defining aspect of many professions before experiencing a decline in academic focus that was later reversed in select applied fields (Vaishnavi & Kuechler, 2015). Artifact design has been a central human activity for centuries, distinguishing professions like architecture, business, and medicine from pure sciences. However, in the 20th century, natural sciences nearly displaced design from professional school curricula, with exceptions for fields like management science and computer science (Simon, 1996).

Thus, Design is fundamentally about the process of inventing and creating new artifacts that do not yet exist. This implies that the knowledge to create such an artifact already exists; the design is routine. However, if the required knowledge is lacking, the design becomes innovative, often requiring conducting a research cycle to fill knowledge gaps and lead to outcomes such as research publications or patents (Vaishnavi & Kuechler, 2015). Therefore, design ranges from routine application of existing knowledge to innovative work that pushes boundaries and necessitates new research. The level of innovation determines the appropriate design approach.

Simon (1996) distinguishes between natural sciences, which focus on understanding natural and societal phenomena, and design science, which centres on creating artificial objects and systems to achieve specific goals. In design science, the critical activity involves crafting an interface between an artifact's internal components and external environment, ensuring that the artifact operates effectively within these constraints. As discussed by Maturana and Varela (1987) and Varela (1988), this concept highlights the interdependence between an artifact and its surroundings.

Furthermore, Takeda et al. (1990) described design as a process of mapping from functional requirements to the attributes of an artifact, a critical component of design science. This field develops the methods and models for this mapping and advances later through Design Science Research (DSR), which generates new knowledge through design, analysis, reflection, and abstraction. Design science in IS research, as outlined by Walls, Widmeyer, and El Sawy (1992), embraces a dual perspective where design is recognised both as a process and as a product. This dualistic approach allows IS researchers to shift their focus between the expert activities involved in the design process and the innovative products that result in artifacts.

DSR approach first gained traction in the IS field in the early 1990s due to key contributions from Nunamaker, Chen, and Purdin (1990) and March and Smith (1995). Since then, the influence of the DSR approach has expanded, with significant advancements being made by Hevner et al. (2004), Vaishnavi and Kuechler (2004), Peffers et al. (2007), and Gregor et al. (2007), as illustrated in Table 3.2.

DSR, fundamentally a rigorous problem-solving process similar to engineering practices, focuses on creating practical artifacts to generate scientific knowledge, as outlined by Hevner et al. (2004) and other researchers. Building on that, as the DSR approach facilitates a problem-solving paradigm adept at addressing complex issues by integrating and balancing the dynamics of both the design activities and their tangible outcomes, this dual focus not only deepens understanding but also promotes innovation within the field of design science (Walls, Widmeyer & El Sawy, 1992). These artifacts, which include constructs, models, methods, and theories, are essential for thoroughly understanding the development, implementation, and utilisation of IS (Hevner & Chatterjee, 2010; Vaishnavi & Kuechler, 2015). To put it another way, the critical focus of a design science or science of design is to address real-world organisational challenges by leveraging the creative design process to produce innovative IT-based solutions (i.e., artifacts) that can improve organisational performance and decision-making (Hevner et al., 2004). Rather than just observing and describing existing phenomena, DSR actively seeks to create new and innovative IT-based solutions to organisational problems. DSR enables researchers to generate academically rigorous and practically relevant knowledge by combining theory, design, and empirical evaluation. This emphasis on relevance and rigour is a defining characteristic of the DSR approach within IS research (Vaishnavi & Kuechler, 2015).

IT artifacts manifest in bridging theoretical knowledge and practical applications within IS research. Gregor et al. (2007) also significantly contributed to the evolution of DSR by identifying theorising as a crucial component. This is illustrated by the implications of DSR that address real-world organisational needs directly relating to the philosophical tradition of pragmatism, particularly citing Aboulafia (1991). The argument emphasises the interconnected nature of technology and behaviour within the IS setting and research. This pragmatist view advocates that pursuing theoretical truth and developing practical artifacts are interconnected endeavours that scientific research should pursue simultaneously (Aboulafia, 1991). IT artifacts play a critical role in this regard,

as they provide concrete prescriptions that aid IT researchers and practitioners understand and address the challenges involved in developing and implementing IS within organisations (March & Smith, 1995).

Table 3.2: A review of DSR models
Sources: Offermann et al. (2009) and Peffers et al. (2020)

| | **DSR Main Phases** | | |
|---|---|---|---|
| **DSR Model** | **Problem Identification** | **Solution Design** | **Evaluation** |
| (Takeda et al., 1990) | -Enumeration of problems | -Suggestion<br>-Development | -Evaluation to confirm the solution<br>-Decision on a solution to be adopted |
| (Nunamaker, Chen & Purdin, 1990) | -Construct a Conceptual Framework | -Develop a System Architecture<br>-Analyse & Design the System<br>-Build the System | -Observe & Evaluate the System |
| (Walls, Widmeyer & El Sawy, 1992) | Meta-requirements<br>Kernel theories | Design method Meta design | Testable design process/product hypotheses |
| (March & Smith, 1995) | | -Build | -Evaluate |
| (Peffers et al., 2007) | -Problem identification and motivation<br>-Define the objectives for a solution | -Design and development | -Demonstration<br>-Evaluation |
| (Hevner et al., 2004) | -Important and relevant problems<br>-Implicit in “relevance” | -Iterative search process, Artifact | -Evaluate<br>-Communication |
| (Vaishnavi & Kuechler, 2015) | -Awareness of the Problem | -Suggestion<br>-Development | -Evaluation<br>-Conclusion |
| **DSR Process Objectives** | • Identify problem<br>• Literature research<br>• Expert interviews<br>• Pre-evaluate relevance | • Design artefact<br>• Literature research | • Refine hypothesis<br>• Expert survey<br>• Laboratory experiment<br>• Case study/action research<br>• Summarise results |
| **DSR Activities** | 1. Problem identification and motivation<br>2. Objectives of a solution | 3. Design and development | 4. Demonstration<br>5. Evaluation<br>6. Communication |

Broadly, according to Hevner et al. (2004), IT artifacts can be categorised into four main types: constructs (the vocabulary and symbols used to represent problems and solutions), models (abstractions and representations that characterise real-world situations), methods (algorithms, practices, and guidelines for performing tasks), and instantiations (implemented and prototype systems that operationalise constructs, models, and methods). The nature and evaluation of prescriptive theories in IS research should focus on the effectiveness of these various types of prescriptions, such as development practices (methods) and specific system solutions (instantiations) designed to meet defined user requirements (models).

Moreover, when evaluating IS research, it is crucial to consider its practical implications in line with pragmatic principles (Aboulafia, 1991), as highlighted by the dynamics of interaction among people, organisations, and technology (Hevner et al., 2004). Importantly, IS research should be assessed and evaluated for its theoretical contributions, utility, and real-world applicability, reflecting a truly pragmatic approach to scientific inquiry

(Hevner et al., 2004). The evaluation of this artifact provides feedback that enhances understanding of the underlying problem, improving both the artifact and the design process itself, as noted by Markus, Majchrzak, and Les (2002). This iterative build-and-evaluate loop is essential in refining the final design artifact. Throughout this iterative creative process, design-science researchers must focus on developing both the design process and the artifact, ensuring that both evolve together as part of the research endeavour. By providing concrete prescriptions through IT artifacts, researchers and practitioners can enhance their understanding and ability to tackle the inherent challenges in developing and implementing IS within an organisation.

### 3.2.1 Rationale for Choosing the DSR Approach

Given the nature of the research and investigation that falls under the IS research area, adopting a well-accepted research framework in the IS domain ensures the accomplishment of the research goals and answers the research question. This research fits into a design science type of research. DSR is justified and recognised as a legitimate research process in the IS area (Hevner et al., 2004; Vaishnavi & Kuechler, 2004; Gregor et al., 2007; Peffers et al., 2007). DSR is particularly dedicated to creating socio-technical artifacts that address organisational problems and generate prescriptive design knowledge, making it ideal for developing and validating a digital platform-based intermediary (Hevner & Chatterjee, 2010; Venable, Pries-Heje & Baskerville, 2012; Vaishnavi & Kuechler, 2015).

This intermediary is intended to enhance KT/TT activities and improve practices within the UIC setting, which contribute to effectively bridging existing gaps. Due to the study's complexity and innovative aspects, as well as the limited knowledge in this area, the DSR approach is essential for gaining the insights needed to develop such a platform. To pursue the research objectives and address the research questions, this study follows the methodology framework established by Vaishnavi and Kuechler (2015), referred to as the iterative design research cycle. This framework consists of five phases: problem awareness, solution suggestion, development, evaluation, and conclusion, as summarised in Table 1.1. The inclusion of these phases offers a comprehensive overview of the research process undertaken.

## 3.3 DSR FRAMEWORK

This study adopts the DSR framework initially outlined by Vaishnavi and Kuechler (2004) and further refined in their later publications and books, such as Vaishnavi and Kuechler (2015). This DSR is characterised by an iterative five-phase cycle. Initially, DSR involves identifying and acknowledging the essential steps required to address a specific problem despite the absence of a clear solution or such a solution being unknown at that stage. Following this, a proposed solution is introduced and subjected to implementation, evaluation, and continual refinement through subsequent iterations. This comprehensive approach allows for the progressive development and enhancement of solutions (i.e., an IT artifact) to ensure that the suggested solution is effectively developed and evaluated to meet the needs identified at the beginning (i.e., within the UIC setting in this case). The DSR activities are comprehensively illustrated in Figure 3.1, which visually outlines the process's various stages and critical components to provide a clear and systematic representation of the approach used. *Details of the DSR framework, including the process and outcomes for each phase, are provided in Figure 1.1.*

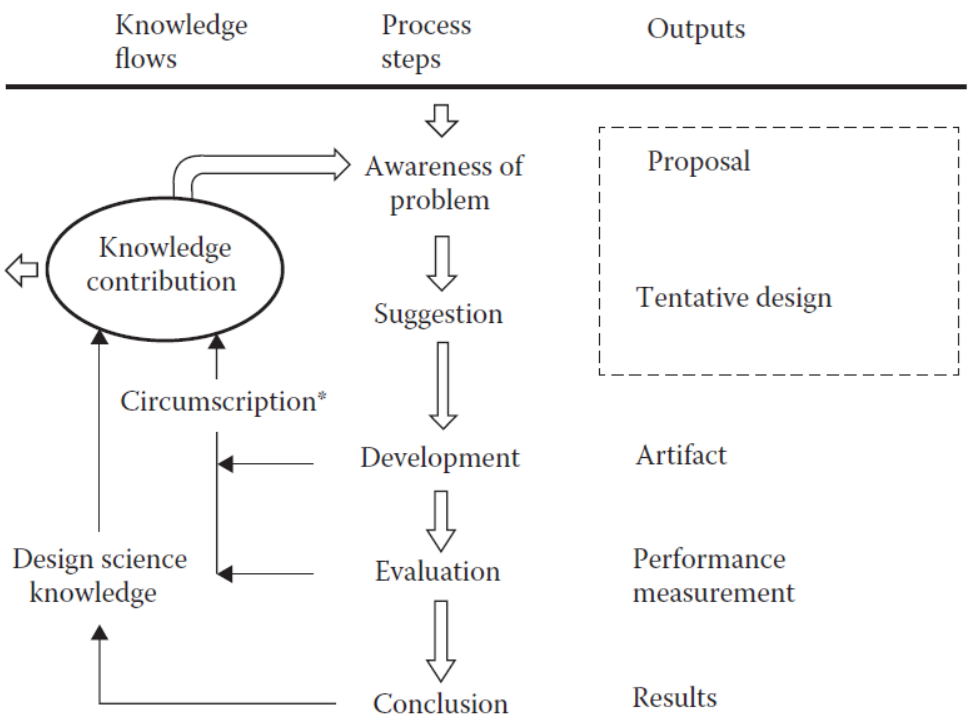



Figure 3.1: DSR Process Model (DSR Cycle)
Source: (Vaishnavi & Kuechler, 2015, p. 15)

### 3.3.1 DSR Phase (1)- Problem Awareness

The first phase, problem awareness, focuses on comprehensively understanding the research problem. This phase involves conducting a general literature review in the UIC and KT/TT-UIC activities, performing a systematic literature review specific to the MENA region, and gathering qualitative insights through exploratory semi-structured expert interviews in the Saudi Arabian context. As a critical player in the MENA region, Saudi Arabia represents a unique and influential context for investigating such collaborations. These activities aim to provide an overview of existing literature, comprehensively analyse relevant literature in the MENA region, and gather qualitative insights from key stakeholders and experts within the UIC ecosystem. The qualitative insights are analysed through the lens of SC Theory, which includes structural, relational, and cognitive dimensions. This theoretical lens is used to develop a conceptual model highlighting the key drivers and barriers within the UIC setting.

### 3.3.2 DSR Phase (2)- Solution Suggestion

The second phase, solution suggestion, aims to propose a solution to the identified problem in the first phase. Building on the insights from the previous phase, a deeper analysis is conducted, examining both current practices and emerging forms of intermediation to identify the most effective solutions. Therefore, this study proposes an IT artifact in the form of a digital platform-based intermediary as a solution to achieve its objectives. This approach considers the socio-technical perspective and the factors identified as prevalent in the research context.

After that, DRs are derived by integrating theoretical perspectives with empirical findings. DRs are high-level, generic criteria developed here to align with the specific needs of the UIC ecosystem, where they must be met by any artifact designed to solve a particular category of problems, as outlined by Gregor et al. (2007). Understanding these requirements requires recognising the context of the artifact. Concurrently, follow-up expert interviews (as ex-ante evaluation) are conducted to refine the proposed solution and further shape the DRs based on expert feedback. On this solid foundation, a comprehensive set of tentative DPs is established. The outcomes of this development phase are significant, including a list of DRs and tentative DPs for the proposed solution. Also, a structured framework is developed to accurately align DRs with their respective DPs within the UIC setting to ensure coherence between theory and practice. Such requirements are systematically identified and refined through the alignment process.

### 3.3.3 DSR Phase (3)- Development

In this phase, the development process included several critical activities essential for ensuring the practical application of theoretical insights. During the DSR development phase, DPs are strategically incorporated and instantiated directly as tangible DFs within the proposed prototype. The proposed prototype, designed as a digital-based platform intermediary, is comprehensively developed to facilitate its demonstration within the UIC ecosystem in the subsequent phase. The outcomes of this phase are significant: a mapping model is developed that correlates DRs and DPs with DFs, enhancing the understanding of the implementation process. Additionally, the prototype acts as a dynamic and proof-of-concept instantiation, demonstrating the application of DPs in real-world scenarios to highlight the functionality and potential impact of DPs and validate the design approach, refining the artifact for broader application. The goal of this phase is to implement and prepare the prototype by instantiating DPs. Subsequently, in the next phase, the prototype is demonstrated within the UIC ecosystem to gather feedback and evaluate its functionality.

### 3.3.4 DSR Phase (4)- Evaluation

The fourth phase of this DSR study, evaluation, aims to validate and refine the established criteria alongside the proposed solution. According to Vaishnavi and Kuechler (2015), IT Artifacts can range from software and formal logic to rigorous mathematics and informal natural language descriptions. These artifacts are evaluated within their specific organisational contexts using both empirical quantitative and qualitative methods. The evaluation methodology used follows the 'Naturalistic framework' as described by Venable, Pries-Heje, and Baskerville (2012, 2016), which includes both ex-ante and ex-post evaluations. Due to the iterative and overlapping nature of the DSR cycle, this allows for a comprehensive analysis of empirical data gathered in earlier phases. During the DSR process, ex-ante evaluation occurs in phase (2), where DRs are derived by aligning theoretical perspectives with empirical findings via follow-up expert interviews. On the other hand, ex-post evaluation takes place in phase 4 and involves conducting further expert interviews and focus groups as a follow-up to gather feedback on the solutions proposed in phase 2. Further critical feedback on the artifacts is collected through a targeted feedback questionnaire (qualitative) in this evaluation phase. This questionnaire assesses the reusability of the prototype and gathers insights into the effectiveness and adaptability of Instantiated DPs by demonstrating a prototype and the design framework itself. This feedback is instrumental in concurrently validating the DRs, DPs, and DFs and

enhancing the conceptual framework to ensure that it aligns with empirical insights within the UIC setting. Based on expert feedback, findings are revised to improve the overall research outcomes. Thus, the outcomes from this phase are noteworthy and can be summarised as a comprehensive collection of feedback and practical recommendations gathered, which leads to an update in DPs and artifact design based on the feedback received.

### 3.3.5 DSR Phase (5)- Conclusion

Finally, the fifth phase, the conclusion as a final reflection, synthesises the findings and offers recommendations for both general and specific contexts, mainly focusing on Saudi Arabia and the broader MENA region. This conclusion is integral for reflecting upon, abstracting, and summarising the research outcomes. It sets the stage for discussing the theoretical and practical implications and proposing future directions within the UIC setting. This phase also details how such findings address the research questions and research gaps, highlights the significant publications resulting from this study, and summarises the lessons learned. Overall, this iterative DSR methodology cycle ensures a rigorous and comprehensive approach to investigating the research question by combining comprehensive literature reviews, theoretical foundation, empirical data, and qualitative expert feedback. This approach contributes valuable insights and practical solutions to the unique contexts and challenges of fostering effective collaborations within the UIC setting.

## 3.4 DATA COLLECTION AND DATA ANALYSIS

Data collection is fundamental to all research efforts, and choosing the proper methods is as important as planning the overall research strategy (Maxwell, 2012), where the selection of research methods depends heavily on the goals of the project, its scope, and the theoretical frameworks guiding the research. According to Hevner and Chatterjee (2010), methods such as experiments, modelling, and exploratory studies are beneficial for tackling practical issues like how user-friendly artifacts are. Methods such as qualitative interviews, feedback questionnaires (qualitative), fieldwork, or observational studies are preferred to explore how well these artifacts work in real-world settings. Often, combining these methods is necessary to meet the strict standards of DSR and to ensure the research is thorough and reliable.

Understanding the sources of data is crucial in research (Maxwell, 2012). Primary data consists of new information collected directly for the specific study at hand, providing fresh insights tailored to the research questions. Additionally, secondary data involves information previously collected and analysed by other researchers. This combination type of data collection can be invaluable for contextualising findings within existing knowledge, confirming trends, or providing a baseline for further analysis, where each type serves a distinct purpose and contributes uniquely to the breadth and depth of the overall research (Myers & Avison, 2002; Maxwell, 2012; Myers, 2013).

As for this current study, primary data comes from qualitative methods, specifically through expert interviews and focus groups. These methods are valuable because they allow researchers to engage directly with participants, gaining deep insights into their thoughts and experiences. In a design context, expert interviews and focus group techniques enhance design quality and advance innovation. Designers can employ a cycle of asking and performing at various project stages. "Asking" involves in-depth information gathering about potential users,

including cultural insights. "Performing" requires designers to simulate and test potential user experiences, inviting feedback on these scenarios (Hevner & Chatterjee, 2010).

On the other hand, secondary data is collected through a methodical, two-stage review of existing literature. The initial stage includes a broad exploration of concepts relevant to KT/TT-UIC literature. The aim was to explore and ensure a solid foundational understanding of the key themes and theories. The subsequent stage delves deeper, comprising two thorough and systematic literature reviews. These reviews are focused explicitly on applying SC theory within the UIC context and examining the aspects of UIC in the MENA region. This layered approach guarantees a well-rounded investigation of the existing body of knowledge and facilitates the discovery of new insights that significantly enhance the understanding of the topic. This methodological rigour helps build a coherent narrative that bridges theoretical concepts with regional specificities.

## 3.5 THE SECONDARY DATA COLLECTION METHODS IN THE CURRENT STUDY

### 3.5.1 General Literature Review

The literature review serves as the foundation for research projects (Webster & Watson, 2002), not only confirming its significance but also validating the researcher's credentials, the theoretical underpinnings, and the study's relevance (Oates, 2006). On the DSR, Hevner and Chatterjee (2010) emphasise that a literature review is crucial not just for situating the study within established scientific frameworks, such as models and methods, but also for evaluating existing design processes and the contributions of other researchers. This comprehensive examination typically includes various sources, ranging from books, journal articles, and conference proceedings to multimedia and online content. The primary objective of this extensive literature review is to highlight the current research gaps within the area of focus, thereby guiding the research direction (Webster & Watson, 2002; Oates, 2006).

A comprehensive review of existing literature- including books, theses, conference proceedings, journals, and reports- is conducted to understand UIC's current state and emerging trends. This review delves into the dynamics, mechanisms, and impact of UIC, providing a deep understanding and identifying areas needing further research and development, as detailed below:

- **The UIC:** Examines the phases of UIC and the innovation ecosystem that supports and enhances these collaborations.
- **The Channels/Activities of UIC:** Discusses KT and TT aspects, along with a detailed exploration of the diverse range of KT/TT-UIC channels and activities.
- **Key Factors Influencing UIC:** Analyses the critical role of UIC, identifies impeding factors that hinder collaboration, and highlights the drivers and success factors contributing to effective UIC.
- **Facilitation Mechanisms for UIC:** Considers the role of intermediation in UIC and the integration of socio-technical perspectives with digital platforms in enhancing collaboration.

- **Theoretical Foundation - Social Capital (SC) Theory:** Explores the dimensions of SC—the structural, relational, and cognitive dimensions—and discusses the role of SC in the context of KT/TT-UIC.

### 3.5.2 Systematic Literature Review (1)- Contextual: KT/TT-UIC in the Middle East and North Africa (MENA) Region Context

This section presents a systematic literature review on UIC within the MENA region, building on an extensive review of relevant literature on this topic. It examines UIC practices over the last twenty years, specifically focusing on this geographical area. A critical finding is the notable lack of research on UIC aspects in different regional contexts, particularly in under-researched, developing areas like the MENA region. This review aims to identify and summarise the main themes and explore potential future directions for UIC activities over the past two decades in these regions.

#### 3.5.2.1 The MENA Region Context: An Overview

Previous reviews on the UIC have covered a range of collaboration facets, including the mapping out and identification of general/standard UIC channels (Perkmann & Walsh, 2007), analysing KT through established academic-industry engagement channels like contract research and consulting (Perkmann et al., 2013; de Wit-de Vries et al., 2019), and contrasting UIC environments/contexts between developed and some developing countries (Nsanzumuhire & Groot, 2020). However, research focusing specifically on the MENA region is scarce, highlighting a notable gap in the existing literature. According to The World Bank (2021), the MENA region encompasses the following countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, West Bank and Gaza, and Yemen; as shown in Figure 3.2.

The MENA region, an emerging hub, is home to over 400 million residents, and the population is projected to double by 2050. A significant portion of this population is youthful, with individuals under the age of 35 constituting two-thirds of the total demographic The World Bank (2021). This region, often referred to as 'the cradle of civilisation,' boasts a rich cultural and linguistic diversity, with Arabic being the primary language spoken by most of its inhabitants. The MENA region holds historical significance as the birthplace of major religions, and its populations share a cultural heritage and social norms shaped by these historical influences. Islam is the dominant religion, followed by Christianity and Judaism (UNC, 2021).

Economically, the MENA region's development is closely tied to oil-related activities, which underscore the importance of transforming towards a Knowledge-Based Economy (KBE). With a gross domestic product (GDP) reaching $3.036 trillion in 2020, the region presents promising opportunities for fostering such collaborations in the UIC setting. These activities are crucial in promoting innovation, entrepreneurship, and KT/TT, which are vital for economic development (The World Bank, 2021).

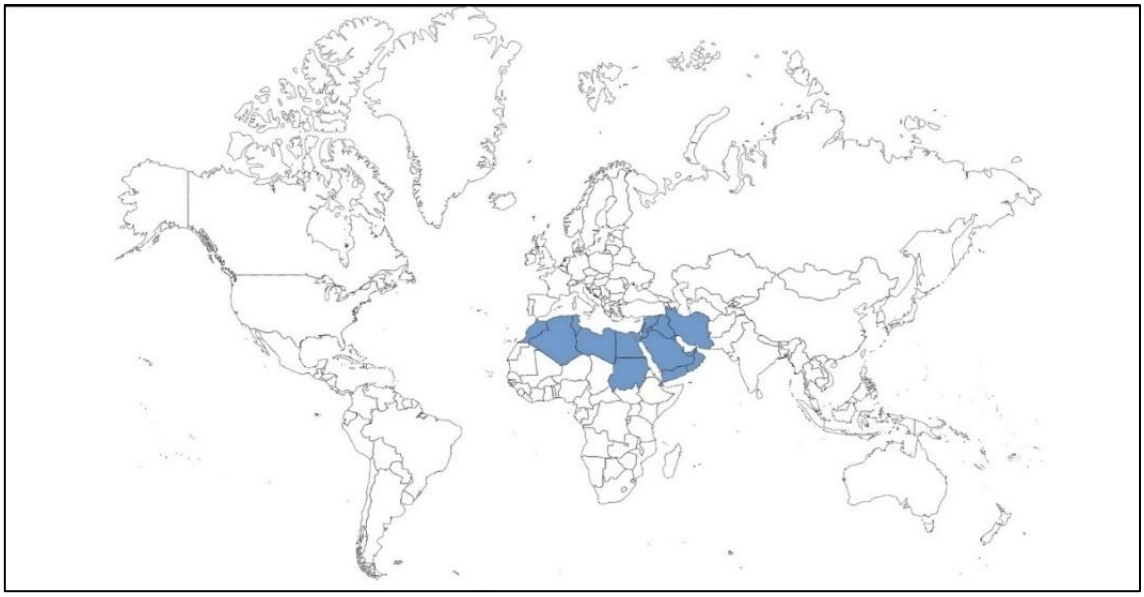


Figure 3.2: MENA Region World Map
Source: (AMCHARTS, 2021)

Despite the potential, several challenges hinder effective KT/TT-UIC in the MENA region. Overcoming these obstacles and leveraging supportive government initiatives and international collaborations could pave the way for successful case studies and best practices. Additionally, understanding the societal factors influencing UIC environments is essential for enhancing these collaborations in the region. The MENA region's promising prospects and recommendations for strengthening UIC are vital to unlocking its potential as an emerging hub for innovation and economic growth.

#### 3.5.2.2 Rational for Selecting the MENA Region

The selection of the MENA region countries, as identified by The World Bank (2021), is grounded in identifying and addressing apparent gaps in the literature concerning examining the UIC phenomenon. Despite the MENA region's emergence as a more robust economic force with an increasing emphasis on knowledge-based activities, research focusing specifically on UIC remains scarce. Studies such as those by Al-Mansoori and Koc (2019); Elyoussoufi Attou (2019); Sultan (2020) suggest that the level of UIC has been relatively low. This systematic review bridges these gaps to delve deeper into the UIC phenomenon within the MENA region, highlighting the critical need for focused research in this under-explored geographical context.

#### 3.5.2.3 Review Design and Search Strategies - MENA

To bridge the existing gap in the literature, a systematic literature review of the KT/TT-UIC in the MENA region is conducted by adhering to the principles and process outlined by Tranfield, Denyer, and Smart (2003). This review aims to identify and synthesise current themes and future avenues in KT/TT-UIC literature over the last two decades that were published starting from 2000 till mid-2021. These findings then help better understand the nature of the KT/TT-UIC in the region broadly and in the context of Saudi Arabian particularity.

This systematic literature review focused on the UIC context in the MENA region countries to identify the current research themes and future avenues. This systematic literature review followed the three phases process demonstrated by Tranfield, Denyer, and Smart (2003), which were also adopted by Perkmann et al. (2013) and de Wit-de Vries et al. (2019) in their major systematic reviews in the related UIC field. The three phases were the data identification phase, data extraction phase, and data analysis and dissemination phase.

**Database Searching:** Multiple search iterations were applied in the selected databases, namely Elsevier's Scopus, Clarivate's Web of Science Core, including (Social Sciences Citation Index (SSCI) and Emerging Sources Citation Index (ESCI)), EBSCOhost including (Business Source Complete database and EconLit database), and Google Scholar. The following search boundaries were applied to filter the initial results: only peer-reviewed journal articles, the timeframe ranged from 2000 to mid-2021, and the language was English. A variety of sets of Boolean search strings were applied through articles' title, abstract, and keywords by using (AND/OR operators) by combining the following search terms: (universit* OR academ* OR research*), (industr* OR business* OR firm* OR privat* OR enterprise*), knowledge-based economy, knowledge transfer*, technology transfer*, (university* industry*), (university* industry* government*), triple helix*, and quadruple helix*. Search terms were then combined separately by each of the following terms to make sure that all related results were covered, "MENA", middle* east* and north* Africa*, Algeria*, Bahrain*, Djibouti*, Egypt*, Iran*, Iraq*, Jordan*, Kuwait*, Lebanon*, Libya*, Morocco*, Oman*, Qatar*, (Saudi Arabia* OR "KSA"), Sudan*, Syria*, Tunisia*, (United Arab Emirates* OR "UAE"), (Palestine* OR "West Bank and Gaza"), and Yemen*. Endnote X9.2 was used as reference management software to organise the results. In this first phase, a total of 827 papers were retrieved. It is worth mentioning that, regarding Google Scholar, similar search strategies were applied through articles' titles only to narrow the findings. Google Scholar was used to trace journals that might not be indexed by well-known reliable databases, such as Scopus. A total of 360 papers were retrieved from Google Scholars.
**Removal of Duplication:** Search boundaries that include language, document type, and journals' scholar status were manually double-checked in each record. It is noted that some articles appeared in search results because their abstracts were published in English. Still, the original papers were written in other languages, such as Persian, French, or Arabic. Also, most of those papers were either published in non-scientific sources or in local scientific journals that have not been scholarly indexed. Thus, 274 records of the Google Scholar results were removed.

**Screening of Records:** Then, 198 articles that were duplicated among databases were removed. By removing (198) duplications and (274) articles from Google Scholar, 355 papers resulted after the first phase, as shown in Figure 3.3. In the second phase, results were evaluated by scanning title and abstract sections based on the inclusion and exclusion criteria in line with the research aims. In some cases, the introduction and conclusion sections were also scanned. The inclusion criteria were that selected papers should mainly focus on UIC matters and/or discuss knowledge-based activities, including KT/TT, which should be associated with the UIC context. Therefore, the exclusion was applied in some instances as follows: studies that discussed other educational institutions like public schools, other than universities or higher education institutions in terms of academic collaborations, studies that examined academic collaboration without involving other external actors, such as the private sector or government, studies that focused only on one stakeholder's aspects, (e.g. academics' careers or productivities, or firms' innovation performance) without associating that with the UIC context, or studies that only discussed the KBE without relating that to UIC context. By employing inclusion and exclusion criteria, 66 papers resulted.

**Assessment for Eligibility:** Furthermore, according to Tranfield, Denyer, and Smart (2003), the 'quality assessment' criteria of the 'management research' was applied by evaluating the fit between research objectives or questions and applied methodology. Subsequently, a complete reading of those 66 papers was conducted, narrowing the relevant research papers to 60. Figure 3.3 presents the systematic review records.

MS Excel 2016 software was used to collate the data extraction and analyse and synthesise findings based on the research aims to reduce human error and bias.

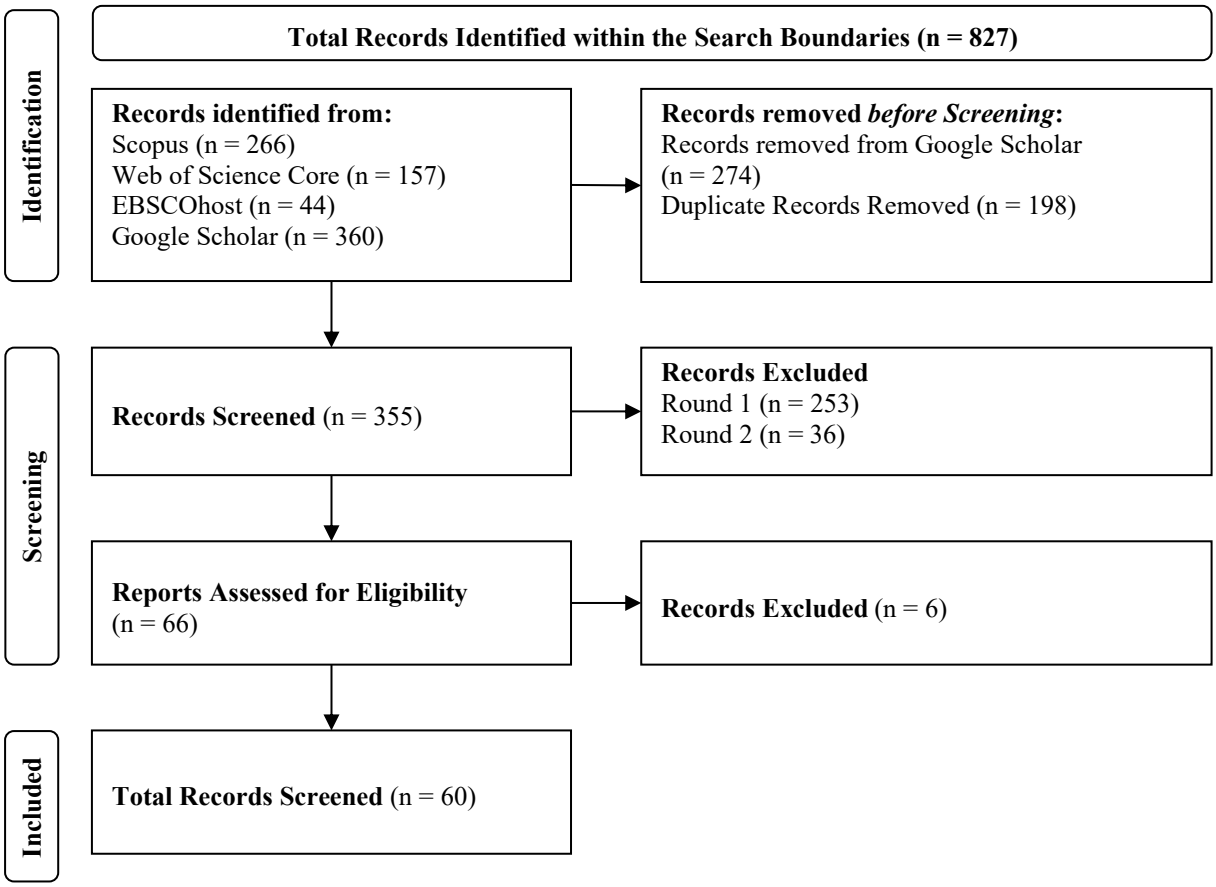



Figure 3.3: The Diagram Illustrating the Systematic Review Selection Process

### 3.5.3 Systematic Literature Review (2)- Theoretical: Investigating the SC-UIC

This systematic review utilises the theoretical framework of SC to enhance understanding and inform research on UIC. It focuses on several key objectives: examining state of the art in literature reviews related to SC-UIC, identifying current research themes, analysing the methods and categories of participants used in SC-UIC studies, and assessing the theoretical contributions of SC-UIC. This concise approach aims to clarify the existing landscape and deepen the academic dialogue around SC and UIC interactions.

#### 3.5.3.1 Theoretical Foundations of SC: An Overview

Detailed explanations regarding this section are provided in Chapter 2 (Section 2.5) of this thesis.

#### 3.5.3.2 Rational for Selecting SC Theory

In the context of IS research, SC theory is often used to understand how the use of information and communication technologies can affect the social relationships within and between organisations and how these technologies can facilitate or hinder the development and maintenance of such relationships (Eklinder-Frick, Eriksson & Hallén, 2012; Al-Tabbaa & Ankrah, 2019). In the context of the UIC setting, SC theory plays a significant role, encompassing the network itself and the potential tangible and intangible resources that can be mobilised through that network. Economic and innovative clusters, known as regional strategic networks, can effectively share knowledge to the extent they possess shared SC (Eklinder-Frick, Eriksson & Hallén, 2012). SC, as a collection of resources embedded in the relationships among social actors, constitutes a valuable asset that yields benefits at **both the individual and organisational levels. Positive effects can be observed in various aspects, including** interpersonal knowledge-sharing and access to diverse sources of information (Adler & Kwon, 2002). Furthermore, inconsistency in the application of social capital dimensions across various contexts and regions, along with a lack of research (de Wit-de Vries et al., 2019), has been documented by Robertson, McCarthy, and Pitt (2019).

#### 3.5.3.3 Review Design and Search Strategies

A systematic literature review was conducted on how the SC theory has been addressed and its dimensions in the standard UIC that involves universities and the industry (in particular with the private sector organisations, which are more prevalent in this context). This literature covered the two decades starting from 2000 till mid-2021. Through the lens of SC theory and following the principles and process of systematic reviews by Tranfield, Denyer, and Smart (2003), the extant research on KT/TT-UIC was explored in the UIC context. The systematic literature review conducted here is similar to major previous 'systematic review studies' in the UIC setting (Perkmann et al., 2013; Ankrah & Al-Tabbaa, 2015; de Wit-de Vries et al., 2019; Pereira & Franco, 2021). **This section was also discussed in Hakami, Pradhan & Mastio (2022a), as follows:**

**Database Searching:** Multiple iterations of searching through selected databases and publishers were applied. The initial search was done via well-known databases and peer-reviewed journals mentioned in the related studies in the UIC setting, EBSCOhost, Scopus, ProQuest, Web of Science, Emerald, ScienceDirect, and Taylor & Francis. The following search boundaries were applied to filter the initial results: only peer-reviewed studies, the timeframe is over two decades from 2000 to 2021 (present), the language is English, and only research papers type of scholarly journals and conference papers, while other document types were omitted.

Search terms were 'social capital', 'universit* OR academ* OR public*', 'industr* OR business* OR firm* OR privat*', and 'collaborat* OR cooperat* OR engag* OR organi* OR link* OR relat* OR research* OR partner*'. Multiple combinations of Boolean search strings were applied through title, abstract and keywords. Additional terms involving SC's factors, such as trust, etc., were also used through the abstract to ensure that all cases were covered; however, in many cases, it revealed studies that did not specifically apply SC theory. It is also noted that

‘public*’ and ‘privat*’ search terms did produce wide general public and private sectors studies that were not in the UIC setting. Taking into consideration the shared articles among databases, around 39% of the results were extracted from the Scopus database, 27% from ProQuest, 22% from Web of Science, 10% from EBSCOhost, and 2% of the results were distributed among the rest of the sources. By applying boundaries and search terms, a total of 707 papers were retrieved.

**Removal of Duplication:** After removing the duplication in each database individually, combining all results, and eliminating duplicates, 363 papers remained. Figure 3.4 summarises the systematic review protocol. Endnote X9.2 was the reference management software that was used.

**Screening of Records:** Results were evaluated by scanning the title and abstract based on the inclusion and exclusion criteria in line with the systematic review aim and themes. In some cases, the introduction and conclusion sections were also scanned. The first inclusion criterion was that direct or standard UIC should be the core focus. So, as the focus was only on the university and the private sector stakeholders, papers that involved other external stakeholders were excluded, such as studies that discussed the ‘triple-helix’ or ‘quadruple-helix’ models, studies that included a third party or ‘boundary spanning’ and intermediaries entities, and studies that explored only independent public research centres outside universities; however, studies that discussed research centres besides universities were included. Moreover, exclusion was also applied to the studies that examined other educational institutions, like public schools, other than universities in terms of academic partnership and studies that addressed partnerships between two or more universities without focusing on the private sector. Finally, studies that addressed only a single stakeholder's perspective (e.g., academics’ careers, productivity) without explicitly linking these aspects to the UIC context were excluded, as they did not align with the objectives of this review. However, studies that clearly demonstrated the actual influence on UIC were included.

The second inclusion criterion was that SC should be explicitly examined, in which papers that only mentioned SC without reviewing it or studied some SC’s factor, e.g. trust, commitment, etc., without explicitly indicating SC as a theoretical paradigm were excluded. Also, studies that verbalised SC as one construct formed by its three main dimensions without identifying factors were included only if they met the inclusion criteria. Furthermore, studies of entrepreneurialism’s characteristics outside the UIC context were excluded. Finally, studies that focused broadly on the science and technology park without relating to the UIC context were excluded; however, only one paper that studied the direct UIC within the science park was included as it met the inclusion criteria.

Furthermore, according to Tranfield, Denyer, and Smart (2003, p. 216), the ‘quality assessment’ criteria of the ‘management research’ were applied by evaluating the fit between the studies’ objectives or research questions and the studies’ applied methodology. After this second step of filtering, 84 papers remained.

**Assessment for Eligibility:** A complete reading of those 84 papers was conducted, further narrowing the relevant research papers to 23. Figure 3.4 presents the conducted process of selecting the systematic review studies.

MS Excel 2016 software was used to collate the data extraction and to analyse and synthesise findings based on the research questions to reduce human error and bias. The data extraction sheet was organised as follows: title, author’s name, year of publication, main aim or research questions, research methods, research sample (numbers, participants’ category), UIC’s mechanisms or activities, country, source (name, type), document type, database/

publisher's name, SC's level of analysis, SC's dimensions (structural, relational, and cognitive) and SC's factors, other constructs, outcome, and additional theories (if any).

To summarise this systematic review protocol, the chosen electronic sources included EBSCOhost, Scopus, ProQuest, Web of Science, Emerald, ScienceDirect, and Taylor & Francis. The initial search boundaries consisted of only peer-reviewed papers, a time frame of 2000 - 2021, the requirement for the English language, the source type of scholarly journals and proceedings, and the document type of research papers, including journal articles and conference papers. The search terms were social capital, universit* OR academ* OR public*, industr* OR business* OR firm* OR privat*, collaborat* OR cooperat* OR engag* OR organi* OR link* OR relat* OR research* OR partner*. The inclusion criteria encompassed the exclusive focus on the UIC context, the explicit examination or mention of the SC theory, and/or the exploration of the direct link between the university and the private sector. Finally, the exclusion criteria comprised the involvement of external actors such as the government leading the partnership, the exploration of a third party like an intermediary between actors, the examination of certain factors like trust without explicitly mentioning the SC theory, and/or the exclusive focus on one side's aspects such as academics' career.

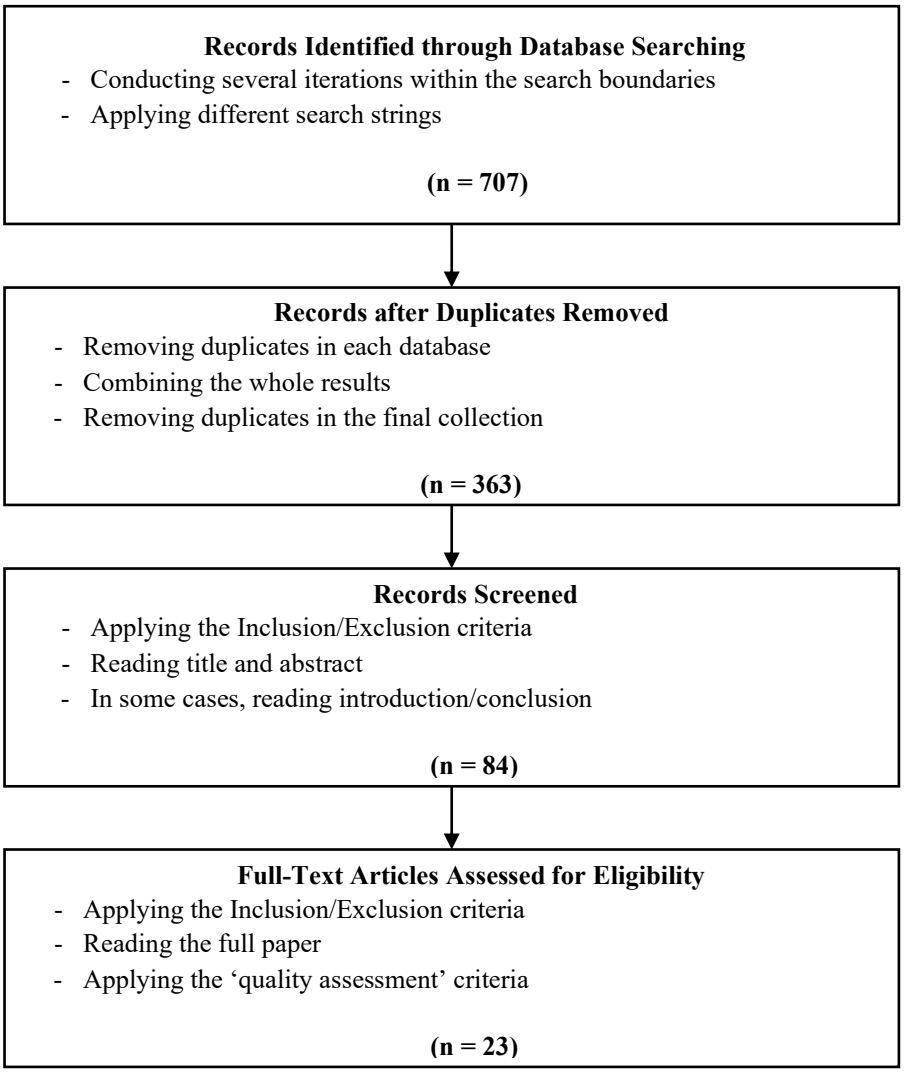



Figure 3.4: The Diagram Illustrating the Systematic Review Selection Process

## 3.6 THE PRIMARY DATA COLLECTION METHODS

To apply the insights gained from both general and systematic literature reviews, primary data collection was undertaken through semi-structured interviews and focus group discussions conducted across various phases of the DSR approach with key stakeholders in Saudi Arabia, a significant contributor and leading country within the MENA region. This method was selected to address the diverse challenges and obstacles in the UIC setting and knowledge-based activities, particularly those arising from the prevalence of teaching-focused universities. Despite active efforts to enhance these inter-organisational relationships, engagement levels in UIC activities still need to improve.

This thorough analysis identifies and evaluates the factors that support or hinder effective collaboration within the UIC ecosystem. Integrating perspectives from universities, industries, and intermediary stakeholders provides a deeper understanding of the factors shaping such collaborations. Moreover, this enhanced understanding plays a crucial role in developing and assessing the IT artifact produced here.

### 3.6.1 The Primary Data Collection Setting (the Saudi Arabian Context)

Drawing on the secondary data collection insights, primary data collection is conducted within the Saudi Arabian context to gain deeper insights within the UIC setting. Research and development (R&D) are essential to sustainable economic growth. In the Saudi Arabian context, KT/TT-UIC is one of the significant R&D ecosystem pillars in line with the national priorities for innovative research, including the health sector, environmental sustainability, energy and manufacturing, and emerging technologies (Ministry of Education, 2024). The Ministry of Education, in particular, undertakes many R&D initiatives to fulfil the short-/long-term national goals embodied in the Saudi Vision 2030 (2016), where it aspires to rank the country among the top 10 countries worldwide and to rank at least 5 Saudi universities among the top 200 universities in the world (Ministry of Education, 2024). Concerning higher education, there are around 70 higher education institutions in Saudi Arabia. Recently, a novel model for an ‘in-house’ intermediary organisation ‘affiliated with’ the university has emerged at some public universities, with a promising added value to bridge the gaps between university and industry. By doing so, the intermediaries’ long-term goal is to make an additional revenue stream for universities and help deliver economic opportunities of national and global value in all sectors. The intermediary (in this Saudi Arabian context) is a wholly owned subsidiary organisation of its affiliation university, comprising members from the university (academic) and industry (non-academic) on its board of directors. These in-house intermediaries aim to integrate with the university to advance the development of the kingdom's innovation towards building a knowledge-based economy through diversified investments and KT/TT-UIC activities.

### 3.6.2 Expert Interviews

In this study, expert interviews are utilised as one of the primary methods for data collection, with the process being iteratively conducted across the different phases of the DSR. An expert interview is a qualitative research tool that gathers in-depth insights and specialised knowledge from recognised authorities in a specific field (Gray, 2018). This method is essential for research as it provides direct access to firsthand information about a topic or organisation, helps validate theories, and refines strategic initiatives. Additionally, it employs a semi-structured

interview format, which is particularly effective for capturing a wide range of participant perspectives, feelings, and experiences related to the investigated phenomenon by balancing structure and flexibility. The term 'experts' refers to those who hold professional positions in their organisations to provide qualified knowledge and experience in the relevant professional disciplines (Bogner, Littig & Menz, 2009). Semi-structured expert interviews, in particular, allow the interviewer to adjust questions based on the interviewees' responses, which would further enrich findings and enable new themes to emerge (Gray, 2018). This qualitative study explores the perspectives of multiple stakeholders on the UIC setting, a still-developing phenomenon in Saudi Arabia.

#### 3.6.2.1 Rationale for Choosing Expert Interviews- The Interview Design

Due to the emerging nature of this research topic (KT/TT-UIC), this study adopted the interpretive approach and the qualitative research method to explore this phenomenon. Regarding research paradigms in the IS field (Orlikowski & Baroudi, 1991; Klein & Myers, 1999), the interpretive approach focuses on exploring and understanding the "how" of the research phenomenon by investigating participants' perspectives and experiences. That contrasts with the positivist approach, where hypotheses are tested with quantifiable measures of variables to examine such a phenomenon. Additionally, qualitative research seeks to understand particular situations and contexts by exploring participants' perspectives and behaviour within such a context, i.e. their lived experience (Kaplan & Maxwell, 2005; Creswell & Creswell, 2018).

#### 3.6.2.2 Empirical Interview Data Sampling

A purposive sampling technique was applied to recruit the most suitable experts from selected universities and their in-house intermediaries, followed by a snowballing sampling technique to recruit experts from the industry who have collaborated with those universities (Bernard, 2017). The sample size was decided by saturation criteria, in which a total of 40 experts: 19, 13, and 8 participants were recruited from university, industry, and intermediary organisations, respectively.

#### 3.6.2.3 Empirical Interview Data Collection

Data was collected by interviewing participants with experientially privileged knowledge of the KT/TT-UIC context. Participants were classified into three expert categories, as follows:

(i) University **(U)** experts (academics) who are PhD holders and are working in leading positions at university entities, such as research institutions and consulting studies, centres for innovation and entrepreneurship, intellectual property offices, centres of research excellence, and expertise offices, selected from five public universities across Saudi Arabia

(ii) Industry **(I)** experts (non-academics) who are in managerial level positions across public, private, and non-for-profit sectors and have been involved in the KT/TT-UIC activities, selected from several industries, such as technology, education, health, and management consulting etc.

(iii) Intermediary **(M)** experts who are either academics or non-academics working together in managerial-level positions at the in-house intermediary organisations.

The selected organisations' and participants' identities were concealed by pseudonymising them, as shown in Table 3.3. The assigned code was a combination of a letter that identifies the professional category of the participants (U, I, and M) followed by a number that represents the chronology of the conducted interview.

All participants were interviewed online during the COVID-19 restrictions and post-lockdown period, primarily through video conferences such as Zoom. Throughout the DSR process, multiple subject matter domain experts are engaged via a structured series of interviews to explore and evaluate the proposed intermediary. These interviews spanned from June 2021 to June 2022, with follow-up interviews planned to continue until June 2024 to fulfil various research objectives. Detailed descriptions of each interview stage are provided in subsequent chapters. The same protocol was followed in all interviews using open-ended questions, while the questions differed based on the interview purposes. Most interviews lasted approximately 45 minutes and were audio-recorded with the participant's permission.

The interview methodology unfolds in several distinct stages:

(i) **Initial exploratory semi-structured expert interviews:** These are designed to collect qualitative empirical data and investigate the inter-organisational factors that serve as drivers and barriers to KT/TT activities within the UIC setting; further *details are provided in Chapter 4- DSR phase (1).*

(ii) **Follow-up semi-structured interviews (Ex-ante Formative Evaluation):** These interviews aim to derive DRs by further analysing empirical data on the drivers and barriers experienced within the UIC setting, which then assists in formulating DPs for the platform. This tool guides development early when knowledge is limited; additional details are provided in Chapter 5 - DSR Phase (2).

(iii) **Follow-up semi-structured interviews (Ex-post Summative Evaluation):** These interviews are centred on a rigorous evaluation of the artifacts' effectiveness, where the platform's proposed design is instantiated as an artifact. This ensures that it addresses the outlined problems DRs and achieves the expected benefits DPs. This tool tests hypotheses and assesses results after completion; further details are provided in Chapter 7 - DSR Phase (4).

Moreover, various research activities were employed, utilising different communication methods, such as phone calls and direct messaging, based on participants' preferences and logistical requirements. This approach ensured the accuracy of information, facilitated meaningful discussions, and promptly addressed any misunderstandings that may have arisen. These measures strengthened the research process, enhancing the findings' trustworthiness and validity. Additionally, further informal data collection was undertaken gradually to explore the nature of the KT/TT-UIC activities in Saudi Arabia, including publicly available information on selected organisations' websites, news, and annual reports.

Table 3.3: A List of Participants with their Roles in Organisations

| Participants' category | Identifier | The role of participants in their organisations |
|---|---|---|
| University expert (1) | U-1 | University Expertise Offices- Director |
| University expert (2) | U-2 | Institute of Research & Consulting Studies- Vice-Dean |
| University expert (3) | U-3 | Centre of Research Excellence- Director |

| Participants' category | Identifier | The role of participants in their organisations |
|---|---|---|
| University expert (4) | U-4 | Centre of Research Excellence- Director |
| University expert (5) | U-5 | Institute of Research & Consulting Studies- Vice-Dean |
| University expert (6) | U-6 | Intellectual Property Office- Director |
| University expert (7) | U-7 | Institute of Research & Consulting Studies- Dean |
| University expert (8) | U-8 | Centre for innovation and entrepreneurship- Vice-Dean |
| University expert (9) | U-9 | Institute of Research & Consulting Studies- Vice-Dean |
| University expert (10) | U-10 | Institute of Research & Consulting Studies- Vice-Dean |
| University expert (11) | U-11 | Institute of Research & Consulting Studies- Dean |
| University expert (12) | U-12 | Institute of Research & Consulting Studies- Dean |
| University expert (13) | U-13 | Centre for innovation and entrepreneurship- Dean |
| University expert (14) | U-14 | Institute of Research & Consulting Studies- Dean |
| University expert (15) | U-15 | Institute of Research & Consulting Studies- Dean |
| University expert (16) | U-16 | Institute of Research & Consulting Studies- Dean |
| University expert (17) | U-17 | Institute of Research & Consulting Studies- Vice-Dean |
| University expert (18) | U-18 | University Expertise Offices- Director |
| University expert (19) | U-19 | Centre of Research Excellence- Director |
| Industry expert (1) | I-1 | Private Sector- Manufacturing/Health Industry- CEO |
| Industry expert (2) | I-2 | Private Sector- Technology Industry- CEO |
| Industry expert (3) | I-3 | Private Sector- Technology/Training Industry- CEO |
| Industry expert (4) | I-4 | Private Sector- Technology Industry- CEO |
| Industry expert (5) | I-5 | Non-Profit Sector- Education Industry- Partnerships Manager |
| Industry expert (6) | I-6 | Private/Semi-Government Sector- Technology Industry- Director |
| Industry expert (7) | I-7 | Private Sector- Technology Industry- Manager |
| Industry expert (8) | I-8 | Private Sector- Management Consulting/Marketing Industry- CEO |
| Industry expert (9) | I-9 | Private Sector- Media and Production/Training Industry- CEO |
| Industry expert (10) | I-10 | Private Sector- Agriculture Industry- CEO |
| Industry expert (11) | I-11 | Government/Semi-Government Sector- Recruiting Industry- Director |
| Industry expert (12) | I-12 | Private Sector- Management Consulting Industry- Manager |
| Industry expert (13) | I-13 | Government/Semi-Government Sector- Engineering Industry- CEO |
| Intermediary expert (1) | M-1 | Intermediary Organisation- CEO |
| Intermediary expert (2) | M-2 | Intermediary Organisation- Director |
| Intermediary expert (3) | M-3 | Intermediary Organisation- CEO |
| Intermediary expert (4) | M-4 | Intermediary Organisation- Director |
| Intermediary expert (5) | M-5 | Intermediary Organisation- CEO |
| Intermediary expert (6) | M-6 | Intermediary Organisation- Manager |
| Intermediary expert (7) | M-7 | Intermediary Organisation- CEO |
| Intermediary expert (8) | M-8 | Intermediary Organisation- CEO |

#### 3.6.2.4 Empirical Interview Data Analysis

The interview data results were analysed using the thematic analysis approach proposed by Braun and Clarke (2006). This approach has been widely adopted to identify, analyse and then report emergent themes within the investigated data by following the six-stage guideline, namely "familiarising yourself with your data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report" (Braun & Clarke, 2006, p. 87).

To better understand the thematic analysis approach, the following summary outlines its stages:

- Stage 1- Familiarising yourself with your data: researchers immerse themselves in the data, which may involve transcribing interviews or other data forms, repeatedly reading through the material to gain a deep understanding and identifying initial patterns or themes.
- Stage 2- Generating initial codes: it involves systematically identifying and marking relevant features within the data, organising these into initial codes, and gathering related data under each code.
- Stage 3- Searching for themes: researchers start to collate the established codes into overarching themes, compiling all the data that pertains to each emerging theme.
- Stage 4- Reviewing themes: researchers review the themes to ensure they accurately reflect the coded data and the broader dataset. This process may include adjusting the themes and creating a thematic map to visualise relationships and patterns.
- Stage 5- Defining and naming themes: this involves a detailed analysis to refine each theme, ensuring they represent the dataset's narrative. Researchers work on defining and naming the themes, focusing on clarity and relevance.
- Stage 6- Producing the report: it entails synthesising the analysis into a structured report. Researchers select key examples highlighting the themes, analyse these extracts in-depth, and discuss how the findings relate to the research question and the existing literature.

MAXQDA software was used to manage, code, analyse and cluster the data. The collected data were transcribed verbatim into the original language (Arabic). Even though all interviewees were experts in their fields and bilinguals, the decision to let them speak in their native language allowed free and open expressions of their perspectives without facing any language barriers (Littig & Pöchhacker, 2014). Consequently, transcripts were kept in the original interviewees' words and expressions to grasp in-depth implications during the data analysis process (the interviewer's mother tongue is Arabic and is also fluent in Arabic). After reading and re-reading transcripts, all interview data were carefully coded and categorised into relevant themes. All authors engaged in discussions regarding the data analysis process to avoid biases. Furthermore, all authors participated in further discussions regarding the emerging themes and coding. As a next step, specific sections of the transcripts were professionally translated into English to provide supporting quotes.

During the DSR process within a UIC setting, iterative expert interviews are conducted as needed across various phases. These interviews aim to deeply explore specific areas, gain profound insights, and gather comprehensive

expert perspectives. Their iterative nature helps develop a rich, multifaceted understanding of the subject matter, incorporating diverse viewpoints and extensive expertise.

Initially, exploratory semi-structured interviews aim to examine and identify specific phenomena in the UIC context, (during DSR Phase 1). These interviews delve into understanding the underlying issues, identifying areas for improvement, and gathering detailed insights into the factors that influence such collaborations within the UIC setting. Subsequent follow-up expert interviews critically analyse the proposed solution and its alignment with the identified needs and requirements (held in DSR Phase 2). Finally, (in DSR Phase 4), these follow-up interviews thoroughly gather expert feedback to assess and evaluate the suggested solutions instantiated in the artifacts, ensuring they effectively address the identified phenomena.

Accordingly, to enhance the analysis, thematic analysis was employed using the Gioia Methodology developed by Gioia, Corley, and Hamilton (2013). This approach helped further identify and define potential themes through the lens of SC theory, deepening the understanding of the data.

### 3.6.3 Focus Group

The focus group method has been used in marketing and business communications research for decades, particularly in studies of consumer attitudes, perceptions, and opinions (i.e., to study what people think and feel) (Krueger, 1988; Stewart, Shamdasani & Rook, 2007). In a focus group, as a qualitative data-gathering technique, several people are brought together for a collaborative planned discussion to explore specific topics of interest in a friendly setting. Numerous researchers have provided detailed descriptions of this method (Krueger, 1988; Stewart, Shamdasani & Rook, 2007), and IS research as well (Kaplan & Maxwell, 2005; Tremblay et al., 2010; Belanger, 2012; Henriques & O'Neill, 2023). This process reveals shared ideas, reactions, and opinions that may not emerge in individual interviews. Thus, the benefit of focus group research lies in how participants' interactions influence each other and may shape the researcher's interpretation, leading to solid contributions to the investigated topic. Focus groups offer unique advantages, providing a concentrated set of interactions and rich contextual information about participants' responses (Krueger, 1988), and particularly valuable in several critical scenarios, such as studying phenomena that emerge from group interactions, developing theoretical models of phenomena, conducting exploratory research on emerging or understudied topics, exploring group interactions, developing theoretical models of phenomena, and gaining contextual insights into complex IS issues.

Focus groups use skilled moderators to facilitate discussion, ensuring all participants contribute effectively. Participants are selected for their expertise to enrich discussions. Sessions are recorded and transcribed for analysis with qualitative methods to identify key insights to gain a deep understanding of the topic from diverse perspectives (Krueger, 1988; Stewart, Shamdasani & Rook, 2007; Burgess, 2010; Tremblay et al., 2010; Henriques & O'Neill, 2023). According to Morgan (1996, p. 130), focus groups as a qualitative collection method can be defined as: "a research technique that collects data through group interaction on a topic determined by the researcher." Morgan further elaborates on this definition, highlighting its key components: "First, it clearly states that focus groups are a research method devoted to data collection. Second, it locates the interaction in a group discussion as the data source. Third, it acknowledges the researcher's active role in creating the group discussion for data collection purposes."

#### 3.6.3.1 Rationale for Choosing Focus Group- The Focus Group Design

Focus groups are an effective data collection method and primary research tool. This technique is proper for exploratory purposes as a naturalistic formative ex-ante evaluation tool *(details are provided in Section 7.1)* when knowledge about a phenomenon is limited. Additionally, it acts as a confirmatory tool to test hypotheses and evaluate artifacts, serving as a naturalistic summative ex-post evaluation tool. The interactive nature of focus groups allows participants to both influence and be influenced, enhancing the depth and quality of the data collected (Hevner & Chatterjee, 2010; Venable, Pries-Heje & Baskerville, 2016).

Focus groups are an integral method in the evaluation phase of DSR studies within the IS field, particularly for evaluation purposes. They serve dual roles: initially, (i) as a naturalistic formative ex-ante evaluation tool when preliminary knowledge is limited, and subsequently (ii) as a summative ex-post evaluation tool for hypothesis testing and artifact assessment (Hevner & Chatterjee, 2010; Venable, Pries-Heje & Baskerville, 2016), *(details are provided in Section 7.1)*. The interactive setup of focus groups facilitates in-depth, qualitative feedback, aligning perfectly with the iterative nature of the DSR cycle. This dynamic exchange allows for real-time insights and rich data collection, essential for refining and optimising artifacts based on user interactions and feedback (Burgess, 2010).

Combining this interactive tool with an additional method for written feedback enhances the evaluation process. A feedback questionnaire (qualitative) tool is also added to further enrich the collection of participant responses. This combination not only strengthens the insights gathered but also allows participants to provide further detailed feedback at their own pace, which can reveal more detailed and specific points that might not emerge during group discussions (Venable, Pries-Heje & Baskerville, 2012). Therefore, focus groups align well with the study objectives by facilitating a thorough examination of how theoretical constructs function in practical scenarios. This approach ensures that the solutions developed are innovative and meet user needs and expectations effectively.

#### 3.6.3.2 Empirical Focus Group Data Sampling

In the focus group method, participants are selected from the original pool of experts. These experts were initially recruited for the expert interviews using purposive and snowball sampling techniques within the UIC ecosystem. They were selected for their relevance and deep understanding of the context. From this group, experts who expressed their willingness to continue their involvement were recruited again for the focus group activity to ensure their sustained commitment to contributing to the objectives and providing valuable insights.

#### 3.6.3.3 Empirical Focus Group Data Collection and Data Analysis

The utilisation of focus groups follows a structured process as outlined by Stewart, Shamdasani, and Rook (2007). This process includes five essential stages: defining the problem, identifying suitable participants, preparing the moderator discussion guide, conducting the focus group, and performing analysis and interpretation of the data gathered. Each stage plays a crucial role in ensuring the effectiveness and reliability of the focus group as a research method.

The focus group's primary objective is to rigorously assess the effectiveness of a proposed solution instantiated as an IT artifact (Venable, Pries-Heje & Baskerville, 2012, 2016). This ex-post summative evaluation serves dual purposes: firstly, to verify that the IT artifact addresses the specified DRs and achieves the expected DPs, grounded in a reusability evaluation framework (Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021), which has been expanded to 10 descriptive questions, as detailed in Chapter 7. Secondly, it evaluates the design framework itself and user interfaces, providing insights into its consistency and utility (Hevner et al., 2004; Prat, Wattiau & Akoka, 2014), with an extended focus on assessing the alignment of the IS artifact within the UIC setting.

Depending on the research objectives, the focus group approach can be either exploratory or confirmatory in nature (Hevner & Chatterjee, 2010). An exploratory focus group is recommended when the design artifact aims to refine or improve the design. On the contrary, a confirmatory focus group should be employed when the goal is to validate the utility of the design artifact. In the current study context, the focus group is used in a confirmatory scope, as one of the evaluation objectives is to validate the reusability of the DPs in practice.

Furthermore, given the specific aims a single mini-focus group format was selected over the traditional focus group size of 10-12 participants (Krueger, 1988; Hevner & Chatterjee, 2010). This single mini-focus group, typically comprising 6-8 participants, facilitates more in-depth and concentrated discussions, which aligns well with the confirmatory nature of the evaluation (Hevner & Chatterjee, 2010; Ramakrishnan et al., 2023). Accordingly, this study employs a single mini-focus group (n= 6) to ensure the discussions are both focused and manageable.

The data collection process begins with sending invitations to a pre-selected pool of 40 experts initially involved in expert interviews. This step formalises their continued involvement and determines their availability and interest in the focus group. Of these, 15 are chosen based on their more profound engagement readiness, with 6 forming one online focus group session.

The remaining 9 participants, who prefer a one-on-one discussion, participated in additional individual expert interviews conducted via Zoom. This flexible approach accommodates varying schedules and preferences, enriching the evaluation with expert insights. However, 3 of these nine experts, facing scheduling conflicts that prevent them from attending the ZOOM meetings, choose an alternative communication method. They participated by engaging with the prototype via interactive online chatting platforms and subsequently provided their feedback through a feedback questionnaire (qualitative).

The focus group session is initiated with a comprehensive demonstration of the IT artifact, followed by a Q&A session. Subsequently, participants are asked to evaluate the artifact's reusability and the design framework's consistency using an online anonymous feedback questionnaire (qualitative). This tool is designed not as a quantitative tool but to facilitate individual reflection and sharing of collective insights, which precedes group discussion. All sessions are first recorded with participants' permission and then transcribed. To analyse the focus group discussion qualitatively, focused on two evaluation objectives, all criteria are discussed, and findings are collectively analysed along with feedback from an online questionnaire (qualitative).

The discussion-based technique addresses each criterion for a detailed examination of the findings. The analysis addresses areas of agreement and disagreement within the UIC ecosystem about the artifact in use. It also identifies opportunities for further improvement to provide a comprehensive evaluation that meets defined goals. This is

especially beneficial and practical due to the scarcity of research and knowledge about digital platform intermediaries within the UIC context. Therefore, this structured approach to data collection and analysis via focus groups adheres to established methodological frameworks and also integrates flexibility adapted to the specific needs and contexts of IT artifact evaluation for both rigour and relevance in research findings (Stewart, Shamdasani & Rook, 2007; Venable, Pries-Heje & Baskerville, 2016). *Further explanatory details on this ex-post evaluation process are elaborated in Chapter 7.*

## 3.7 CHAPTER SUMMARY

Chapter 3, as previously stated, outlines the comprehensive research methodology employed in this study, providing a structured approach to address the research objectives within the context of UIC. The chapter has established the philosophical foundation of the study within the IS field and justified the adoption of the DSR approach. It has detailed the research framework, including problem identification, solution development, and evaluation processes. The chapter has expanded on secondary and primary data collection methods, including general and systematic literature reviews, expert interviews, and focus groups, focusing on the Saudi Arabian context. These methodological choices have been carefully selected to ensure the rigour and reliability of the research process. Therefore, Chapter 3 sets the stage for the subsequent chapters, where these methods will be applied to collect and analyse data, address the identified research gaps, and contribute to enhancing KT/TT-UIC activities. This well-rounded methodology ensures that the findings are based on empirical evidence and theoretical insights to improve both research and practical implementation of UIC in the IS field.

# PART III- RESEARCH FINDINGS & DISCUSSION

## Chapter 4: DSR | Problem Awareness

## Chapter 5: DSR | Solution Suggestion

## Chapter 6: DSR | Development

## Chapter 7: DSR | Evaluation

# 4 DSR | PROBLEM AWARENESS

Chapter 4 serves as the foundational phase of the DSR study, where the primary goal is to enhance understanding and raise awareness of the current phenomena within the UIC setting. This chapter employs empirical methods to delve into the complexities of UIC settings, mainly focusing on identifying the key drivers and barriers within the primary data collection context. Two systematic literature reviews coupled with expert interviews form the strength of the empirical investigation, providing a robust platform for gathering and analysing data. The chapter initiates by presenting descriptive data and distributions from reviewed papers, offering a comprehensive overview of the overall UIC landscape in the MENA region (Section 4.1). This setup provides a broad view of the research themes established in UIC studies within the region, thereby identifying areas that require further exploration and understanding. The subsequent sections delve deeper into contextualising these insights within the MENA context (Section 4.2). Further, the theoretical foundations and the rationale for selecting specific theoretical frameworks of the SC theory are discussed (Section 4.3). These sections start with a general overview of the review context and the rationale for its selection. This is followed by a detailed explanation of the systematic review design and the search strategies employed to gather the relevant literature. Then, the chapter discusses the key findings from the systematic literature review, subdivided into insights regarding descriptive data, significant themes, and an overview of the reviewed papers. These insights add layers to the understanding of UIC, offering a detailed and clear overview of the current situation and key research themes.

The chapter then transitions into a focused examination of the UIC insights within the Saudi Arabian context (Section 4.4), exploring unique regional impacts on UIC activities through subject matter expert interviews. This is followed by a detailed analysis and discussion of the interview data, guided by the SC theory lens, which examines the structural, relational, and cognitive dimensions of such UIC activities (Section 4.5).

The chapter concludes with a summary of the insights and analyses presented, setting the stage for the subsequent DSR phases to enhance such collaboration activities (Section 4.6). This in-depth analysis enriches our understanding of UIC dynamics generally and particularly in the region and establishes a solid foundation of problem awareness that informs and guides the suggested solution phases of the thesis.

## 4.1 GAINING INSIGHTS INTO THE UIC SETTING

*To fully comprehend the UIC setting, it is essential to closely examine its foundational elements and the broader contextual background. These elements provide the necessary framework for understanding its dynamics to offer a deeper insight into how it operates within its specific context. This section refers to the key insights already established in Chapters 2 and Chapter 3.*

## 4.2 CONTEXTUALISING THE UIC INSIGHTS WITHIN THE MENA REGION

Building upon a comprehensive literature review of relevant UIC settings and their associated knowledge-based activities, this section extends the study through a systematic literature review focused on the Middle East and North Africa (MENA) region. The review analyses UIC practices over the past two decades, examining the

dynamics within this specific geographical context. The present review aims to identify and synthesise current themes and future avenues in UIC over the last two decades within this region. The research incorporates a detailed analysis of 60 peer-reviewed scholarly articles and is conducted with the following themes/aspects:

- Examine the main UIC models within the ecosystem.
- Identify mechanisms that currently exist to facilitate UIC.
- Explore the channels currently used for KT and TT.
- Investigate the factors that inhibit UIC.

### 4.2.1 Key Contextual Findings from the Systematic Literature Review- Review Insights: Descriptive Data

This systematic review identified 60 papers that met the inclusion criteria. These papers were published in scholarly peer-reviewed journals and provided valuable insights into the phenomenon of UIC in the MENA region. Figure 4.1 presents the distribution of these papers across different publication years from 2000 to 2021. Notably, the highest number of publications occurred in 2015, with 8 papers. This demonstrates UIC's evolving interest and research activity over the last two decades.

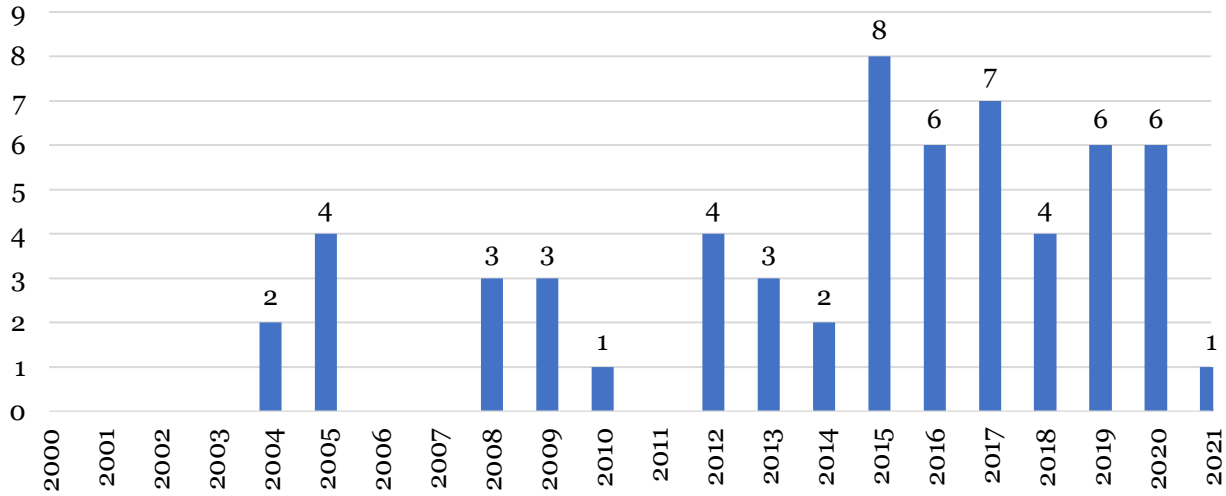



Figure 4.1: Numbers of Papers According to the Publication Year

All the papers selected for inclusion in this systematic review were published in scholarly peer-reviewed journals. The two journals with the highest number of articles included were "*Industry and Higher Education*" and "*International Journal of Technology Management & Sustainable Development*," with each journal featuring four out of the total sixty articles. "*The Journal of Technology Transfer*" followed closely with three articles, while "*Innovation: Management, Policy & Practice*" and "*World Review of Science, Technology and Sustainable Development*" each had two articles included. The remaining forty-five articles were published in various other journals. Among the geographical origins of the papers, the majority (thirteen out of sixty) were from Iran. Notably, there were no publications related to the UIC phenomenon from five countries in the region, namely

Djibouti, Iraq, Kuwait, Syria, and Yemen. Furthermore, the two papers in Table 4.1 provided a broader investigation of the general Arab world within the MENA region.

Table 4.1 classifies the reviewed papers based on the countries within the MENA region where the research or data collection was conducted. The table provides an overview of the distribution of papers across different countries. Iran had the highest number of publications, with a total of 13 papers, indicating a significant research focus on UIC within the country. However, it is worth noting that some countries, such as Djibouti, Iraq, Kuwait, Syria, and Yemen, had no related publications during the reviewed period. Furthermore, Table 4.1 highlights two papers that broadly investigated the UIC phenomenon in the general Arab world within the MENA region. These papers provide a broader perspective and contribute to understanding UIC dynamics beyond individual countries.

Table 4.1: Distribution of Papers Across Different Countries in the MENA Region

| Country | # of Papers | Source/Authors |
|---|---|---|
| Algeria | 5 | Mohammed Saad (2004); Mohammed Saad and Zawdie (2005); Mohammed Saad, Zawdie, and Malairaja (2008); Boutifour, Saad, and Guermat (2015); M. Saad, Datta, and Razak (2017) |
| Arab Countries (MENA) | 2 | Al-Mabrouk and Soar (2009a, 2009b) |
| Bahrain | 1 | AL-Obaidy (2012) |
| Djibouti | 0 | - |
| Egypt | 8 | Seleim, Ashour, and Khalil (2005); Attia (2015); Hadidi and Kirby (2015); Sobaih and Jones (2015); H. El Hadidi and Kirby (2016); AlAyouty (2017); H. H. El Hadidi and Kirby (2017); Kirby and El Hadidi (2019) |
| Iran | 13 | BagheriMoghadam, Hosseini, and SahafZadeh (2012); Majidpour (2012); Borghei et al. (2013); Sayadi et al. (2013); Mazdeh et al. (2015); Ansari, Armaghan, and Ghasemi (2016); Rafiei, Akhavan, and Hayati (2016); Soleimani, Tabriz, and Shavarini (2016); Farzin (2017); Friedrichsen et al. (2017); Namdarian and Naimi-Sadigh (2018); Mavi et al. (2019); Zarghami, Amrollahi, and Jafari (2020) |
| Iraq | 0 | - |
| Jordan | 2 | Salem and Amjed (2008); Abu-Rumman (2019) |
| Kuwait | 0 | - |
| Lebanon | 3 | Ben Hassen (2018); Bizri et al. (2019); El Achi et al. (2020) |
| Libya | 1 | Al-Mabrouk and Soar (2009c) |
| Morocco | 3 | Khadhraoui et al. (2018); Elyoussoufi Attou (2019); Taouaf et al. (2021) |
| Oman | 3 | Al-Belushi, Stead, and Burgess (2015); Halibas, Sibayan, and Maata (2017); Chryssou (2020) |
| Palestine | 4 | Sharabati-Shahin and Thiruchelvam (2013); Alkhaldi et al. (2020); Morrar and Arman (2020); Sultan (2020) |
| Qatar | 2 | Abduljawad (2015); Al-Mansoori and Koc (2019) |
| Saudi Arabia | 5 | Alshumaimri, Aldridge, and Audretsch (2010); Alshumaimri, Aldridge, and Audretsch (2012); Khorsheed and Al-Fawzan (2014); Sebak et al. (2014); Alshehri et al. (2016) |
| Sudan | 3 | Allam Ahmed (2004, 2005); A. Ahmed and Newton (2005) |
| Syria | 0 | - |
| Tunisia | 2 | Khadhraoui et al. (2016); Khadhraoui et al. (2017) |
| UAE | 3 | Parashar (2008); (Bhayani, 2015); Iqbal et al. (2018) |

| Country | # of Papers | Source/Authors |
|---|---|---|
| Yemen | 0 | - |

The research methods employed in the reviewed papers can be broadly categorised into qualitative, quantitative, and mixed methods. Among the 60 papers, 34 utilised qualitative research methods, with interviews being the most commonly employed tool. Other qualitative methods included reviews, case studies, focus groups, content analysis, Delphi methods, and benchmarking. Quantitative research methods were found in 20 papers, with the survey study design being the most prevalent approach. These papers employed various statistical analyses to explore different aspects of UIC. Additionally, 6 papers applied mixed research methods, combining qualitative and quantitative approaches to gain a comprehensive understanding of UIC. These mixed-methods studies utilised various data collection techniques and analysis strategies to capture the complexity of UIC phenomena. Figure 4.2 presents the number of papers categorised by country and research methods.

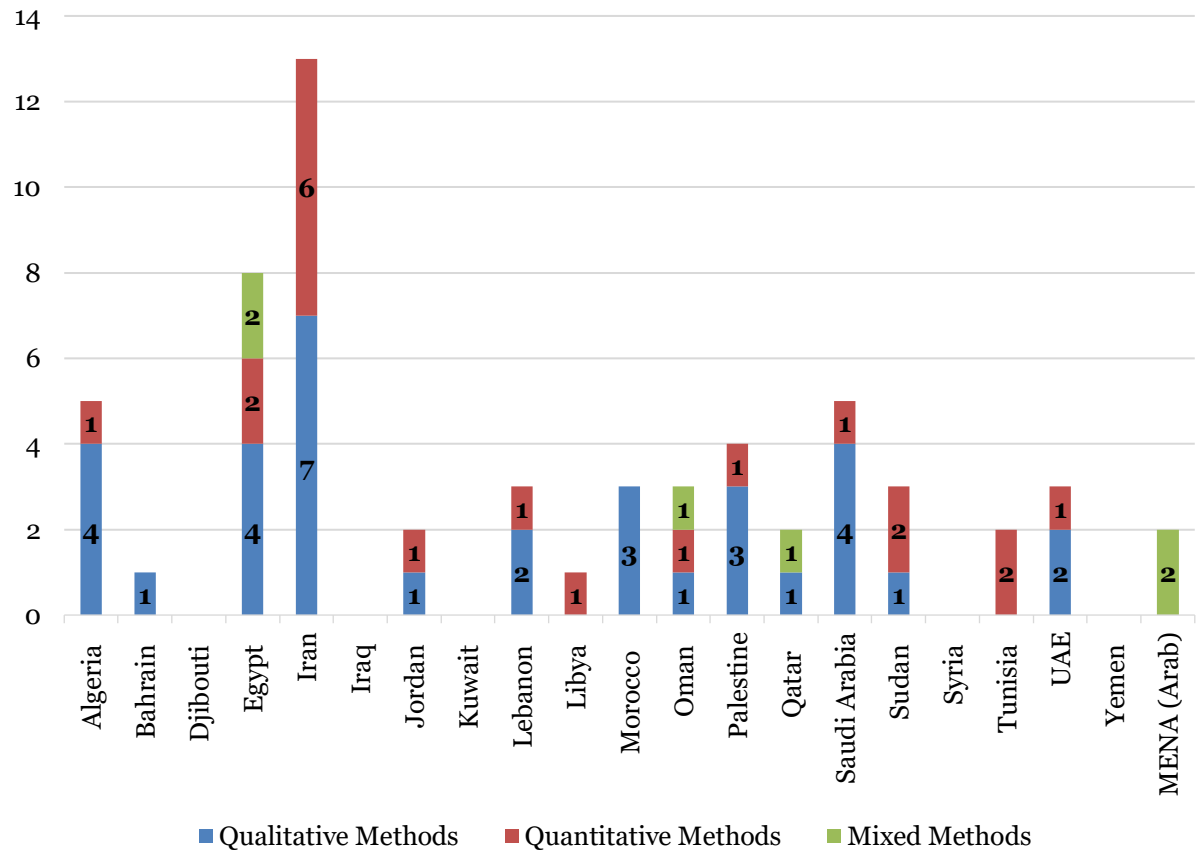



Figure 4.2: Numbers of Papers According to Country and Research Methods

A matrix containing the relevant information will be provided in the Appendix for further details and a comprehensive overview of the reviewed papers. This matrix will serve as a valuable resource for delving deeper into the literature and exploring various dimensions of UIC in the MENA region.

### 4.2.2 Review Insights: Major Themes

This section identifies the main research themes and major investigated issues that emerged from the Systematic Literature Review in the MENA region. Four research themes are illustrated: UIC models, channels (i.e. KT/TT-UIC Activities), mechanisms, and barriers. These themes provide a comprehensive framework for understanding UIC's different regional aspects and dynamics. By exploring these themes, a contribution is made to the existing body of knowledge and light is shed on the various dimensions of UIC in the MENA context.

**Theme 1- UIC Models:** Under this theme, the discourse centres on the diversity of UIC models (i.e. UIC settings). UIC commonly denotes the traditional/standard model connecting universities and industry organisations. However, the reviewed papers also encompass terms such as 'university-business', 'academia-business', and 'university-enterprise' collaboration. Additionally, the UIC concept extends to 'U-I-G collaborations' that introduce the government as a third crucial actor, or what is known in the context of open innovation as the 'triple helix' model, which has been extensively explored in the MENA region's research across various fields such as veterinary science (A. Ahmed & Newton, 2005), nanotechnology (Alshumaimri, Aldridge & Audretsch, 2010; Sebak et al., 2014), agriculture (Allam Ahmed, 2004, 2005; A. Ahmed & Newton, 2005; Al-Belushi, Stead & Burgess, 2015), health systems (Alkhaldi et al., 2020; El Achi et al., 2020), and science and technology (Khorsheed & Al-Fawzan, 2014; Sobaih & Jones, 2015; Soleimani, Tabriz & Shavarini, 2016; Farzin, 2017; Mavi et al., 2019).

These studies aim to elucidate the distinct roles of different actors, noting that the government often assumes the roles of policymakers, facilitators, or funder; the industry typically acts as an investor or occasionally as a knowledge provider; and the university principally serves as a knowledge producer or problem solver. It has been stressed that strategic alignment of these actors' roles and research agendas is essential for driving effective innovation performance (Mohammed Saad, 2004; Mohammed Saad & Zawdie, 2005; Mohammed Saad, Zawdie & Malairaja, 2008; Morrar & Arman, 2020; Sultan, 2020).

Moreover, the 'quadruple helix' model represents an evolution of the 'triple helix', including civil society or non-governmental organisations (NGOs) as a fourth participant, fostering local and regional social development. However, the literature review reveals scant evidence of this model's implementation, with the exception of a UAE case study documented by Iqbal et al. (2018). In addition, a nascent model known as the ‘penta helix’ was reported in Oman, where individual social entrepreneurs join the collaborative network as a fifth actor, aimed at exploring innovative concepts and entrepreneurial ventures within the ecosystem (Halibas, Sibayan & Maata, 2017). As subsequent themes will detail, knowledge-based activities (i.e. KT/TT-UIC Activities) are vital components implemented through various UIC channels across all these models or different UIC settings.

**Theme 2- UIC Channels:** Within this theme, UIC channels (i.e. KT/TT-UIC Activities) are reviewed according to the classification illustrated in Table 2.1 (*Activities Category*). To enhance clarity in this discussion, the channels 'commercialisation of property rights' and 'academic entrepreneurship' are classified as TT channels, while the remaining channels, including 'research partnerships,' 'research services,' 'human resource transfer,' 'informal interaction,' and 'scientific publications,' are categorised as KT channels.

Regarding KT channels, ‘research partnerships’ that include inter-organisational joint research and development (R&D) and ‘research services’ that include contract-based research and consultation are identified as the most

prevalent channels, as evidenced by various studies (Al-Mabrouk & Soar, 2009a, 2009b, 2009c; Sebak et al., 2014; Abduljawad, 2015; Sobaih & Jones, 2015; H. El Hadidi & Kirby, 2016; Friedrichsen et al., 2017; Khadhraoui et al., 2017; Mavi et al., 2019; Alkhaldi et al., 2020; Taouaf et al., 2021). 'Scientific publications' have been analysed from a micro-level perspective, focusing on the research productivity of academics (Al-Belushi, Stead & Burgess, 2015; Alshehri et al., 2016; Kirby & El Hadidi, 2019; Zarghami, Amrollahi & Jafari, 2020). The academic and industrial sectors also favour 'human resource transfer' and 'informal interaction' channels. For example, a recent study in Oman by Chryssou (2020) revealed that over 50% of respondents favoured KT channels, such as student mobility and participation in academic conferences, compared to 0% for licensing activities. The training was also highlighted as a preferred KT channel in the literature reviewed.

On the TT side, the commercialisation of intellectual property (IP), specifically patents, was noted in nearly half of the reviewed papers as a preferred channel. Patents, for example, are frequently used as a metric to assess UIC performance alongside other factors (Alshehri et al., 2016). However, the creation of spin-offs and startups, the management of incubation activities, and the execution of licensing agreements have encountered various challenges, including legislative obstacles and a lack of entrepreneurial skills within the academic institutions (Iqbal et al., 2018; Elyoussoufi Attou, 2019; Kirby & El Hadidi, 2019; Chryssou, 2020). Consequently, the following theme explores specific mechanisms to manage and facilitate UIC amidst these barriers and challenges.

**Theme 3- UIC Mechanisms:** The entrepreneurial university concept is prominent in several reviewed papers. This concept pertains to a university that engages in the 'third mission' through knowledge-based activities such as Knowledge Transfer (KT) and Technology Transfer (TT), leading to innovation and contributing to regional or national economic growth, as well as diversifying its income sources (Etzkowitz & Leydesdorff, 2000). Successful entrepreneurial universities embody an entrepreneurial culture among stakeholders, which is crucial for enhancing resource-based factors that promote entrepreneurship, bridging the gaps between academia and industry, and driving innovation, especially in the MENA region. For instance, the maturity level of university entrepreneurship has been assessed by measuring knowledge management components, including 'knowledge creation', 'knowledge sharing', 'knowledge use', 'knowledge acquisition', and 'knowledge preservation', with a particular emphasis on the significance of knowledge creation and sharing (Abu-Rumman, 2019).

Leadership skills play a pivotal role in supporting and sustaining academic entrepreneurial activities. Governmental funding, along with governance and regulatory frameworks, are also emphasised for their role in protecting and motivating academics to commercialise their services and knowledge-intensive products (Alshumaimri, Aldridge & Audretsch, 2012; Soleimani, Tabriz & Shavarini, 2016; Farzin, 2017; Khadhraoui et al., 2018; Abu-Rumman, 2019; Bizri et al., 2019). The intermediation role of entities such as Technology Transfer Offices (TTOs) is recognised as a crucial mechanism for fostering entrepreneurial universities.

Intermediary organisations facilitate such collaborations as well. An intermediary is “an organisation or body that acts as agent or broker in any aspect of the innovation process between two or more parties”. Intermediary involves various activities such as “providing information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between bodies or organisations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations” (Howells, 2006, p. 720). Intermediaries, ranging from individuals to organisations, effectively mitigate barriers and enhance collaborative projects within the UIC setting.

The types/natures and roles of intermediaries are explored in some reviewed papers. TTOs, as intermediaries, were particularly noted in studies conducted in Morocco (Elyoussoufi Attou, 2019; Taouaf et al., 2021) and Tunisia (Khadhraoui et al., 2017). Other intermediary types alongside TTOs, such as the Innovation Support and Patent Registration Facilitation Office, Technology Innovation and Commercialisation Office (TICO) in Egypt (H. El Hadidi & Kirby, 2016; Kirby & El Hadidi, 2019), commercialisation office, and University Business Incubators (UBIs) in Iran (Ansari, Armaghan & Ghasemi, 2016; Mavi et al., 2019), Industry Relation Office (IRO) in Qatar (Abduljawad, 2015), Technology Innovation Centres (TICs) similar to Cooperative Research Centres (CRCs) in developed countries, incubators, and Science and Technology Parks in Saudi Arabia (Alshumaimri, Aldridge & Audretsch, 2010; Khorsheed & Al-Fawzan, 2014), and Science and Technology Park in UAE (Bhayani, 2015; Iqbal et al., 2018) have been reported.

The role of intermediaries in the MENA region mainly involves examining the extent of TT within universities and evaluating their performance, hence assessing the impact of research commercialisation in the UIC context. For example, to determine the competencies of TTOs, Likert scales were employed to measure technical, marketing, and negotiation skills, as well as other legal aspects (Khadhraoui et al., 2017). Therefore, UIC mechanisms can be summarised as bridging the divide between academia and external actors by commercialising research and efficiently managing UIC channels, such as intellectual properties and patents. As discussed in the subsequent section, the absence of intermediaries and suboptimal commercialisation strategies are identified as barriers to UIC within the MENA region.

**Theme 4- UIC Barriers:** The most common UIC barriers and challenges can be categorised into two main categories: cultural-based barriers related to organisational culture, commercialisation culture, and leadership culture, and resource-based barriers comprising a lack of infrastructure, professional staff, technical aspects, and funding shortages. For instance, in a recent quantitative survey examining the nature of UIC in Oman by Chryssou (2020), the top-ranked barrier for academics was "time constraint due to heavy teaching and administrative workload," while the majority of the industry reported the top barriers as 'lack of awareness regarding expertise/facilities available at universities,' 'lack of autonomy to work with industry,' and 'absence of a proper mechanism for university collaboration.' Similarly, barriers to UIC were also reported in terms of a lack of supportive culture and a lack of required resources for successful collaborations in different countries, including Algeria (Mohammed Saad, 2004), Egypt (Attia, 2015; Sobaih & Jones, 2015; H. El Hadidi & Kirby, 2016; H. H. El Hadidi & Kirby, 2017), Iran (Ansari, Armaghan & Ghasemi, 2016; Namdarian & Naimi-Sadigh, 2018), Jordan (Abu-Rumman, 2019), Lebanon (El Achi et al., 2020), Palestine (Alkhaldi et al., 2020), Qatar (Abduljawad, 2015), Sudan (Allam Ahmed, 2005; A. Ahmed & Newton, 2005), and Tunisia (Khadhraoui et al., 2016). Therefore, to overcome these barriers, it is crucial to positively shape the viewpoints and mindsets of all relevant stakeholders within the UIC setting, fostering an environment that values inter-organisational collaborations and recognises the potential mutual benefits such partnerships can provide and gain.

From the university perspective, external stakeholders tend to underestimate local/national capabilities by collaborating internationally with Western universities, as they perceive themselves as self-sufficient in hiring consultants. However, academics express confidence in their abilities. During UIC, academics often face challenges in accessing specific information for publication due to the industry's high level of confidentiality or

the bureaucracy and inflexibility within universities, which hinders the growth and development of these collaborations. Additionally, a lack of funding and infrastructure is reported as a barrier to UIC.

Moreover, from the industry perspective, universities are perceived as not giving adequate attention to commercialising their capabilities for the market. While academics attribute this to their high teaching loads and managerial duties that consume their time, the industry cites a lack of entrepreneurship culture among academics as the reason. The complexity of university regulations and governance discourages external stakeholders from establishing partnerships with them. Furthermore, production challenges were stated in translating research outcomes/patents and materialising them into innovative products and services to meet market demands.

### 4.2.3 Review Insights: Overview of the Reviewed Papers

A matrix containing the relevant information is provided in Table A.2 for further details and a comprehensive overview of the reviewed papers. This matrix is a valuable resource for delving deeper into the literature and exploring various dimensions of UIC in the MENA region.

## 4.3 INTERPRETING EMPIRICAL INTERVIEW INSIGHTS

### 4.3.1 Key Theoretical Findings from the Systematic Literature Review - Review Insights: Descriptive Data

This systematic review yielded 23 papers that fit the inclusion criteria. Figure 4.3 demonstrates the distribution of publications per year during the last two decades; the number increased since 2016, reaching the highest number of publications in 2019. Among the reviewed studies papers, only two studies were conference papers, while the rest were journal articles. Furthermore, the top scholarly journal in this systematic review that reported in three articles was '*European Journal of Innovation Management*', whereas the following journals were reported in two articles each, '*Journal of Knowledge Management*', '*Knowledge Management Research & Practice*', '*Science & Public Policy*', '*The Journal of Technology Transfer*', and '*Industry and Innovation*'. The rest of the journals were reported in one article each. Moreover, ten studies were conducted in European countries, followed by five studies in Asian countries. The rest of the studies were from other continents: two in North America, one in Africa, and one was conducted among three regions, including Europe, Asia, and Australia. In addition, four other 'review studies' which met the objectives of this study were also included. **The key theoretical insights from this systematic review were also discussed in Hakami, Pradhan, and Mastio (2022a), as outlined in the following sections.**

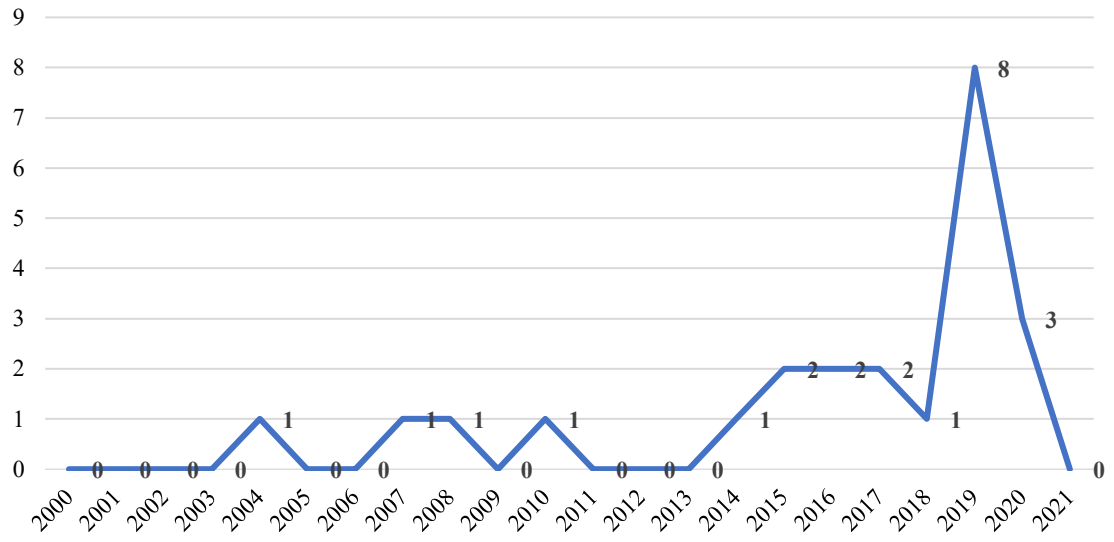



Figure 4.3: Papers According to the Publication Year

### 4.3.2 Review Insights: Major Themes

This section outlines the key research areas and significant topics revealed through the Systematic Literature Review on SC-UIC studies. It covers four related SC-UIC themes: state-of-the-art, research streams, research approaches, and theoretical contributions. Investigating these themes enhances our understanding of UIC practices within the MENA region and contributes to the existing knowledge base.

**Theme 1- The Current SC-UIC Studies:** The first review theme refers to the state of the art in the related SC-UIC 'review studies' shown in Table 4.2. A number of 'review studies' discussed SC-UIC but were excluded from records for the following reasons. Some of the 'review studies' focused on the different aspects of the direct UIC without explicitly mentioning SC (Perkmann & Walsh, 2007; Perkmann et al., 2013; Ankrah & Al-Tabbaa, 2015), and others that reviewed SC but focused only on the 'triple-helix' model (Al-Tabbaa & Ankrah, 2019). However, a few 'review studies' directly focused on UIC and explicitly examined SC within that context. Table 4.2 summarises related review studies that met the purpose of this study.

Table 4.2: A summary of related 'review studies'

| Source | Reviewed Studies # | Main Aim |
|---|---|---|
| (Thomas & Paul, 2019) | N/A | This 'literature review' aimed to identify factors that affect KT-UIC and then develop a theoretical framework. |
| (Robertson, McCarthy & Pitt, 2019) | 9 | This 'comparative review' aimed to develop a framework to understand how SC-UIC influences KT strategies, which then impacts innovation, by comparing nine studies from three stage countries, including Canada, Malta, and South Africa. |
| (de Wit-de Vries et al., 2019) | 35 | This 'systematic review' proposed a theoretical model for the research partnerships in the context of KT-UIC and what practices facilitate KT. |

| | | |
|---|---|---|
| (Chakrabarti & Santoro, 2004) | N/A | This 'literature review' built a clear understanding of the impact of UIC through the lens of SC. |

The importance of SC in facilitating resources' transfer towards fostering UIC and the organisation's innovation was proved in the following two traditional 'literature reviews' (Chakrabarti & Santoro, 2004; Thomas & Paul, 2019), one 'systematic review' (de Wit-de Vries et al., 2019), and one 'comparative review' (Robertson, McCarthy & Pitt, 2019). According to de Wit-de Vries et al. (2019), SC has been proven to positively influence the context of 'academic engagement', which comprises 'collaborative research, contract research and consulting' towards KT's success. As well, according to Robertson, McCarthy, and Pitt (2019), by comparing projects from developed to developing countries, they proved that SC influences differ based on the various environments or regions.

**Theme 2- Current SC-UIC Research Streams:** The second review theme concerns the current research themes or the nature of the studies. The SC has been applied to a number of UIC studies, which would be perceived as conceptual perspectives that focus theoretically on developing research models and empirical perspectives that mainly studied primary data via a variety of research methods to analyse how SC facilitates UIC, whereas others even combined data from related primary and secondary sources. In this systematic review, selected papers were classified into two main research streams: knowledge-based and resource-based research themes. The majority of papers (13, total) (57%) was in the knowledge-based theme where they studied the KT/TT through UIC and examined factors that influence from the knowledge-based perspective (Philbin, 2008; Filieri et al., 2014; Mäkimattila, Junell & Rantala, 2015; Kalar & Antoncic, 2016; Yang, 2016; de Wit-de Vries et al., 2019; Leonchuk & Gray, 2019; Robertson, McCarthy & Pitt, 2019; Thomas & Paul, 2019; Ting, Yahya & Tan, 2019a; Abdulai, Murphy & Thomas, 2020; Gerbin & Drnovsek, 2020; Tootell et al., 2020). While resource-based themes yielded for 10 papers in total (43%), where some papers drew insights from the actors' characteristics and how that affected SC-UIC from different perspectives, including academics' research performance or researchers' competence (Zhang & Wang, 2017; Ting, Yahya & Tan, 2019a, 2019b), partner selection criteria (Wei, Hui & Yu-ning, 2017), firms' performance and firms' reputations (Martínez-Cañas & Ruiz-Palomino, 2010), and organisations' experience level (Steinmo, 2015; Steinmo & Rasmussen, 2018). Figure 4.4 describes the SC-UIC research themes in the related studies. UIC mechanisms were discussed from the SC point of view and how that would formulate UIC associated with the risk levels (low/ high) (Pinheiro, Pinho & Lucas, 2015). UIC motivations and UIC barriers/challenges were also explored from different points of view through the SC theory lens (Thune, 2007; Pinheiro, Pinho & Lucas, 2015; Steinmo, 2015; Steinmo & Rasmussen, 2018; Dalkir, Iancu & Oliveira, 2019). UIC channels/activities/mechanisms (refer to Table 2.1) were also discussed broadly in all papers as network channels between university-industry actors (U-I) or from the perspective of KT/TT activities through UIC, as most papers involved more than one mechanism. Besides, contract-based mechanisms are considered formal channels, such as R&D projects, contract research, contract consultations, licensing agreements, patents, spin-offs, and joint (U-I) doctoral theses, whereas scientific publications, meetings, conferences, and training workshops were considered informal channels.

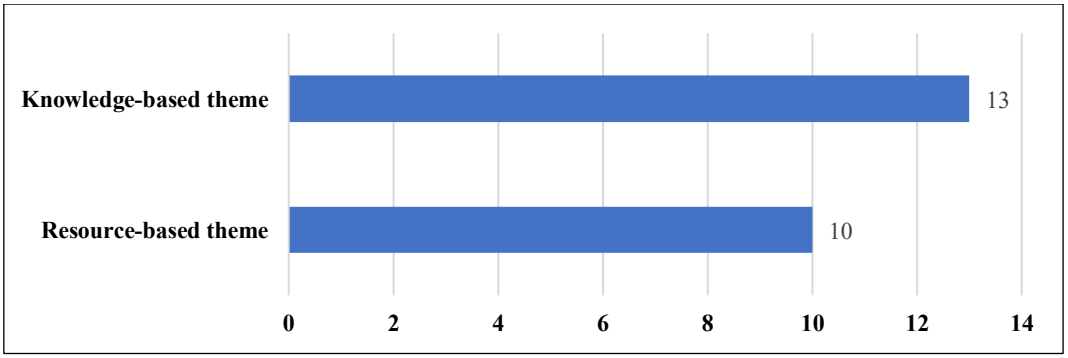



Figure 4.4: SC-UIC Research Themes

**Theme 3- Research Approaches within the SC-UIC Studies:** The third review theme discusses research methods and participants' categories in the related studies. There were two streams of research methods in which nearly half of the studies used quantitative methods (44%), while others applied qualitative methods (39%). The survey study design was the most commonly used among quantitative studies (Martínez-Cañas & Ruiz-Palomino, 2010; Kalar & Antoncic, 2016; Yang, 2016; Zhang & Wang, 2017; Ting, Yahya & Tan, 2019a, 2019b; Abdulai, Murphy & Thomas, 2020; Gerbin & Drnovsek, 2020), followed by one experiment design (Wei, Hui & Yu-ning, 2017) and one quasi-experiment research design (Leonchuk & Gray, 2019). While conducting interviews was the most popular tool among qualitative studies (Thune, 2007; Philbin, 2008; Pinheiro, Pinho & Lucas, 2015; Tootell et al., 2020). Several case studies followed them (Filieri et al., 2014; Mäkimattila, Junell & Rantala, 2015), including longitudinal case studies (Steinmo, 2015; Steinmo & Rasmussen, 2018). Also, two studies applied action research design (Mäkimattila, Junell & Rantala, 2015; Dalkir, Iancu & Oliveira, 2019), where one of them was associated with the case study design (Mäkimattila, Junell & Rantala, 2015). The remaining papers (17%) were 'review studies' (Chakrabarti & Santoro, 2004; de Wit-de Vries et al., 2019; Robertson, McCarthy & Pitt, 2019; Thomas & Paul, 2019). Figure 4.5 shows research methods that were applied in the related studies.

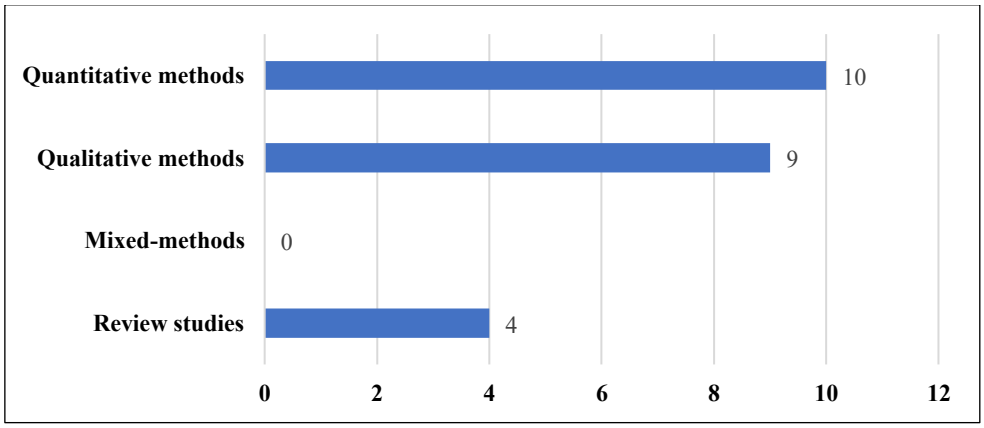



Figure 4.5: Types of Conducted Research Methods

Regarding the research participants (samples) for those studies, three categories include participants from only the university (U) or academic researchers, only industry (the private sector in particular) (I) or practitioners, or

from both partners (I). Almost half of the papers were selecting participants from (U-P) category (45%) (Thune, 2007; Philbin, 2008; Filieri et al., 2014; Mäkimattila, Junell & Rantala, 2015; Yang, 2016; Wei, Hui & Yu-ning, 2017; Dalkir, Iancu & Oliveira, 2019; Tootell et al., 2020). Followed by the (U) category (35%) (Pinheiro, Pinho & Lucas, 2015; Kalar & Antoncic, 2016; Zhang & Wang, 2017; Leonchuk & Gray, 2019; Ting, Yahya & Tan, 2019a, 2019b; Gerbin & Drnovsek, 2020). It's important to highlight that only a few studies were targeting the (P) category (20%) (Martínez-Cañas & Ruiz-Palomino, 2010; Steinmo, 2015; Steinmo & Rasmussen, 2018; Abdulai, Murphy & Thomas, 2020). Figure 4.6 illustrates research methods that were applied in the related studies. This result corroborates the study by de Wit-de Vries et al. (2019) that the perspective of the industry (the private sector in particular) stakeholders has not received much attention compared to the academic partners, and comprising both may contribute to moving the UIC research field forward. Additionally, it was noted that scholars preferred to conduct qualitative methods when their sample included stakeholders from the (U-I) category. The papers' synthesis also revealed that SC factors in the UIC context have been examined qualitatively or quantitatively, but the results were not integrated. Therefore, a mixed-methods design is needed to bridge the gap and enrich the UIC field by combining statistical and textual results.

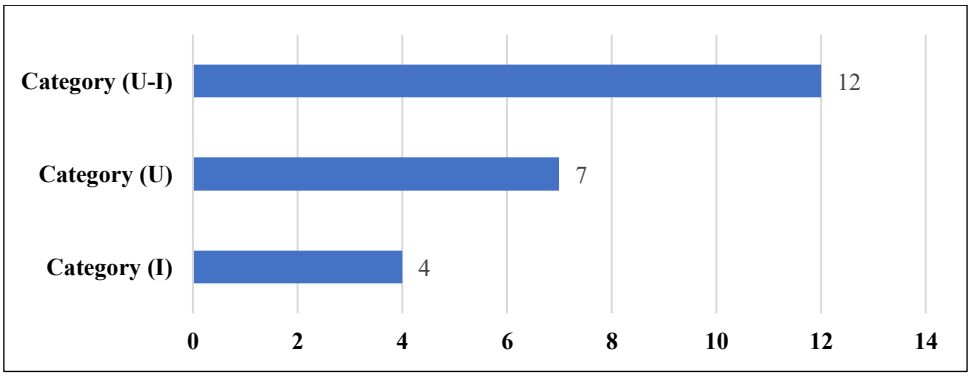



Figure 4.6: Categories of Research Participants

Given the analysis levels, the inter-organisational level was the most examined among other levels, with a rate of 61%. Followed by an intra-organisational level of analysis in only three studies (13%) (Zhang & Wang, 2017; Dalkir, Iancu & Oliveira, 2019; Abdulai, Murphy & Thomas, 2020), whereas the individual level was the least measured one in only two studies (9%) (Kalar & Antoncic, 2016; Leonchuk & Gray, 2019). There was also an interest by scholars in measuring SC among a mix of different levels of analysis (17%), such as (individual, intra-organisation, and inter-organisation) (Steinmo, 2015), or (intra-organisation, and inter-organisation) (Filieri et al., 2014; Pinheiro, Pinho & Lucas, 2015; Gerbin & Drnovsek, 2020). Figure 4.7 describes SC levels of analysis that were summarised from the related studies.

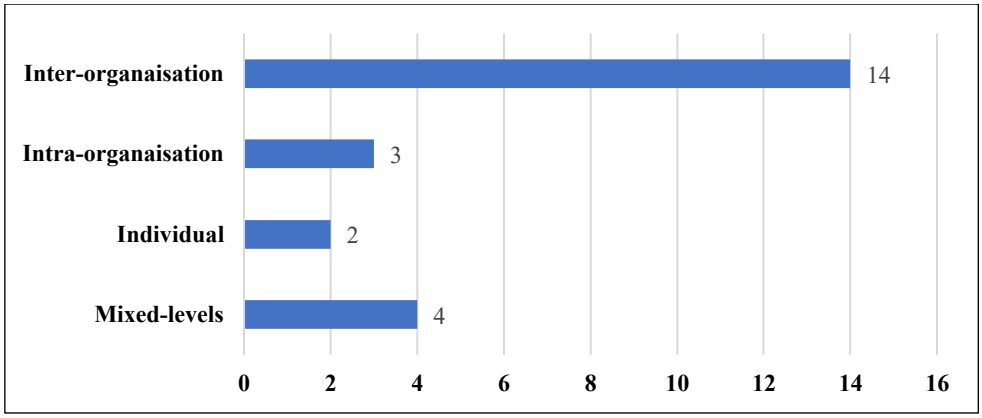



Figure 4.7: SC Levels of Analysis

**Theme 4- Theoretical Contributions of SC-UIC Studies: The fourth review theme refers to the theoretical contributions of SC that have** been investigated in related UIC literature within various topics. Table A.2 summarises SC factors studied in the selected papers and lists each SC dimension. For SC's dimensions proposed by Nahapiet and Ghoshal (1998), the relational dimension was the most examined, followed by structural and cognitive dimensions. Compared to structural and relational in SC-UIC literature, studies on cognitive dimension are inconsistent and haven't been investigated as much as the other two dimensions, and that might be attributed to difficulties in measuring SC factors (Nahapiet & Ghoshal, 1998; Zhang & Wang, 2017; de Wit-de Vries et al., 2019). With respect to factors, trust (relational) was proved to be the most critical factor among others, followed by network ties (structural) and then shared goals (cognitive). In some studies (Martínez-Cañas & Ruiz-Palomino, 2010; Mäkimattila, Junell & Rantala, 2015; Wei, Hui & Yu-ning, 2017; Abdulai, Murphy & Thomas, 2020), SC factors were not specifically determined; thus, '✓' symbol refers to each dimension measured in the corresponding paper. They considered SC as one construct formed by its three main dimensions without mentioning embedded factors, as proposed by (Adler & Kwon, 2002). Those studies were included since they met the inclusion criteria. Also, the '-' symbol in Table A.2 refers to the non-examined dimensions, as some reviewed studies highlighted only one or two dimensions instead of analysing all three SC three dimensions.

Besides SC, other theoretical lenses were applied in a few studies. 'Absorptive capacity theory' was the most mentioned one associated with SC in related literature (Martínez-Cañas & Ruiz-Palomino, 2010; Mäkimattila, Junell & Rantala, 2015; Steinmo & Rasmussen, 2018; de Wit-de Vries et al., 2019), followed by 'relationship marketing theory' (Tootell et al., 2020), and 'stimulus organism response theory' (Ting, Yahya & Tan, 2019a). 'Absorptive capacity theory' and SC were proved to positively influence an organisation's ability to create the appropriate values. It refers to the organisation's ability "to recognise the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990, p. 128).

This systematic review of the literature on SC-UIC identified a significant body of research that has examined the influence and impact of different dimensions of social capital on various dependent variables or outcome constructs in the context of the UIC setting. As the final dependent variable or outcome (construct) evaluated and measured in these empirical studies, the results were summarised into four key categories: knowledge-related aspects, innovation, UIC aspects, and resource-related aspects, as shown in Figure 4.8. Knowledge-relates aspects were also stated in 30% of papers as 'knowledge sharing' (Gerbin & Drnovsek, 2020), 'KT and TT' (Kalar &

Antoncic, 2016), 'KT success' (de Wit-de Vries et al., 2019), 'KT strategies' (Robertson, McCarthy & Pitt, 2019), 'KT' (Filieri et al., 2014), 'knowledge creation' (Tootell et al., 2020), and 'knowledge chain' (Yang, 2016). Innovation was reported in 26% of papers as 'innovation' (Martínez-Cañas & Ruiz-Palomino, 2010; Mäkimattila, Junell & Rantala, 2015; Steinmo, 2015; Steinmo & Rasmussen, 2018; Thomas & Paul, 2019) and 'innovation performance' (Abdulai, Murphy & Thomas, 2020). Innovation is associated with SC as actors' resource levels (e.g. trust) and is positively related to the performance of innovative projects. In addition, improving long-term SC will facilitate KT between partners and foster innovation because KT is a complex process that gets enhanced across long-term relationships. However, inter-organisational KT is more complicated than transferring knowledge at the individual level. Resource-based activities were presented in 17% of papers as 'academic research performance' (Zhang & Wang, 2017), 'graduate students outcome' (Leonchuk & Gray, 2019), 'appropriate partner selection' (Wei, Hui & Yu-ning, 2017) that requires an adequate amount of participants' SC to complete shared projects and 'shared activities (mechanisms)' (Pinheiro, Pinho & Lucas, 2015), which would evolve through the partners' SC. SC resources, such as trust, shared goals, and network ties, have been proven to facilitate and formulate a successful partnership between partners. In the final category, UIC aspects were reported in 26% of papers as 'UIC formation' (Philbin, 2008; Ting, Yahya & Tan, 2019a, 2019b) and 'UIC success' (Chakrabarti & Santoro, 2004; Thune, 2007; Dalkir, Iancu & Oliveira, 2019).

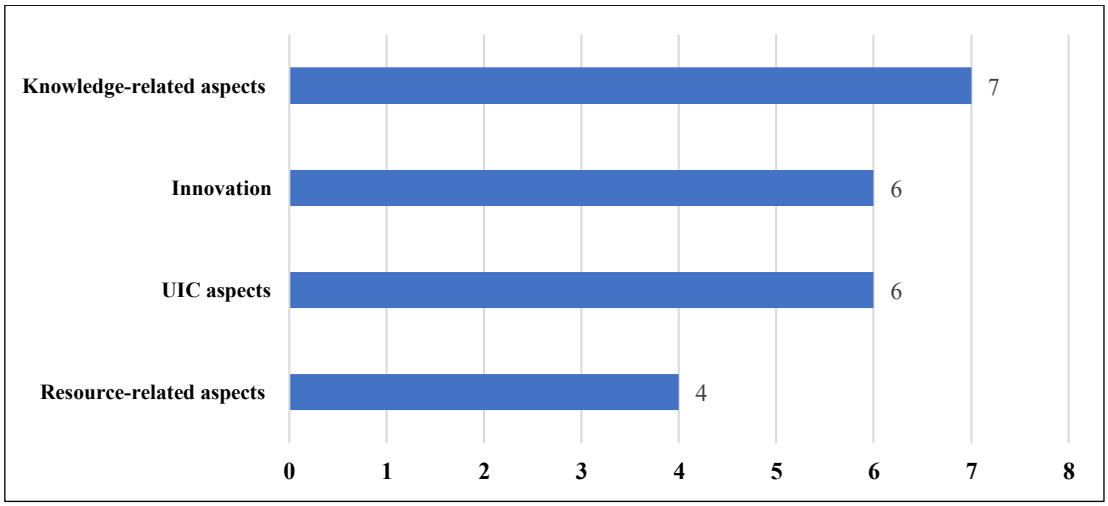



Figure 4.8: Categories of Evaluated Outcomes

It is also noted that some studies involved external constructs as mediators to play certain roles, such as 'communication' that helps facilitate KT and overcome KT-UIC barriers, where lack of communication hinders KT-UIC. 'Absorptive capacity' was also considered to strengthen actors' willingness to transfer knowledge (Steinmo, 2015; de Wit-de Vries et al., 2019; Thomas & Paul, 2019).

UIC is evolving through a long-term SC between partners. SC is constructed through a range of good quality resources between partners via UIC mechanisms (refer to Table 2.1), strengthening the partners' relationships, raising trust, and compromising cognitive differences in partnerships' goals, boosting UIC outcomes. SC is

investigated in different ways based on the nature of the study, where SC's three dimensions were not necessary to be all involved, and SC's factors were also selected to meet research objectives.

### 4.3.3 Review Insights: Overview of the Reviewed Papers

A matrix containing the relevant information is provided in Table A.2 for further details and a comprehensive overview of the reviewed papers. This matrix is a useful tool for further exploration of the literature and for examining various aspects of SC-UIC literature.

## 4.4 INTEGRATING THE UIC INSIGHTS WITHIN THE SAUDI ARABIAN CONTEXT

To complement the systematic literature review and put findings into practice, exploratory semi-structured expert interviews were conducted with relevant stakeholders from Saudi Arabia, one of the leading countries in the MENA region. Also, it becomes evident that countries in the MENA region have encountered related challenges in the UIC setting and knowledge-based activities, albeit to varying degrees. The prevalence of 'teaching-dominant universities' in these countries is closely associated with the existing barriers within the UIC setting (Al-Mansoori & Koc, 2019; Elyoussoufi Attou, 2019; Sultan, 2020). Despite efforts to raise awareness about the significance of inter-organisational relationships and collaborations, the level of UIC remains relatively low. Expert interviews were conducted within the Saudi Arabian context to gain deeper insights into these barriers; in addition to exploring the barriers and challenges, it was necessary to examine the drivers that influence the implementation of UIC to understand the phenomena better, which can offer additional insights into the factors that contribute to such collaborations. Therefore, this section comprehensively identifies and analyses the factors that enhance (i.e., drivers) or hinder (i.e., barriers) such collaborations in the UIC ecosystem, considering the perspectives of the university, industry, and intermediary stakeholders.

A total of 40 expert interviews with universities, industry, and intermediary organisations in Saudi Arabia. These interviews aimed to gather qualitative empirical data and explore the inter-organisational factors that act as drivers and barriers to KT/TT activities in the UIC context. Interview questions related to participants' backgrounds and experiences, partner/project selection criteria, challenges of UIC activities, motivations to be involved in such activities, and recommendations. Most interviews lasted approximately 45 minutes and were audio-recorded with the participant's permission. Additionally, secondary data collection was undertaken gradually to explore the nature of the KT/TT-UIC activities in Saudi Arabia, including publicly available information on selected organisations' websites, news, and annual reports.

### 4.4.1 Expert Interview Insights- Drivers to KT/TT-UIC Activities

Based on the interview transcriptions, geographic proximity, i.e. the physical distance between organisations, can play a positive and a negative role in such collaborations. As a positive motivator, what seems to stand out is that industry actors are keen to collaborate with universities in big cities. That is, the closer the university is to central locations, the more likely it is to establish a collaboration/partnership with industries. As clarified by one of the industry experts:

*"[…] that is why we often prefer to partner with universities in large cities/regions. These are our focus areas because they have connections with as many target groups/stakeholders as possible to fulfil our goals. Due to their attractive geographical location, they also work with many surrounding businesses." (I-13)*

It is also noticeable that public universities and their in-house intermediaries tend to collaborate more with the public/government sector than with the private sector, as they have a similar governance structure. In the Saudi Arabian context, one explanation can be attributed to the advantages and facilities of the public sector concerning the general regulations on tendering and government procurement. One of the participants expressed:

*"Promoting the University's services to the government sector was the most flexible of other types of partnerships, as we are all classified as public sectors. We have noted a mutual understanding, and the establishment of contracts is often facilitated smoothly, sometimes to the point of courtesy." (U-10)*

Also, all categories of participants, especially industry actors, commented that the emerging collaboration models among different sectors have recently led them to look beyond just forming a new partnership. These new configurations have helped other sectors collaborate and bridge the gap by evolving the ecosystem. For instance, various collaborations are likely to be formed on the triple, quadruple, or even quintuple helix innovation model, as addressed by one industry participant:

*"We have been witnessing partnerships that bring together diverse sectors. For example, in one of our recent projects, we have collaborated with several sectors as follows: [...] as a funding entity, the Ministry of [...], a private sector company that specialised in [...], and we are the fourth partner as a non-profit organisation. We look forward to adding universities as a fifth partner to this emerging business model. We aspire to achieve the objectives and expectations of the Sudi Vision 2030." (I-5)*

Undoubtedly, all organisations at all levels seek to maximise their financial resources and create additional sustainable resources to strengthen their industry profiles, and universities are not excluded. The need to make sufficient contributions in response to the government's demands led to the evolution of university missions. In this context, inter-organisational collaboration is one of the essential mechanisms in creating diverse sources of income for universities. One of the university experts said:

*"From my point of view as an academic, the private sector is a rapidly evolving sector, working towards financial freedom and has diverse relationships with many stakeholders, as well as good market understanding… that motivates me to reach them in the best possible way. We can also benefit from such collaborations for full/partial lab funding and to support the development of the research team." (U-11)*

Intermediaries have also affirmed this sentiment, as follows.

*"Thus, one of the objectives of establishing in-house intermediary organisations is to be a source of income in the future, i.e. a 'revenue stream' that supports universities financially at different levels." (M-7)*

Likewise, this point of view has also been echoed by the industry.

*"With the exception of socially focused projects, any potential partnership with universities must be financially feasible. I'm a businessman. I'm looking for financial interests in the first place and generating additional sources of income for my facility." (I-9)*

Moreover, opportunities for career progression were also one of the drivers for such collaborations. It has been noted that some of the outcomes of research partnerships are published in relevant conferences and journals. Research productivity is one of the key performance indicators (KPIs) for attaining success in academia as it relates to promotion and other advantages of the profession, as well as higher education institutions' prominence as it relates to the world rankings. As one academic expert stated:

*"[…] or also for career promotions, where usually academics benefit from partnerships and produce scientific outputs." (U-16)*

With the omnipresence of digital transformation in society, participants from all three categories have also stated that such collaborations contribute to the goals of Vision 2030 and the fourth industrial revolution in the country. In such research partnerships, all partners can benefit from localising and adopting specific new technologies as part of the kingdom's innovation ecosystem. It was also noticed that several agreements were established with other national/international educational institutions and independent research centres for adopting new technologies and commercialising research. This is exemplified by one of the university experts:

*"Also, to strengthen our Knowledge community, I was the academic supervisor of one of the initiatives aimed at adopting specific technology in the field of [...]. This collaboration was between the university's various scientific disciplines of [... and ...] and a number of private sector companies in the technology industry at the domestic and international levels. The technology we adopted was later put on the market and successfully invested in for the university." (U-10)*

Inter-organisational collaborations may include complexity in IP arrangements because they can lead to new inventions. University and intermediary actors revealed opportunities created by some successful collaborations that urged them to develop and facilitate IP arrangements. Accordingly, universities have developed dedicated programs to facilitate IP management and technology licensing to commercialise research and provide innovative solutions. These programs take multiple forms and have diverse responsibilities, such as obtaining patent protection, creating spin-off companies, and coordinating industry access to university research. As one intermediary expert added:

*"I have participated in one of the collaborative initiatives with the private sector. One of our services at [...] was to build a prototype for creative ideas provided by students and academic members. As well as to test the feasibility of this idea and validate it in the sense of its applicability in the market or its lack thereof by transforming the idea into a minimum viable product (MVP)." (M-2)*

One of the most important outcomes of such collaborations is facilitating students' training and employment preparation, where the duration of such training programs may vary, e.g. post-graduation ones may extend up to two years. This was remarked on by an industry expert, who stated:

*"As a businessman, I have participated in some universities for two years. […] I provided information to students through lectures and practical applications in […]; I was training students on an ongoing project through my company. I also took students on field visits to relevant stakeholders." (I-8)*

Another aspect of students' employment was shared by one of the intermediary actors as follows:

*"[…] students graduate from universities after completing a certain degree and apply for jobs in whatever sectors and universities are proud that they prepare their students for the market. The model we have not seen is that some students, instead of job seekers, have become job generators. In other words, given the increased awareness of entrepreneurial practices among academia, some students may be able to set up a company even to recruit their peers. This way of thinking is new to academia and even society, whether that job generator is a student or an academic!" (M-3)*

In addition, this study found concurrence among participants from different categories on the importance of collaborations for co-branding purposes, as a university expert highlighted:

*"[…] and partners benefit from each other in such a collaboration. For example, some companies benefit from prestigious universities as propaganda by glorifying and marketing themselves, especially in advertising campaigns or initiatives." (U-1)*

In general, collaboration opportunities often arise from existing personal relationships. New relationships can also emerge, leading to new alliances with potential new partners. For successful partnerships, all actors must be keen to build and maintain collaborative relationships and expand the network. One of the industry participants mentioned:

*"We can benefit from universities' offices of expertise as they comprise a distinctive group of academics. This also helps us to build a relationship with them to serve our goals, raise the efficiency of our business, and increase our societal impact." (I-5)*

Sharing resources to achieve compatible mutual benefits at different levels is one of the most significant pursuits of such collaborations. Often, an agreement will only occur if partners, universities or industry organisations guarantee the benefit in return. Industry actors usually seek tangible and intangible human, financial, logistical, and knowledge resources. For example, one of the university's experts commented:

*"We are all interested, in the first place, in what benefits can be earned in return. That is, partners focus on what resources can be exchanged in such a collaboration, tangible and intangible ones, such as financial resources, development solutions or potential opportunities." (U-15)*

One intermediary expert reaffirmed this by noting that mutual benefit is not necessarily seen as a goal of such collaboration. On the contrary, resource sharing may be in the project's initial stage, especially in emerging technological projects. Mutual benefits are apparent during the project, where there is considerable knowledge exchange.

*"As I said about the project […], we divided the tasks and funding between partners so that they took over the hardware and provided the specialists who were doing […]. We were responsible for the part*

*of the development and […]. This has been interspersed with frequent meetings/field visits, which was an added value for all of us." (M-1)*

It is also noticeable that academics are keen to gain relevant practical experience because most have no industry experience, whereas some experts also raised a lack thereof as a barrier. Thus, collaborations can benefit academics and strengthen their expertise in different aspects. This was illustrated in the following academic's response:

*"In my personal experience. I have been seconded several times. In addition to the professional advantages in terms of experience/skills developed, I noticed an improvement in my teaching style. Considering the broad spectrum of majors, I have linked theoretical concepts with real-life examples and applications, which helped my students better understand the curriculums." (U-14)*

Community and social-focused projects have received a wide range of attention from participants from all categories who responded to this study. For example:

*"As an academic, sometimes I participate in social projects, where it serves society, contributing to its development, helping to build it and tackling a range of problems, as happened in […]." (U-14)*

Also, it is noteworthy that large companies undertake more socially oriented projects than small ones under corporate social responsibility (CSR). Since large companies have more human and financial resources, they can support community projects and engage with universities, as highlighted by one of the industry experts:

*"Yes, most of us are interested in the concept of CSR, which is an excellent motivation for us to continue to serve the community. But our contributions hardly compete with large companies that maintain an annual budget for CSR, where they support universities and the R&D sector." (I-1)*

Concerning the reputation gained, each partner can benefit from engaging in UIC to attract more collaborative partnerships. One of the academics expressed that:

*"[…], we were keen to partner with different organisations across different sectors such as [… and …] that were related to … at the local and global levels. Some of them were intended to earn a good reputation for us and thus gain the confidence of potential partners." (U-17)*

In addition, a reputation goes beyond individual gain for academic or non-academics, where partners can gain a good reputation due to these collaborations. Some industry actors recognise reputation as one of the essential selection criteria, as one industry expert revealed:

*"One of the criteria for selecting a partner […] that we are eager to collaborate with is based on its reputation in the area of […]." (I-10)*

Also, committed partners and mutual commitment can influence the success of such collaborations, as one of the participants clarified:

*"From my experience, mutual commitment incentivises industry actors to ensure their continuity with the university. It raises their appetite for more collaborations. In other words, if external partners*

*believe in the usefulness of the patent and its possibility of being transformed into a product that may contribute to their growth, they will adopt patents within their production lines. Some may be unwilling, but some may even support you by building MVP and helping you grow further." (U-13)*

### 4.4.2 Expert Interview Insights- Barriers to KT/TT-UIC Activities

Interviewees from different categories indicated that an organisation's proximity and geographical distance affected the strength of its relationship with others. Building productive relationships is more accessible to those in close geographical proximity, e.g. city centres. University and intermediary experts affirmed this view:

*"[...] we are in a small city; the volume of partnerships and work cannot be compared against that of other universities in large cities as their location […] entails the existence of a larger number of companies and factories in their vicinity." (U-12)*

*"Building a relationship with the private sector is not always easy. Add to this that when your organisation is geographically distant from major industrial areas, this is also a barrier that is often difficult to address." (M-8)*

Through the process of data collection, it is evident that the equivalency and compatibility of university governance and regulations with some local ministries and government agencies have led to the possibility of forming solid ties with them. Thus, university experts have explained that cooperating and negotiating with governmental agencies is more manageable than dealing with the private sector, contributing to their weaker relationships with those bodies. One of the university experts stated:

*"We have succeeded in cooperating across many government agencies [...], and we experienced that dealing with them and addressing potential challenges that usually arise during partnerships are more affordable than in the private sector." (U-10)*

Intermediaries also expressed concerns about their dependence on university resources for collaboration activities. Their reliance on university resources has hindered their progress in extending their services with existing and new partners.

Within universities, academics focus primarily on academic duties and only engage with their peers to exchange knowledge. This often cuts them off from professional networks and confines their activities to the limits of the relationships they have built through their careers, also known as academic isolation. One university expert expresses an example of this matter:

*"Academics are often devoted to universities and purely academic work through their teaching and research activities, where they gradually disappear with the glamour of titles and stability of jobs [...], causing their academic isolation." (U-3)*

Moreover, this study found that one of the most prevalent features was weak ties within universities, posed by poor communication and negotiation skills. As one industry expert said:

*"We noticed the imbalance and lack of communication within the same university entities [...], as many decision-makers approached us about the same project, which confused us because we could not determine who exactly we could establish an agreement with!" (I-11)*

It is also apparent that the discriminative treatment, in terms of inequity and favouritism among academic settings (either between academics or between them and industry actors), also constrains such collaborations from thriving. One of the university experts disclosed:

*"[…] some activities are sometimes confined to a group of university individuals. That is why such collaboration benefits are not extended to the majority who may contribute if they have a suitable opportunity." (U-2)*

University bureaucracy was the most common concern posed by many participants and was one of the leading causes of discouraging participation in such collaboration activities. Additional structural barriers are also cited, such as the complexity of the organisational structure, ambiguity and inflexibility in internal policies, and tardiness in financial decision-making.

A quote from one of the university participants is:

*"... Bureaucratic and functional sagging in the universities. There is a big difference between working for a private corporation owned by one person, where decision-making is more flexible, compared to universities with complicated rules and procedures and overlapping authorities' control." (U-11)*

Likewise, an industry expert resonated with this sentiment:

*"We demonstrate agility in the decision-making process, and we have more clarity regarding the financial authorisation and delegation, unlike universities […]. We sometimes find it difficult to establish partnerships with universities..." (I-5)*

Since intermediaries are affiliated with the universities, they are also exposed to the universities' structural barriers. One intermediary expert emphasised:

*"The private sector is flexible and agile, while it takes a while in universities to make such an effective decision. This indecisiveness negatively impacts […] our potential collaborations, mostly caused by the university's bureaucracy, which affects us too." (M-5)*

Academics also identified different leadership styles which either facilitate or impede collaboration activities. As mentioned by a participant:

*" Some universities are inflexible and hidebound; therefore, their network is limited, such as [...]. While others, which are few, [...] have an open appetite for diverse partnerships. This depends on the university's policies, research directions, and leadership style." (U-9)*

Similarly, this study found that ineffective intellectual property (IP) policies have played a role in delaying and disrupting knowledge/technology transfers across sectors.

Moreover, overlapping in university authorities is a prevalent issue, which also causes internal competitiveness among internal members. It revealed that several entities with similar authorities are functioning in activities similar to UIC activities, i.e., competing. As a participant stated:

*" Unfortunately, more than one entity is competing for the same opportunities within some universities, for example [...]. So they are competitors rather than complementing each other towards the success and prosperity of such collaborations." (U-2)*

Like university experts, intermediaries have also experienced overlapping authorities within the internal university entities. Some intermediaries mentioned their urgent need for an integrated business model, in which a lack thereof impedes their development. The visionary business models can then contribute to structuring their affiliations across sectors and configure their innovative ecosystem to grasp further opportunities. Other intermediaries stated that the existing organisational structure posed a challenge. Some mentioned that they experienced a lack of proper governance as a structural barrier. For example:

*"One of the toughest problems encountered is the administrative structure because some academic staff were appointed in senior management positions. […] needs staff with considerable experience in both sectors and know business jargon. […] they should be aware of how to grab opportunities in the market." (M-2)*

Several university participants mentioned the frequent change and turnover rate of decision-makers and how that can impact the university's established relationships and ongoing projects with the industry. When a decision-maker leaves, the pre-existing ties with external sectors weaken or sometimes disappear, and a just-hired one often appoints new policies and directions. One participant expressed:

*"[…] everything stopped due to the change of officials who are responsible, and this negatively affected the confidence of our partners." (U-5)*

The industry experts also mentioned the change in the university decision-makers and how it caused network instability. A quote from one of the industry participants:

*"We have also faced challenges in building a long-lasting relationship with universities due to ongoing changes in their administrative and organisational structure, as sometimes we have had to re-establish agreements for existing projects with the university." (I-2)*

On the contrary, this study also discovered that network stability could encourage members to lean on their comfort zone (and rely on existing strong relations/ties, as mentioned earlier), which is also classified as a hindrance to the prosperity and development of such collaborations.

*"[...], yes, in government jobs with long-term contracts generally, you settle and drift over times to the extent you might stop developing your abilities as you continue to perform alike duties for long periods as long as the job is assured." (U-4)*

University actors mentioned a lack of trust as the industry actors' unwillingness to share and exchange information during/after the partnership due to their fear of leaking their data to other competitors. Moreover, since publication

is an expected KPI in academia and is one of the KT/TT activities, academics are concerned about the unwillingness of industry actors. An example of a lack of trust shared by a university expert is:

*"Unfortunately, sometimes we are not able to publish or talk about results of our collaborative projects that are rich in data where they are kept hidden and remain confidential between partners." (U-16)*

An inferiority view towards academics' work was also reported from an industry perspective, which demotivates academics from participating in such collaborative activities. A lack of trust is also reflected in uncertainty towards academic partnerships, either because of unsuccessful experiences with universities in the past or the poor reputation formed over time. One industry participant stated:

*"Our relationship with universities is somewhat unstable. They are uncertain about their desire to partner with us. [...] and we found that unsustainable short-term engagements can be an issue; you need a long-term engagement to build that trust!" (I-4)*

Experts from intermediaries also believe that a lack of trust is raised from both the industry and university sides. The industry actors do not show enough interest and consider universities are not market-ready for such collaborations. Intermediaries also pointed out that the industry is not cooperating in this space. An example shared by a participant is:

*"Universities must keep updating and modifying their systems and mechanisms to improve the quality of outcomes in line with the constantly evolving market requirements." (M-4)*

Furthermore, this study revealed that lacking a sense of belonging/identity is one of the most common behaviours among university actors. It has also noted that this behaviour can be attributed to inflexible governance and policies (as mentioned in the structural dimension above). The lack of clear KPIs in the organisation leads to uncertainty about the organisation's collective objectives, and weak incentives discourage individuals from collaborating, ultimately leading to academic isolation. For intermediaries, they proclaimed that their lack of organisational belongingness is caused by the nature of their role as a 'middle-man', which is usually surrounded by a high level of complexity. As one mediator put it:

*"We have experienced a challenge in determining our organisational identity because we are affiliated with the university and belong to the entities of […]. Another internal challenge is the difference in our frames of reference regarding regulations and mandates compared to the universities with which they are affiliated." (M-6)*

Most academics have the "know-how" and tremendous knowledge about their field of speciality. However, they need to gain more interpersonal skills, thus hindering them from keeping pace with the industry because they are, in most cases, described as 'pure academics'. Likewise, time constraints and workloads for academics have often been mentioned as a barrier that deters academics (who are willing to participate in these activities) from their intent to do so, which may lead to academic isolation over time. An assertion from one of the university experts:

*"Our challenge is to transform such an academic [who is interested in engaging in such collaborations] into a businessperson. This means integrating and expanding their focuses and interests from the scholar world of scientific matters into the business world." (U-11)*

Similarly, inadequate and inconsistent rewards/incentives provided by the university or industry also hinder individuals (i.e. academics) from participating or re-participating in such collaboration activities. One of the participants specified:

*"Incentives include rewards and appraisals besides financial rewards, which are very important. [...] I cannot work on a project that is time-consuming without any convenient reward in return." (U-14)*

Also, a lack of teamwork in the academic environment has been referred to as a cultural barrier towards sharing resources within universities. As shared by one of the university participants:

*"[...] we seek support from other entities within our university [regarding such collaboration], and they often refuse or neglect our requests." (U-5)*

Continuing with the above theme, the industry also mentioned individualism as one of the cultural barriers. They pointed out that individualism is almost widespread within the ecosystem but is more evident within academic settings, according to their experience with universities during such collaborations. One of the reasons was the lack of a sense of belonging to the organisation. Consequently, some individuals strive to earn and attribute success to themselves, distancing themselves from their organisations. The emergence of individualism in academia appears to be a foreseeable consequence of their lack of teamwork among themselves, as noted by one university expert:

*"If you pay attention to that […], there is no significant cooperation within the university's internal entities; each unit operates individually rather than cooperating to tackle the problem." (I-12)*

Both academics and non-academics who join intermediary organisations have also experienced similar challenges in adapting to these new settings. They have been forced to shift from the regular practices they were accustomed to towards new roles and responsibilities for such collaborations. Industry actors also mentioned the urgent need for new or improved business practices to contribute positively to innovation and research commercialisation. An industry participant said:

*"While intermediaries, located within universities, are supposed to bridge gaps between universities and industry organisations, some of them are still managed by academic culture/standards. [...] a new social norm is what they should bring to the table." (I-1)*

Mutual commitments are embodied in reciprocity between stakeholders to succeed in such collaborations. Limited dedicated resources, poor environmental settings, and difficulties in prompt hiring professional/qualified employees are recognised as challenges for managing and commercialising IPs to obtain internal/external support for innovation. The inadequate infrastructure preparation and the lack of basic facilities constrain KT/TT-UIC activities by affecting the ability to provide an attractive environment for researchers first and then for the industry, such as ineffective project management professional services. Some academics also revealed that they need to accelerate the hiring process for experienced and qualified employees. For example, two different quotes highlighted this barrier:

*"Universities need more technology infrastructure to meet industry needs and to serve researchers to build minimum valid products (MVPs). […] development needs money, […] it is a tough challenge! We*

*have been endeavouring to handle the bulk of patents and other IPs that are not marketable or convertible to products at the current status and condition. […] a further challenge is to give up some patents [...] to save money for other critical related matters." (U-13)*

Academics have also underlined the inconsistent funding from other industry actors in some related activities, where inadequate resources have been a significant cause of weakening partnerships.

Similarly, the industry also mentioned the scarcity of dedicated resources, including financial ones, to manage and commercialise IPs, impacting the mutual commitment and trust between partners. One industry expert expressed this:

*"When considering university, 'do they have money for this?' Sometimes, the university has a massive grant for conducting scientific research; however, when it comes to materialising and commercialising research, they do not have enough budget because they do not understand that." (I-4)*

Moreover, this study indicates that cross-organisational cognitive differences, alongside the nature of the organisational structure and institutional culture, have contributed to increasing ambiguity over time. Regarding cultural diversity within the ecosystem, it has been observed that over time, this obstacle has resulted in a deficiency of shared language, causing communication breakdowns among partners and thereby undermining collaborative efforts. The industry has also highlighted the significant cultural divide arising from differences in cultural practices across sectors.

University actors argued that the industry must gain awareness of universities' facilities and expertise, while universities require assistance conveying their research value to attract potential investors. One participant serves as an example of this challenge.

*"We know the private sector focuses more on earning financial profits than anything else. Thus, our challenge is to convince the private sector that our experts can help them not only in fixing/reducing production issues but also in developing that." (U-6)*

In addition, industry participants noted that the absence of a shared culture intensifies the lack of common ground, resulting in poor communication among partners. They stressed the importance of an intermediary for translation purposes to achieve a point of convergence, as one participant emphasised:

*"The challenge we face is that there are no common interests! We will not understand each other unless there is a translator or knowledge broker; then, we can share a similar ambition or mandate." (I-4)*

Moreover, intermediaries are perceived as an investment arm for their affiliated universities and can play a crucial role in maximising revenue streams for universities by facilitating TT and commercialisation activities. However, there can be misinterpretations between universities and their in-house intermediaries concerning commercialising research-based products and maximising revenue streams. Intermediary participants expressed concerns about the pressure to find practical approaches and mechanisms to achieve that. As one of the participants explained:

*"Universities nowadays seek financial gains, and there needs to be a clear understanding regarding investment in IPs (e.g. patents), which requires time and diverse transformations before being ready for*

*commercialisation. […] mindset is different, which makes addressing such issues a real challenge!" (M-3)*

Besides, industry participants identified a misconception of the technology readiness level (TRL) between partners during their collaborative efforts. [According to Mankins (1995, p. 028), "TRLs are a systematic metric/measurement system that supports assessments of the maturity of a particular technology and the consistent comparison of maturity between different types of technology"]. The inconsistency in perspectives, attributed to cultural and professional differences among heterogeneous participants, caused this matter. Additionally, limited resources to support cooperative activities across organisations led to a misinterpretation. As an illustration, an industry participant expressed surprise at the university partners' eagerness to commercialise a technical product that the participant believed was not yet ready for launch.

Also, cognitive differences among partners can hinder the success of collaborative efforts. Thus, regular communication can help to establish a system of meaning among partners, but experts have noted that differences in knowledge backgrounds and work domains can contribute to this dilemma. Research is typically categorised as either basic (knowledge-specific) or applied (solution-driven) research, which some industry actors may misunderstand or underestimate research goals. According to one participant, this has been reported by academics who accused it of being too theoretical.

*"[…] they (industry actors) often seek the end product in line with market demands, regardless of those methodological and theoretical aspects that may only be of interest to academics; and that is contrary to the nature of the research that requires time to conduct and materialise!" (U-2)*

Other industry experts reinforced the misalignment and lack of applicability of scientific research with some viewpoints that explained why there was a reluctance from the industry to cooperate with universities. For example:

Industry experts underscored the misalignment and lack of applicability of scientific research, contributing to industry reluctance to collaborate with universities. Some viewpoints were shared to elucidate this:

*"Most universities' research projects take years to materialise outcomes and to be applicable, in which the private sector does not have the luxury of time to wait for those results." (I-11)*

Industry participants noted the need for shared goals related to the mentioned issues. One industry participant supported this by stating:

*"Academics conduct research and dive into theories, whereas the non-academics [industry actors] discuss profits and business deals. These two pillars cannot incorporate each other unless they learn how to deal with their differences; translator or intermediary can help in tacking that […]" (I-9)*

One industry expert underscored the necessity of intermediaries in navigating such complexities:

*"[…] I have attended various events worldwide, and they all face the same issue. What happens is that these two sectors speak different languages. They are entirely unconvincing to each other, and the more*

*one sector tries to play the other's role, the worse the problem is. Here is where intermediaries should intervene." (I-4).*

Furthermore, most universities lack clear KPIs, which have been reported to be another common cognitive barrier. This increases gaps and cultural obstacles that eventually lead to individualism within the work environments. Another expert evidenced it:

*"[...] universities need clear guidelines to manage such collaborations, with clear KPIs to pursue and get motivated by […]." (U-1)*

This study uncovered a prevailing sentiment within the industry that most universities lack clarity on KPIs, impeding effective collaboration. Industry experts attributed this misalignment to the leadership style in universities, which has significantly shaped social norms and culture. The findings suggest that lacking KPI clarification and leadership style may hinder such productive collaborations. As one participant pointed out, this situation warrants attention and action.

*"The issue with universities and even their intermediaries is that they do not have clear KPIs. […] I have not seen successful products from universities or their intermediary organisations. One of the spin-offs I heard about was a prototype that still does not have a production line yet." (I-6)*

We also found that intermediaries agreed with the university and industry actors' viewpoints on the lack of clear KPIs at universities, which caused confusion and a lack of clear vision. One of them emphasised:

*"There should also be clear indicators to evaluate the intermediaries' performance [...], especially in research commercialisation activities […]. Up to now, several matters have been ambiguous." (M-6)*

Moreover, different interpretations and the lack of shared value between partners rely on the organisations' culture to facilitate reciprocal understanding. This study found that the industry's difficulty in recognising university structuring and the nature of research leads to different interpretations of time frames for the university. One participant emphasised this challenge:

*"[...] We apply for a project with a private sector that can finish the project within one to three months. But we, in the university, request a period of four to six months for the same project completion." (U-2)*

Likewise, industry participants also noted having different interpretations of time-frames with university partners. This issue was raised by them as well:

*"Understanding of time-frame by n universities and private sectors is different. […] the university provided me with an unattainable timeline to implement a commercialisation process."(I-4)*

## 4.5 ANALYSIS AND DISCUSSION OF INTERVIEW DATA GUIDED BY THE SC THEORY LENS

This section delves into the empirical data through the lens of SC Theory, specifically examining its three distinct dimensions: Structural, Relational, and Cognitive. Each dimension provides unique insights into the dynamics of such a collaboration.

Accordingly, the insights obtained from in-depth interviews are interpreted through the theoretical lens of SC theory, focusing on its structural, relational, and cognitive dimensions as outlined by Nahapiet and Ghoshal (1998). A thematic analysis uses the interview data to understand the factors influencing such collaborations. This approach allows for a holistic view of the participants' lived experiences, encompassing drivers and barriers, and contributes to the literature on SC and the KT/TT-UIC context by mapping these factors onto the dimensions and sub-dimensions of SC theory. Importantly, this research identifies inter-organisational factors related to KT/TT-UIC from the perspectives of multiple stakeholders, including universities, industries, and intermediaries, thereby enhancing our understanding of the complex dynamics in the UIC setting and advancing this field of study.

Table 4.3 summarises the main drivers and barriers to KT/TT activities in the UIC setting, focusing on the perspectives of universities, intermediaries, and industry organisations. Additionally, the table highlights overlapping insights to provide a more comprehensive understanding. For example, the notation (U | I) indicates insights mentioned by experts from both university and industry organisations.

Moving forward, a summary of the conducted data analysis is provided in Table 4.3. Subsequently, the following sections delve into a comprehensive discussion of the empirical findings, exploring their alignment with the theoretical framework of SC theory. The structural dimension, examining network ties that aid knowledge exchange, is discussed first. Relationship quality and trust among UIC partners are assessed in the relational dimension. Analysis of the cognitive dimension reveals shared goals and values. The discussion illustrates how these dimensions enhance the UIC ecosystem by developing embedded resources. This comprehensive approach clarifies the mechanics of SC in UICs and suggests ways to strengthen these networks. Furthermore, suggestions are proposed to incorporate enablers derived from literature and participants' lived experiences, aiming to enhance and critically assess the discussion, ultimately fostering a deeper understanding of UIC practices in the MENA region.

Table 4.3: A Summary of Data Analysis Guided by the SC Theory Lens

| 1st Order Coding (Concepts) Drivers | 1st Order Coding (Concepts) Barriers | 2nd Order Coding (Themes) | Aggregate Dimension |
|---|---|---|---|
| ▪ Utilising geographical proximity (U \| M \| I)<br>▪ Incorporating similar governance structures within public sectors (U \| M) | ▪ Being geographic distance (U \| M)<br>▪ Tackling instances of miscommunication within the university (I)<br>▪ Experiencing persistent reliance between the in-house intermediary and affiliated university (U \| M)<br>▪ Depending on government entities for support (U)<br>▪ Overcoming academic isolation (U)<br>▪ Addressing internal inequity and favouritism within the university (U) | **Tie Strength** | **Structural Dimension** |
| ▪ Initiating a collaborative model (I)<br>▪ Seeking additional sources of income (U \| M \| I)<br>▪ Pursuing funding opportunities for equipment/lab (U)<br>▪ Actively seeking possibilities for career progression (U)<br>▪ Promoting research publication (U)<br>▪ Exploring opportunities for new technology adoption (U \| M \| I)<br>▪ Pursuing opportunities for creating and commercialising IPs (U \| M \| I) | ▪ Managing university bureaucracy (U \| M \| I)<br>▪ Handling challenging government payment terms and conditions (U \| M \| I)<br>▪ Resolving situations with overlapping authorities in internal entities and university-intermediary (U \| M)<br>▪ Adapting to various leadership styles within the university (U)<br>▪ Rectifying ineffective IP policies (U)<br>▪ Lacking influential organisational structure in the in-house intermediaries (M)<br>▪ Implementing clear governance in the in-house intermediaries (M)<br>▪ Developing an integrated business model in the in-house intermediaries (M) | **Network Configurations** | |
| | ▪ Dealing with instability among university decision-makers (U \| I)<br>▪ Stepping out of comfort zones and embracing risks (U \| M \| I) | **Network Stability** | |
| ▪ Offering work-integrated learning for students (U \| M \| I)<br>▪ Leveraging co-branding opportunities (U \| M \| I)<br>▪ Building and maintaining collaborative relationships (U \| M \| I)<br>▪ Sharing resources for mutual interests/benefits (U \| M \| I) | ▪ Persuading external partners to share information (U)<br>▪ Facing inferiority views towards academics (U)<br>▪ Having uncertainty towards academia (I)<br>▪ Addressing market readiness and maturity level (M) | **Trust** | **Relational Dimension** |
| | ▪ Experiencing a lack of a sense of belonging and identification (U \| M) | **Identification** | |
| ▪ Focusing on gaining relevant practical/industry experience for academics (U)<br>▪ Seeking potential reputational gain proximity (U \| M \| I)<br>▪ Engaging in community and social-focused projects (U \| M \| I) | ▪ Offering insufficient university rewards for accomplishments (U)<br>▪ Coping with inconsistent industry funding (U)<br>▪ Balancing time constraints and heavy workloads (U)<br>▪ Undergoing a lack of teamwork within the university (U) | **Social Norm** | |

| 1st Order Coding (Concepts) Drivers | 1st Order Coding (Concepts) Barriers | 2nd Order Coding (Themes) | Aggregate Dimension |
|---|---|---|---|
| | ▪ Enhancing inadequate interpersonal skills of academics (U \| I)<br>▪ Confronting individualistic academic culture (I)<br>▪ Adapting to build collaboration in new settings (M) | | |
| ▪ Encouraging committed academics (U) | ▪ Securing dedicated resources (U \| I)<br>▪ Improving poor environmental settings (U)<br>▪ Recruiting competent personnel when needed (U) | **Mutual Obligations** | |
| | ▪ Communicating research values to attract potential investors (U)<br>▪ Raising self-awareness of university facilities and expertise (U)<br>▪ Lacking shared values among partners (I)<br>▪ Clarifying interpretations of revenue and impact in university-intermediary (M)<br>▪ Correcting academics' misconceptions of technology readiness level (TRL) (I) | **Shared Culture** | **Cognitive Dimension** |
| | ▪ Aligning research goals and reducing misunderstandings (U \| I)<br>▪ Addressing the lack of practical KPIs in universities (U \| M \| I)<br>▪ Encountering the absence of a clear vision in universities and in-house intermediaries (M \| I)<br>▪ Managing differing interpretations of time-frame (U \| M \| I) | **Shared Goals** | |

### 4.5.1 Discussion on the Structural Dimension

Drawing upon the SC theory, the structural dimension is embodied among partners as a pattern of interconnected relationship networks of inter-organisational entities. This study presents evidence of various KT/TT activities, such as consulting services and research partnerships, that partners engaged in to establish and sustain their structural networks. These findings align with earlier studies that highlight factors motivating partners to participate in such activities, including opportunities for career growth, technology adoption, and acquiring additional financial resources (Klofsten et al., 2019; Hossinger, Chen & Werner, 2020). On the other hand, the empirical evidence highlights that miscommunication within and between universities and industry is a noteworthy constraint. This emphasises the need for university leaders to define and communicate a shared attitude and behaviour towards effective communication in academic communities (Klofsten et al., 2019). To strengthen network ties, frequent and meaningful communication and mutual trust are essential (Plewa, Korff, Johnson, et al., 2013; Al-Tabbaa & Ankrah, 2019). It builds on previous research by suggesting that meaningful communication through effective meetings and informal activities within universities plays a vital role in promoting open and interactive communication, increasing the comfort and possibility of sharing knowledge, and

enhancing understanding of individual and partner needs. Such a role is crucial in strengthening organisational adaptability and responsiveness to external conditions and ideas (Michael D. Santoro & Gopalakrishnan, 2000).

This research project argues that the lack of clear purpose and shared meaning inhibits purposeful communication and translation activities (i.e. intermediation role). In the same vein, the rigid and bureaucratic character exhibited by the university system constitutes an impediment to the promotion of KT/TT-UIC activities (de Wit-de Vries et al., 2019), thereby obstructing the cultivation of shared comprehension and reciprocal trust and impeding the establishment of UIC agreements (Lopes & Lussuamo, 2020), which is primarily responsible for the efficacy of UICs. While it is customary for universities to maintain a certain level of bureaucracy concerning KT/TT activities (Alexander & Miller, 2017), there is a growing apprehension that some institutions require more effective policies about KT/TT and Ips or that the existing approaches may need more efficient implementation. These concerns are still subject to further deliberation and discussion. The findings also align with previous studies by Inkpen and Tsang (2005), Villani, Rasmussen, and Grimaldi (2017), and identifying strategic geographical proximity in facilitating successful KT/TT collaborations. Lack of proximity negatively affects collaboration activities. To address this constraint, it has been suggested that leveraging the benefits of the geographical location can be achieved by directing research efforts towards issues that are relevant to the geographical area. In addition, augmenting network ties by promoting communication and physical interaction is essential to strengthening the collaboration between universities and industries. Correspondingly, in line with Al-Tabbaa and Ankrah (2019), it is recommended that UICs prioritises pre-existing relationships between committed partners to address instability. However, institutionalising the partnership effectively is crucial to mitigate potential partnership issues due to the departure of key personnel, as personnel turnover during collaborations can have significant effects.

### 4.5.2 Discussion on the Relational Dimension

The relational dimension is critical to effective collaboration (M. D. Santoro & Bierly, 2006; de Wit-de Vries et al., 2019). The empirical evidence has presented insights confirming that working collaboratively requires establishing and maintaining positive relationships. This involves building mutual trust, respect, and understanding and establishing norms and obligations that guide the behaviour of all parties involved. Effective collaboration also requires a sense of identification or shared purpose, where all members feel invested in the success of the collaborative effort. In line with the potential driving forces and determinants to participating in such activities, these findings conclude that collaborating with partners can bring various benefits, such as enhancing relationships, sharing resources, providing learning opportunities, co-branding, gaining industry experience, pursuing community projects, improving reputation, and engaging academics. The current findings are consistent with previous studies, such as Plewa, Korff, Johnson, et al. (2013); Hossinger, Chen, and Werner (2020); Lopes and Lussuamo (2020); Perkmann et al. (2021). The reluctance to share knowledge can often be traced to a lack of trust. This research has uncovered that numerous underlying factors can lead to a lack of trust. For example, industry actors may be hesitant to share information out of concerns over losing their competitive advantage, or they may need to see the value in collaborating with other entities, which is consistent with de Wit-de Vries et al. (2019). Additional Insight reported by Tootell et al. (2020) is that a negative perception and attitude towards academics or local capabilities may contribute to a lack of trust. Uncertainty towards academia and concerns over the relevance of academic research to industry needs can also undermine trust. As for the perceived

value of such activities' outcomes can be influenced by the level of market readiness, leading to a potential lack of trust and reluctance to engage in collaborative efforts, which may ultimately impede innovation. It is essential to establish frequent and effective communication to address these challenges and strengthen network ties, particularly in the early stages, which can be instrumental in gradually and sustainably achieving shared goals (Plewa, Korff, Johnson, et al., 2013). Also, to establish and maintain trust with industry actors, universities can engage in applied research that involves graduate students collaborating with businesses. This collaboration showcases the university's ability to address industry issues and may enhance its production processes. Academic initiatives like internships and entrepreneurship programs can further enhance credibility and promote innovation (Lopes & Lussuamo, 2020). Furthermore, although individuals who share the same physical space of relations are organisationally proximate (Villani, Rasmussen & Grimaldi, 2017), this research indicates that it is not a decisive factor in determining an individual's sense of belonging to their organisation. Establishing a sense of belonging and identification is crucial to promoting engagement in such collaborations. It also suggests that universities can promote engagement and drive success in these associations by valuing and supporting their individuals through transparency, open communication, shared values, and a supportive organisational culture. Open communication and transparency foster trust and understanding (Plewa, Korff, Johnson, et al., 2013). Supportive organisational culture involves policies and practices that support collaboration, provide resources and incentives, and foster innovation (de Wit-de Vries et al., 2019).

### 4.5.3 Discussion on the Cognitive Dimension

In the cognitive dimension, the alignment of partners on shared culture (i.e. shared values) and shared goals is integral to their collective motivation and commitment within a UIC ecosystem. However, the formation of such collaborations can be impeded by epistemic disparities, which may result in cognitive barriers that obstruct effective communication and collaboration, thereby complicating the values and expected outcomes from the KT/TT activities. Lacking shared culture can also stem from differences in the nature and complexity of academic knowledge (basic vs applied research) (de Wit-de Vries et al., 2019) and a lack of shared values (Inkpen & Tsang, 2005). For industry partners, the practical relevance of research may be more critical for building collaborations than research quality alone (Muscio & Pozzali, 2013). Partners in the UIC context occupy significantly different realms of experience and hold heterogeneous knowledge sets (Hossinger, Chen & Werner, 2020). Consequently, the involvement of intermediaries is proposed as an enabler for overcoming cognitive barriers between partners (de Wit-de Vries et al., 2019; Albats, Alexander & Cunningham, 2022); however, the findings revealed that gaps and tensions persist even with the intervention of in-house intermediaries. Concerning shared goals that outline the degree to which network members share a collective sense and strategy for realising network progress and outcomes, findings indicate that shared goals enable partners to cultivate similar perceptions of interaction, fostering mutual understanding and the exchange of ideas and resources and facilitating knowledge integration, aligning with Inkpen and Tsang (2005). Over time, this process assists in lacking cultural differences by fostering shared understanding in UIC contexts where values are challenging to align. According to Al-Tabbaa and Ankrah (2019), formal contracts help create standardised rules and norms for partner behaviour, contributing to developing shared goals. While not indicative of mistrust, they represent a systematic approach to coordination. For instance, this research found that misunderstandings related to time-frames and deadlines are linked to how projects are managed and goals are set, and these issues were sometimes addressed through official contractual

agreements. Furthermore, it stresses the impact of a lack of guiding/practical KPIs within universities on fostering such activities, in which these KPIs need to be elucidated when engaging with other sectors (Inkpen & Tsang, 2005; de Wit-de Vries et al., 2019). As an enabler, this study suggests that opportunities to bridge these gaps are presented by the findings as follows: "*Industry and the university are two sides of the same coin. Only if a higher authoritative directs them with common strategies (goals), they work together to achieve a shared vision*" (I-1). Although considerable evidence supports establishing shared goals, partners scarcely discussed sharing organisational values. In line with Tootell et al. (2020), it is posited that the SC cognitive dimension of shared values may not be as vital in UIC as in other contexts where organisations with collaborative inclinations share common motivational factors. However, the extent to which both partners in the UIC context underline values, goals, and policies varies, indicating that while sharing culture and values may not be as significant in the UIC ecosystem, demonstrating a mutual acceptance and understanding of differences is essential for effective collaboration. This study suggests that potential strategies for overcoming these cognitive barriers may include utilising shared language and terminology, engaging in joint problem-solving activities, and developing a common understanding of each other's goals and priorities, with frequent communication assisting in bridging divergent viewpoints by enhancing the understanding of partners' needs (Plewa, Korff, Johnson, et al., 2013).

### 4.5.4 Developing Embedded Resources for the UIC Ecosystem

Overall, the empirical evidence obtained emphasises that evolving SC between partners structurally, relationally, and cognitively can facilitate KT/TT-UIC by reinforcing their embedded resources, like reinforcing network ties, maintaining mutual trust and social norms, and sharing common goals and culture, which is broadly in line with what concluded in previous studies Nahapiet and Ghoshal (1998); Chakrabarti and Santoro (2004); M. D. Santoro and Bierly (2006); Plewa, Korff, Johnson, et al. (2013); Steinmo and Rasmussen (2018); Al-Tabbaa and Ankrah (2019); de Wit-de Vries et al. (2019); Robertson, McCarthy, and Pitt (2019). Over time, developing embedded resources in the UIC ecosystem positively impacts partner interaction, collaboration potential, and the frequency of such activities. Therefore, this study demonstrates the interplay/interconnectedness and the importance of such interaction among SC dimensions, consistent with the perspectives of previous studies, such as Nahapiet and Ghoshal (1998); Steinmo and Rasmussen (2018); Al-Tabbaa and Ankrah (2019), where these dimensions are mutually reinforcing rather than one being antecedent to the others. As has been discussed by Al-Tabbaa and Ankrah (2019), interactions and networking among partners can build trust, and trustworthiness leads to a greater willingness to identify with each other and collaborate. Likewise, structuring relationships among partners during activities such as conferences can enhance the level of shared meaning between partners by promoting the exchange of experiences, while shared goals determine the activities in which university and industry actors engage, as well as vice versa. Trust between partners encourages the sharing of experiences during these activities. Another example is the positive influence of tie strength and shared goals on trust in inter-organisational relationships is countered by the negative impact of dissimilarities in knowledge and cultural differences, necessitating shared goals to establish a common understanding of desired outcomes and interpretation of such activities (de Wit-de Vries et al., 2019). For a further example, trust is positively associated with frequent communication, or what is referred to as affiliated ties, between partners. As partners communicate more frequently, they can better establish a shared understanding of each other’s perspectives, goals, and priorities, leading to higher levels of trust (Plewa, Korff, Johnson, et al., 2013).

## 4.6 CHAPTER SUMMARY

Drawing from the insights presented, Chapter 4 provides a general exploration of the UIC setting, with a comprehensive focus on the MENA region, specifically Saudi Arabia. It has employed a multi-faceted approach, combining systematic literature reviews and expert interviews to develop a deep understanding of the current UIC phenomena. This presents a broad overview of UIC research themes in the MENA region, contextualising these insights within the regional setting. This chapter has explored the theoretical foundations of SC theory and its applications in UIC studies. Through expert interviews, it has delved into the unique regional impacts on UIC activities in Saudi Arabia. Drivers and barriers to such collaborations were analysed through the structural dimension by exploring network ties that facilitate knowledge exchange, addressing relationship quality and trust among UIC partners in the relational dimension, and revealing shared goals and values in the cognitive dimension. This in-depth investigation has uncovered critical factors within the primary data collection context, providing a nuanced understanding of UIC dynamics, thereby addressing RQ1 and RQ2. Chapter 4, through synthesising insights from literature reviews and empirical data findings, has established a solid foundation of problem awareness that will inform the subsequent phases of the DSR study. In the following chapter, the suggestions for innovative solutions will be discussed further.

# 5 DSR | SOLUTION SUGGESTION

Chapter 5 presents a critical shift in this thesis by focusing on the second phase of the DSR process. This phase, essential in transitioning from theoretical frameworks to practical applications, suggests solutions. This stage emphasises articulating a potential solution after identifying and understanding the core problems within the UIC setting during the first DSR phase (Chapter 4). It involves suggesting a creative solution that is both practical and well-founded in theory, aiming to directly address the complexities and challenges identified in earlier discussions, setting a clear path toward subsequent chapters on implementation and evaluation of such a solution in real-world settings. This iterative approach refines and adapts the solution based on continuous feedback, reflecting the cyclical nature of the DSR methodology.

Chapter 5 starts with transitioning from theoretical exploration to practical application within the UIC setting (Section 5.1). This leverages DSR methodologies to propose actionable solutions to enhance these collaborations' effectiveness and efficiency. It begins with exploring the role of intermediaries in facilitating KT/TT-UIC activities, analysing various forms such as in-house subsidiaries and suggesting a novel digital platform intermediary as a solution to the identified problem. The discussion then progresses to identifying and assessing the design requirements for successfully implementing this digital platform, breaking these down into theoretical lenses of SC: structural, relational, and cognitive dimensions to ensure the platform's comprehensive functionality (Section 5.2). Building upon these foundations, the chapter moves to formulate tentative design principles, aligning each principle with specific design needs to address real-world challenges faced by UICs effectively (Section 5.3). The subsequent mapping of these design principles to corresponding design requirements is then presented (Section 5.4). This mapping is illustrated through a matrix that serves as a foundational tool, ensuring that each design principle is directly aligned with its corresponding design requirement to foster a purpose-driven development process. This methodical approach highlights the practical implications of the research and sets a foundation for the subsequent DSR phases towards developing and evaluating such a digital platform intermediary.

## 5.1 BRIDGING THE GAP BY TRANSITIONING FROM PROBLEM RECOGNITION TO SOLUTION CONCEPTION

### 5.1.1 Highlighting the Role of Intermediaries in Facilitating Collaboration within the UIC Setting

Intermediaries facilitate KT/TT-UIC activities by managing relationships across various boundaries among diverse stakeholders (Al-Tabbaa & Ankrah, 2019; Albats, Alexander & Cunningham, 2022b; Alexander & Martin, 2013). These intermediaries, such as cooperative research centres (UICRCs), help bridge cognitive gaps that often act as barriers to effective collaboration (Trune & Goslin, 1998; Howells, 2006; Villani, Rasmussen & Grimaldi, 2017; Takanashi & Lee, 2019). Moreover, challenges in the UIC ecosystem, particularly regarding successful collaboration and overcoming cognitive differences, have been noted in various studies (Klofsten et

al., 2019; Granstrand & Holgersson, 2020; Hossinger, Chen & Werner, 2020). Despite the recognised barriers, intermediaries are suggested to expand and enrich the ecosystem, facilitating better interactions and understanding among heterogeneous partners (Villani, Rasmussen & Grimaldi, 2017; de Wit-de Vries et al., 2019). However, there is a noted research gap in fully understanding and documenting the impact of intermediaries in reducing these barriers and fostering long-term successful UICs (de Wit-de Vries et al., 2019).

Examining their various forms is essential better to understand these intermediaries and their influence on UIC ecosystems. Based on the work of Alexander and Miller (2017) and Albats, Alexander, and Cunningham (2022), intermediaries can be classified into two main categories. The first category comprises physical or traditional intermediaries embedded within parent organisations (such as UTTOs), arms-length institutions external to hosts, and regional clusters. Regional clusters represent geographically concentrated networks of interconnected companies, specialised suppliers, and associated institutions in a particular field. The second category consists of virtual or digital platform-based intermediaries, which can be further differentiated into virtual communities that operate without a permanent digital platform and digital intermediaries that conduct activities entirely through digital infrastructures or web-based platforms. This classification helps to distinguish between different types of intermediaries based on their structure and mode of operation, providing a framework for analysing their roles within the UIC setting.

*Further details on digital platform intermediation within the UIC context are in Chapter 2 (Section 2.4).*

### 5.1.2 Investigating In-House (Arms-Length Subsidiary) Intermediaries Form

The empirical findings presented demonstrate the challenges faced by the UIC ecosystem in establishing effective collaboration practices. One of the key challenges revolves around the critical role of in-house intermediaries who act as bridges between academia and industry, balancing divergent goals and priorities. These intermediaries play a multifaceted role, serving as investment arms by identifying opportunities, providing resources, and facilitating knowledge-based activities within the UIC setting. Their contribution drives innovation and fosters successful partnerships within the UIC ecosystem.

However, findings indicate that despite numerous driving factors, stakeholders continue to encounter barriers that hinder their practical actions in such endeavours. Furthermore, these corroborate the findings of previous literature by Villani, Rasmussen, and Grimaldi (2017), demonstrating the effective facilitation of KT/TT-UIC activities by intermediaries, mainly when partners exhibit cognitive proximity. Moreover, the findings are consistent with prior research conducted by Alexander and Miller (2017) and Geoghegan, O'Kane, and Fitzgerald (2015), identifies two sources of barriers: (i) internal organisational tensions stemming from overlapping authorities and responsibilities, and (ii) challenges in coordinating mismatched priorities between academia and industry. While the latter is to be expected, the former creates unnecessary strain that can undermine shared goals with external stakeholders, thus making collaboration more challenging.

Additionally, this study highlights that when universities attempt to engage with industry by employing internal intermediaries, it can inadvertently create new tensions within the university itself. To address these potential challenges stemming from internal organisational tensions, in-house intermediaries must strategically establish their own well-defined and robust organisational structure. This empowers in-house intermediaries with the

necessary autonomy, clarity, and operational framework to effectively fulfil their roles and navigate the multifaceted challenges they encounter in facilitating such collaborations. However, they often come across challenges due to several resource-related challenges. Likewise, Alexander and Miller (2017, p. 387) recommend that in-house intermediaries, such as UKTOs, should be “required to devise their performance mechanisms, but they often lack resources, legitimacy, and power when faced with managing the complexity arising from the multiple and sometimes contradictory expectations of university environments in conjunction with external stakeholder expectations”. Therefore, while maintaining intermediaries in close proximity to universities may enable the leveraging of shared frames of reference, it can also introduce new tensions and competition.

Consequently, this research emphasises the ongoing difficulty of ensuring that knowledge is effectively communicated and shared without being misunderstood or overlooked in the complex and interconnected dynamics of stakeholder collaboration and the heterogeneous ecosystems of the UIC setting. It underscores the importance of preventing knowledge from being "lost in translation" and highlights the need for clear and effective communication among stakeholders to foster successful collaborations.

Hence, this emphasises the importance of understanding intermediaries' various structural arrangements and configurations and their impact on these settings. This lays the foundation for the forthcoming discussion section regarding potential arrangements and types/forms that can be integrated into the UIC ecosystem to overcome existing barriers.

### 5.1.3 Proposing a Digital Platform-Based Intermediary as a Solution

Building upon the earlier discussion, this study is an IT artifact as a proposed prototype for a digital-based platform intermediary as a solution artifact to bridge existing gaps within the UIC setting. While digital forms within the UIC settings and intermediaries are still relatively new and less prominent (Albats, Alexander & Cunningham, 2022), it suggests that digital platform intermediaries can serve as an innovation hub for actors within the UIC ecosystem- enabling connection, collaboration, resource exchange, and the sharing of expertise and assets within the UIC setting. As emerging tools and platforms, they have yet to achieve broad recognition or adoption. Leveraging the capabilities and untapped potential of digital platforms has the potential to significantly enhance collaborative efforts, foster the creation of new ideas, and facilitate the discovery of innovative approaches (Howells, 2006; Villani, Rasmussen & Grimaldi, 2017).

To address this, an innovative platform is referred to as the "iUIC platform" using the DSR methodology. The “iUIC platform” is envisioned as a socio-technical, multi-sided marketplace designed to act as an intermediary, connecting diverse stakeholders within the UIC setting. It aims to create a cooperative environment that enhances collaboration, optimises resource sharing, and ensures mutual benefits within the UIC ecosystem. Therefore, the proposed solution, the “iUIC platform”, undergoes comprehensive optimisation during the development phase. This involves thoroughly analysing the empirical findings previously studied from the interviews to derive a set of DRs that serve as the foundation for developing such an artifact's specifications and functionalities.

*Further details on the digital platform intermediation are provided in Chapter 2 (Section 2.4).*

#### 5.1.3.1 Existing Digital Platform Intermediaries in Enhancing Diverse Organisational Relationships: An Overview

Digital platform intermediaries are vital in creating connections and enabling value exchanges among stakeholders, playing a crucial role in the context of inter-organisational services (Pousttchi & Gleiss, 2019; Wallbach et al., 2019). Despite their widespread utility, there is a notable absence of platforms designed specifically for UIC at global, regional, and local levels. This section explores the need for a specialised platform tailored to facilitate inter-organisational collaboration, focusing on regional implementation- in subsequent sections. Subsequent sections will delve deeper into the capabilities of the proposed "iUIC," designed to address the evolving demands of UIC by providing targeted solutions that enhance the efficacy of these engagements.

Globally, platforms operating at the inter-organisational level and focusing on UIC activities are critically important in specific areas despite their limitations. These platforms should ideally support a variety of functions, including research collaborations, technology transfers, licensing, and brokerage to connect academic innovations with industry requirements seamlessly. Platforms like **In-Part**, which facilitates research collaborations; **Flintbox**, a technology transfer platform; **Yet2**, specialising in technology scouting and open innovation; and **TechScout**, focusing on technology scouting and brokerage, are examples of their distinct niches. They offer a combination of free and paid services to bridge the gap between academic research and industrial applications, thereby fostering some of the UIC activities. These platforms cater to diverse audiences, including universities, businesses, technology managers, and research institutions, helping them scout new technologies and commercialise research.

In the MENA region, a vibrant ecosystem of platforms exists to support entrepreneurship and innovation across various sectors. Notable platforms include **Wamda**, which provides entrepreneurial support and investment; **MAGNiTT**, a startup investment and data platform; **QSTP**, a research and development hub in Qatar; and **Berytech** in Lebanon, which aids in technology commercialisation and academic collaboration. These platforms enhance regional entrepreneurship by connecting startups with educational and investment resources, facilitating funding, and providing crucial market insights. While locally, in Saudi Arabia, several platforms such as **Etimad**, a government procurement platform; **Monsha'at**, which supports small and medium enterprises; **Takamol**, which focuses on innovation management in public sectors; and **CSR**, which coordinates social responsibility efforts, are instrumental.

Despite ongoing regional efforts, the MENA region continues to face a significant gap in having a comprehensive platform that effectively targets and facilitates KT/TT within the UIC setting. The **"iUIC platform"** outlined here is designed to bridge this gap by providing a specialised ecosystem for KT/TT activities specifically suited to the dynamics of UIC. This proposed platform is designed to enhance collaboration and drive innovation across various sectors by directly addressing the distinct needs of universities, research institutions, and industry partners to facilitate such collaborations.

## 5.2 DERIVING AND ASSESSING DESIGN REQUIREMENTS FOR AN EFFECTIVE IUIC PLATFORM IMPLEMENTATION

This section explains how to establish design requirements (DRs) for the proposed solution, detailing the steps and methodologies to ensure alignment with the solution's objectives (Vaishnavi & Kuechler, 2015). According to Gregor et al. (2007), DRs are generic and high-level criteria tailored to address the identified needs of the UIC ecosystem; these DRs guide developing a framework appropriate for a broad class of artifacts and must be contextualised within the operational environment. The purpose is to ensure that the DRs effectively address the needs of the UIC ecosystem. The "needs of the UIC ecosystem" refers to the meta-users-requirements that emerged from the qualitative expert interviews. These meta-users-requirements were identified as the key drivers and barriers within the UIC setting.

DRs are derived through an argumentative, discussion-based process guided by the SC theory lens, which emphasises the socio-technical perspective (Kapoor et al., 2021); to rigorously capture and translate the expert insights into well-defined DRs. This ensures that the DRs are closely aligned with the real-world requirements and challenges faced by the UIC ecosystem (Gregor et al., 2007). Concurrently, these DRs for the suggested solution, the "*iUIC platform"* artifact, are validated and refined in this phase.

The discussion-based approach involves conducting follow-up semi-structured interviews as part of an ex-ante formative evaluation, *(details are provided in Section 7.1)*. The primary goal of these interviews is to revisit and refine the empirical findings (meta-users-requirements) from the previous expert interviews within the UIC setting and gather critical feedback to derive DRs for the proposed solution. This then supports developing well-rounded DPs for the platform to ensure that DPs are both practical and tailored to meet the specific needs and challenges identified. Thus, this process allows for simultaneous validation of the DRs and enhances the conceptual framework, ensuring it aligns with empirical insights. This alignment and the detailed analysis are guided by the SC theory lens, as detailed in 4.4.

During the interviews, there was some uncertainty about how this proposed platform could be implemented and, more importantly, how it could address the needs within the UIC setting. One participant from a university commented:

> *" [...] and just not sure about the confidentiality of our projects and partners data [...] about this platform. While the idea is interesting, [...] I need to understand how it will comply with the university's policies for research collaborations and data sharing." (U-16)*

Another university representative expressed concern, stating:

> *"We need to ensure that any collaborative platform protects our intellectual property rights and the confidentiality of our research data. [...]I mean to maintain the integrity of our research and protect our assets." (U-1)*

So, while valid concerns were raised regarding the proposed platform, these were carefully noted and acknowledged to be comprehensively addressed through the DSR process, ensuring such an intermediary platform would meet the intended objectives and tackle such a lack of enthusiasm during the initial stages. At the same

time, there was a notable level of encouragement and support for the proposed intermediary platform, as it would fill a significant gap within the UIC setting, where no similar dedicated platform currently exists. The potential benefits of having such a centralised collaboration hub seemed to resonate with many participants, who recognised the need within the UIC setting. University and industry experts affirmed this view:

*"[...] I support this platform as it aligns with the current trend and effective mechanism in the business world. In Saudi […] and such collaborations are no exception [...]" (U-10)*

*"[...] A centralised platform for university-industry collaborations could streamline our processes and foster stronger partnerships." (U-5)*

*"[...] and this is such an amazing idea to have a platform that can facilitate our relationships with universities and ease our networking." (I-5)*

In the next section, the discussion delves into each SC dimension to derive design requirements (DRs) that address the diverse meta-user-requirements identified through qualitative expert interviews as key drivers and barriers within the UIC ecosystem. These meta-user-requirements span the structural, relational, and cognitive dimensions of SC theory. The DRs, presented in Tables 5.1 to 5.9, were further developed and refined with certain requirements excluded- marked as crossed out- if they fell outside the digital platform's core objectives. Finally, the proposed DRs are assessed for their effectiveness in meeting these meta-requirements, as detailed in subsequent sections.

### 5.2.1 Design Requirements: Structural Dimension

The structural dimension provides resources that offer a pattern of interconnected relationship networks among inter-organisational entities, encompassing the existence and formation of network connections, the strength and intensity of those connections, the specific configurations or patterns that the networks take on, and the durability and stability of those network arrangements over time.

**The structural dimension (tie strength)** refers to the quality and intensity of connections within the UIC ecosystem (i.e. social network). Strong ties are characterised by emotional closeness, frequent interaction, and reciprocal exchange of resources and support. In contrast, weak ties tend to be more diverse but less frequent connections. The empirical findings suggest that strong and weak ties (i.e. infrequent interactions, conferences, or short-term collaborations) facilitate UIC. One of the participants expressed:

*"We sometimes struggle to discover suitable academic partners for our projects. [...] yeah, and such a platform could streamline this process and open new avenues for collaboration." (I-5)*

Therefore, the digital platform should support mechanisms to foster both strong and weak ties among stakeholders. This leads to the following overarching DR that lays the foundation for addressing the specific drivers and barriers related to tie strength within the structural dimension as follows:

*DR1: The iUIC platform should facilitate the development and maintenance of solid ties through frequent interactions and resource sharing among stakeholders within the UIC ecosystem, fostering*

*strong and sustainable connections while also enabling the formation of new, diverse connections (weak ties).*

***To achieve this overarching DR, the following sub-DRS are derived from the identified drivers and barriers, as presented in Table 5.1:***

Table 5.1: A Summary of Data Analysis on the Structural Dimension (Tie Strength)

| 1st Order Coding Concepts \| Drivers | 1st Order Coding Concepts \| Barriers | 2nd Order Coding \| Themes | Aggregate Dimension |
|---|---|---|---|
| ▪ Utilising geographical proximity (U \| M \| I)<br>▪ Incorporating similar governance structures within public sectors (U \| M) | ▪ Being geographic distance (U \| M)<br>▪ Tackling instances of miscommunication within the university (I)<br>▪ Experiencing persistent reliance between the in-house intermediary and affiliated university (U \| M)<br>▪ Depending on government entities for support (U)<br>▪ Overcoming academic isolation (U)<br>▪ Addressing internal inequity and favouritism within the university (U) | Tie Strength | Structural Dimension |

Geographical Overcoming pertains to leveraging geographical proximity to enhance stakeholder collaboration and knowledge-based activities. The findings indicate that geographical proximity can be both a barrier and a driver for UIC. While local proximity can facilitate stronger ties and collaboration among stakeholders, geographical distance can hinder establishing solid relations, particularly for universities in smaller cities with fewer local opportunities. Intermediaries have also affirmed this view, as follows.

*"[…] to also ensure that all stakeholders can participate and contribute regardless of their physical location." (M-1)*

To address this, the digital platform should enable seamless remote collaboration and integration across diverse organisational structures and decision-making processes.

*DR1.1: The iUIC platform should facilitate geographical connectivity, proximity-based local engagement, and global collaboration while enabling seamless integration with diverse organisational structures and decision-making processes.*

Internal Integration within universities is crucial for fostering robust connections between universities and industry partners. Academic isolation, miscommunication, internal inequities, and university favouritism can hinder effective collaboration. To overcome these barriers, the digital platform should promote an inclusive environment, facilitate resource sharing, and provide centralised supportive policies, mentorship programs, and networking opportunities.

*DR1.2: The iUIC platform should support flexible collaboration models, accommodating various knowledge transfer and technology transfer activities in the UIC context while enabling seamless integration with diverse organisational structures and decision-making processes.*

As for experiencing persistent reliance between the in-house intermediary and affiliated university and depending on government entities for support, there was an agreement that such digitalisation might not be a straightforward

method, as this needs to be tackled within the UIC ecosystem, university-intermediary in the first place. Only then can a platform help to develop their ties, which an Intermediary expert echoed:

*"It is a chicken-and-egg situation […]. Do we solve the persistent reliance issues first or implement a platform hoping it will help? I think we should tackle the ecosystem challenges head-on […], then leverage the platform's capabilities." (M-1)*

**The structural dimension (network configurations)** focuses on the UIC ecosystem's network configurations and structural aspects, which involve the relationships, connections, and interactions among various stakeholders, including universities, industry partners, intermediaries, and other entities. The digital platform must accommodate and support various network configurations to facilitate such collaborations. Thus, the platform should provide robust infrastructure that is scalable and reliable and can handle a large number of stakeholders, connections, and interactions within the UIC ecosystem. The platform should also provide flexible network infrastructure by establishing and managing various UIC models besides multiple modes of communications to create networks that best suit their needs and objectives. These configurations can range from simple standard UIC models (bilateral collaborations between a university and an industry partner) to more complex UIC models that include multi-stakeholder networks involving multiple universities, companies, intermediaries, and other entities, such as a 'triple-helix' model (i.e. university-industry-government (U-I-G) collaboration). Also, optimisation of network configurations is essential by providing tools and analytics based on stakeholder needs, resource availability, expertise matching, and collaboration objectives. This optimisation can help identify potential partners, facilitate resource sharing, and enhance the overall efficiency and effectiveness of the UIC ecosystem. By doing so, the digital platform should support creating, managing, and optimising these diverse network configurations, facilitating the formation of collaborative networks, partner discovery, and the integration of different stakeholders within the UIC ecosystem, as clarified by one of the university experts:

*"[…] and as we expand our collaborative relationships across other sectors, [i.e. UIC innovation models, such as the triple helix], we need platforms that can support these integrated business models and bring together diverse sectors seamlessly." (U-18)*

This leads to an overarching DR that lays the foundation for addressing the specific drivers and barriers related to network configurations and structural aspects as follows:

*DR2: The iUIC platform should provide a robust and flexible network infrastructure that enables establishing, managing, and optimising diverse network configurations among stakeholders within the UIC ecosystem.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.2:**

Table 5.2: A Summary of Data Analysis on the Structural Dimension (Network Configurations)

| 1st Order Coding<br>Concepts \| Drivers | 1st Order Coding<br>Concepts \| Barriers | 2nd Order<br>Coding \| Themes | Aggregate<br>Dimension |
|---|---|---|---|
| ▪ Initiating a collaborative model (I)<br>▪ Seeking additional sources of income (U \| M \| I)<br>▪ Pursuing funding opportunities for equipment/lab (U)<br>▪ Actively seeking possibilities for career progression (U)<br>▪ Promoting research publication (U)<br>▪ Exploring opportunities for new technology adoption (U \| M \| I)<br>▪ Pursuing opportunities for creating and commercialising IPs (U \| M \| I) | ▪ Managing university bureaucracy (U \| M \| I)<br>~~▪ Handling challenging government payment terms and conditions (U \| M \| I)~~<br>~~▪ Resolving situations with overlapping authorities in internal entities and university-intermediary (U \| M)~~<br>~~▪ Adapting to various leadership styles within the university (U)~~<br>~~▪ Rectifying ineffective IP policies (U)~~<br>~~▪ Lacking influential organisational structure in the in-house intermediaries (M)~~<br>~~▪ Implementing clear governance in the in-house intermediaries (M)~~<br>▪ Developing an integrated business model in the in-house intermediaries (M) | Network Configurations | Structural Dimension |

The digital platform should initiate and establish collaborative models by providing features and functionalities to support the UIC ecosystem, such as networking tools, partner discovery mechanisms, and collaboration facilitation capabilities. Networking tools such as virtual networking events, matchmaking algorithms, and collaboration forums are essential to enable stakeholders to connect and interact with potential partners. This also applies to a partner discovery feature in which search and filtering mechanisms can offer a digital platform to help stakeholders identify suitable partners based on criteria such as expertise, resources, research interests, or geographical location. Collaboration facilitation tools and resources are important to support the establishment of collaborative models, such as project management tools, communication channels, and document-sharing capabilities.

*DR2.1: The iUIC platform should facilitate the initiation and establishment of collaborative models among stakeholders, enabling seamless networking, partner discovery, and collaboration opportunities.*

Moreover, the digital platform should leverage related drivers such as seeking additional sources of income, pursuing funding opportunities for equipment/lab, and Pursuing opportunities for creating and commercialising IPs by incorporating features that allow stakeholders to explore and pursue funding opportunities, additional income sources, and revenue streams, including IP commercialisation opportunities. A University Representative commented:

*"One of our key drivers is finding new funding opportunities, whether for equipment, labs, or even commercialising our IPs. A platform that can help us identify and pursue these opportunities would be game-changing." (U-5)*

As for funding opportunity discovery, the platform should provide a centralised repository or search engine for funding opportunities from various sources, such as government agencies or some private organisations. The platform should also offer tools and resources to help stakeholders explore and identify potential income sources and revenue streams, such as commercialisation opportunities, consulting services, or sponsored research projects. Again, the platform should facilitate matching stakeholders' resource needs with available funding opportunities, income sources, or revenue streams based on their specific requirements and objectives.

*DR2.2: The iUIC platform should enable the exploration and pursuit of funding opportunities, additional income sources, and revenue streams, supporting stakeholders in securing resources and financial sustainability.*

Moreover, the digital platform should leverage related drivers such as seeking possibilities for career progression, promoting research publication, and exploring opportunities for new technology adoption by providing features that enable the UIC ecosystem to discover new research areas, technologies, career progression opportunities, and collaborative projects, supporting their professional growth and research endeavours. As for research area and technology exploration, the platform should provide access to databases, repositories, and analytics tools that allow stakeholders to explore emerging research areas and technologies and identify potential collaborators or experts in specific domains. As a result, career progression opportunities can be leveraged via the platform by offering features that enable stakeholders to discover and pursue career progression opportunities, such as job postings, mentorship programs, or professional development resources, and not to forget the KPIs within universities that publish productivity is one of them. Collaborative Project Discovery, where the platform should facilitate identifying and matching stakeholders with similar research interests or complementary expertise, enabling the formation of collaborative projects or research teams.

*DR2.3: The iUIC platform should facilitate opportunities for discovery, enabling stakeholders to explore new research areas, technologies, career progression paths, and collaborative projects.*

On the other hand, the digital platform can address the barriers of university bureaucracy by incorporating features that streamline administrative processes and facilitate communication and collaboration among stakeholders, mitigating these challenges within the UIC ecosystem. University bureaucracy can be challenging, hindering effective collaboration. Thus, a digital platform is proposed to streamline processes, increase transparency, and promote collaboration, which supports effective governance and organisational workflows. By simplifying administrative processes through automated workflows, digital document management, and centralised communication channels, the digital platform should help stakeholders navigate these bureaucratic hurdles more effectively, reducing delays and minimising frustration.

*DR2.4: The iUIC platform should streamline administrative processes and facilitate communication and collaboration among stakeholders to address challenges related to university bureaucracy.*

It is worth noting that revising ineffective intellectual property (IP) policies falls within the scope of universities, and they should take the initiative to rectify these policies. While the digital platform can offer centralised IP management tools, optimising the IP management process requires policy revisions in advance, as stated by a university expert:

*"We cannot expect it to fix our IP policies, I mean […], that is on us to review and update them first, then leverage the platform's tools to streamline IP management." (U-13)*

Likewise, although the digital platform should provide tools and resources to navigate and manage government payment terms and conditions, enabling stakeholders to address challenges associated with these requirements effectively, such endeavours fall outside the digital platform's core objectives related to higher-level governance

and regulations involving governments. As well, in resolving situations with overlapping authorities in internal entities and university-intermediary, an industry expert stated:

> *"Sure, the platform may help to manage the government payment process, not terms [i.e. currently, there is an e-financial services platform specifically designed for government procurements and tenders]. […] we cannot rely on it to resolve the overlapping authorities between our internal entities and the university-intermediary. That is a fundamental issue we need to tackle within our ecosystem." (I-3)*

Regarding developing integrated business models for in-house intermediaries, it is crucial to recognise that this need extends beyond the capabilities of the digital platform itself. While the platform can accommodate diverse collaborative models and support integrated business structures through a configurable architecture, the primary responsibility lies with the stakeholders, namely universities and their in-house intermediaries. These entities must establish clear governance frameworks and develop comprehensive, integrated business models tailored to their requirements. Accordingly, the digital platform can be effectively leveraged to support and facilitate the implementation of such models, enabling seamless collaboration and streamlined processes within the established governance and business structures.

**The structural dimension (network stability)** is crucial for the long-term success and sustainability of KT/TT activities within the UIC setting. By fostering network stability and resilience, the digital platform can mitigate disruptions, maintain consistent collaboration, and ensure the continuity of ongoing projects and initiatives, ultimately enhancing the overall effectiveness and impact of the UIC ecosystem. An industry expert added:

> *"Consistency is important, but we also need to avoid rigidity. Sometimes, disruptive innovations or market shifts need a renovation of our collaborative representations. […] a flexible platform that offers both stability and agility would be beneficial for our collaboration, allowing us to adapt to changes while maintaining the core network. […] but we are unsure how such a platform can address the impact of internal changes within our university partners during our joint projects. […] if the platform can facilitate seamless transitions and maintain project continuity despite such internal shifts at the university level, it would be invaluable for us." (I-5)*

This leads to overarching DR, which lays the foundation for addressing the specific barriers related to network stability within the structural dimension, as follows:

> *DR3: The iUIC platform should foster network stability and resilience within the UIC ecosystem, ensuring sustained and consistent collaboration among the UIC ecosystem.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.3:**

Table 5.3: A Summary of Data Analysis on the Structural Dimension (Network Stability)

| 1st Order Coding<br>Concepts \| Drivers | 1st Order Coding<br>Concepts \| Barriers | 2nd Order<br>Coding \| Themes | Aggregate<br>Dimension |
|---|---|---|---|
| ▪ N/A | ~~▪ Dealing with instability among university decision-makers (U \| I)~~<br>▪ Stepping out of comfort zones and embracing risks (U \| M \| I) | Network Stability | Structural Dimension |

Stepping out of comfort zones and embracing calculated risks is essential for growth and innovation. However, risks should be approached strategically using risk management tools and scenario analysis capabilities while fostering a culture supporting it. Risk management tools identify, assess, and mitigate risks, allowing stakeholders to develop proactive strategies. Scenario analysis capabilities explore "what-if" scenarios, providing insights into potential outcomes and facilitating contingency planning. By incorporating these tools, stakeholders can make informed decisions based on thorough risk assessments and scenario analyses, fostering innovation, resilience, and adaptability within the ecosystem.

*DR3.1: The iUIC platform should provide risk management tools, scenario analysis capabilities, and contingency planning resources to support stakeholders in embracing calculated risks within the UIC ecosystem.*

Furthermore, dealing with instability among university decision-makers goes beyond what a digital platform can solely address. While such a platform can facilitate transparency and collaboration through automation and digital tools, tackling the root causes of instability requires dedicated university efforts to embrace a culture of accountability, transparency, and consistency in decision-making processes. These institutions must establish robust governance frameworks, effective communication channels, and measures to ensure transition continuity. Such a digital platform can support these efforts by providing a centralised platform for information sharing, decision tracking, and institutional knowledge management.

### 5.2.2 Design Requirements: Relational Dimension

The relational dimension provides resources concentrating on the social and interpersonal aspects influencing collaborative associations' formation, maintenance, and success. It facilitates factors such as mutual trust between the parties, the process whereby individuals or organisations see themselves as aligned with and belonging to the same group or collaboration, adherence to established norms and practices, and a sense of mutual obligation and accountability towards one another.

**The relational dimension (trust)** in the context of the UIC ecosystem plays a pivotal role in fostering successful and sustainable partnerships. Trust is a fundamental component that underpins effective communication, knowledge sharing, and developing long-lasting collaborative relationships among UIC settings. In trust-based relationships, stakeholders are more likely to engage in collaborative projects, embrace risks, and share resources, ultimately driving innovation and economic growth. However, building trust within the UIC ecosystem can be challenging due to various factors, such as differing organisational cultures and conflicting priorities. Addressing

these challenges and fostering an environment of trust, transparency, and mutual understanding is crucial for maximising the potential of the UIC ecosystem. One of the industry experts disclosed:

*"[...] and it is no secret that bridging the cultural gaps between academia and industry can be challenging when collaborating, whether physically or digitally. We often have different priorities and ways of operating, which can trigger mistrust if not addressed properly. [...] Yeah, agreed. Trust is the foundation of any successful relationship, and on such a platform, hopefully, it allows us to share valuable knowledge and collaborate on joint projects. […] that could drive real innovation." (I-10)*

This leads to an overarching DR that lays the foundation for addressing the specific drivers and barriers related to trust within the relational dimension as follows:

*DR4: The iUIC platform should foster trust, transparency, and mutual understanding among stakeholders within the UIC ecosystem, facilitating practical KT/TT activities.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.4:**

Table 5.4: A Summary of Data Analysis on the Relational Dimension (Trust)

| 1st Order Coding Concepts \| Drivers | 1st Order Coding Concepts \| Barriers | 2nd Order Coding \| Themes | Aggregate Dimension |
|---|---|---|---|
| ▪ Offering work-integrated learning for students (U \| M \| I)<br>▪ Leveraging co-branding opportunities (U \| M \| I)<br>▪ Building and maintaining collaborative relationships (U \| M \| I)<br>▪ Sharing resources for mutual interests/benefits (U \| M \| I) | ▪ Persuading external partners to share information (U)<br>▪ Facing inferiority views towards academies (U)<br>▪ Having uncertainty towards academia (I)<br>▪ Addressing market readiness and maturity level (M) | Trust | Relational Dimension |

The digital platform should establish a cohesive UIC ecosystem, fostering long-term strategic collaborations. This ecosystem should seamlessly integrate robust networking capabilities, open communication channels, advanced project management tools, and dedicated spaces to showcase diverse collaborative opportunities, including work-integrated learning initiatives that bridge academia, industry, and students. This was also declared by university experts as follows:

*"To create a successful collaboration environment, it is important to build a system that brings together all the important parts, including students." (U-13)*

*"[…] we need a platform that combines ways to network, talk, manage projects, and show off different group projects, like programs where students learn through work. It is important for this platform to have special areas where students can easily meet and work with different sectors, such as […]. This helps them gain real-world work experience." (U-15)*

Thus, the platform will promote trust, transparency, and mutual understanding. This conducive environment will strengthen existing relationships and pave the way for new synergistic relationships, ultimately driving practical KT/TT activities within the UIC setting.

*DR4.1: The iUIC platform should facilitate networking, communication, and collaboration among stakeholders, including providing a dedicated space for showcasing and promoting work-integrated learning opportunities and supporting the building and maintaining long-term collaborative relationships within the UIC ecosystem.*

Moreover, co-branding and promotional opportunities can foster trust and mutual understanding within the UIC ecosystem. By enabling stakeholders to leverage co-branding opportunities, the digital platform should facilitate the association of their projects, research initiatives, or other joint ventures. Additionally, the platform could provide promotional spaces or channels where stakeholders can showcase their collaborative efforts, achievements, and success stories, further enhancing their reputation and credibility within the UIC ecosystem. This improves the visibility and reputation of the stakeholders involved and promotes a sense of shared ownership and commitment to the collaboration. This was stated by experts, as:

*"[…] I have witnessed the benefits of showcasing our work. It is more than just a marketing strategy; it is a way to build a collective identity and mutual respect between educational institutions and industry. […] so, if the platform can offer ways to advertise these joint projects further effectively, it can help build trust and strengthen the overall network." (U-13)*

*"Working together with other partners and publicly linking our achievements builds trust and shows we are considerable about our partnerships, in which the platform should have features that allow us to highlight these joint efforts, demonstrating our dedication to and engagement with these collaborations." (I-13)*

Thus, the digital platform should foster a sense of partnership, mutual respect, and shared success among stakeholders, ultimately building trust and strengthening collaborative relationships within the UIC ecosystem.

*DR4.2: The iUIC platform should incorporate co-branding and promotional tools to enable stakeholders to leverage co-branding opportunities, enhancing their visibility and reputation within the UIC ecosystem.*

Resource sharing builds trust and understanding in the UIC ecosystem. A resource-sharing platform could enable stakeholders to list and search for available resources, negotiate terms of access or usage, and facilitate the seamless sharing of these resources. It could also include resource booking systems (e.g. facility rental services), usage tracking, and resource management tools to ensure efficient and transparent resource sharing. The resource-sharing platform should also facilitate knowledge exchange and skill development as stakeholders gain access to specialised facilities, equipment, or expertise that might not otherwise be available to them. This exchange of resources and knowledge can further strengthen collaborative relationships and foster an environment of shared learning and growth within the UIC ecosystem. By enabling stakeholders to share and access resources based on mutual interests and benefits, the digital platform should promote a sense of reciprocity and interdependence

among stakeholders. This, in turn, can foster trust and mutual understanding as stakeholders recognise the value of collaboration and the potential for mutually beneficial outcomes.

*DR4.3: The iUIC platform should provide a resource-sharing platform that allows stakeholders to share and access resources, such as facilities, equipment, expertise, or data, based on mutual interests and benefits.*

Nevertheless, building trust over time is crucial, and while the digital platform can partially address some of the related barriers through robust data privacy, security measures, and customisable information-sharing controls that alleviate concerns about confidentiality and IPs protection, further complementary actions such as fostering a culture of collaboration, establishing clear data-sharing agreements, and demonstrating the value proposition of information sharing will be necessary to fully persuade external partners to share information within the UIC ecosystem. However, further actions need to be taken beyond the digital platform's capabilities to fully overcome the barrier of persuading external partners to share information. Factors such as fostering a culture of collaboration, establishing clear data-sharing agreements, and demonstrating the value proposition of knowledge-sharing play a crucial role in building trust and encouraging more open collaboration over time. As the digital platform can contribute significantly through robust security measures and granular information-sharing controls, a holistic approach combining the platform's features with trust-building initiatives, clear agreements, and value demonstration may be necessary to fully persuade external partners to share information within the UIC ecosystem. Experts from the university and industry asserted:

*".. data privacy and security features on the platform can help relieve concerns about confidentiality and control what to share, but fostering a true culture of collaboration through clear data-sharing agreements and demonstrating value is crucial for persuading partners' willingness to share information." (U-3)*

*"Keeping tight control over the specific details we share on the platform helps protect our ideas and inventions, […]. But, the key to encouraging more open collaboration is realising how working together can benefit everyone involved. The platform can help us see these benefits and gradually lead to more sharing of information over time." (I-3)*

Regarding inferior views towards academics and uncertainty towards academia, the digital platform should address these barriers by showcasing academic achievements and real-world applications, facilitating open communication and direct engagement between stakeholders. However, while providing valuable resources, some deep-rooted perceptions or biases may require additional efforts beyond the platform, such as awareness campaigns, stakeholder education programs, or policy reforms. However, while the digital platform should provide valuable resources, tools, and spaces to mitigate these barriers, it is crucial to acknowledge that some aspects may necessitate additional efforts beyond the platform itself. For instance, addressing deep-rooted perceptions or cultural biases towards academia might require broader initiatives, such as awareness campaigns, stakeholder education programs, or policy reforms.

Furthermore, to address concerns regarding the market readiness and maturity levels of academic research or technologies, the digital platform should incorporate robust tools such as TRL evaluations and technology

maturity models for technology readiness assessments, as well as integration with patent databases, market trends and forecast reports. While providing these relevant tools and resources, it is essential to recognise that the actual technology maturation and commercialisation process may necessitate additional support mechanisms beyond the platform. Such support mechanisms could include incubation programs, mentorship opportunities, or access to specialised facilities and expertise, which may not be fully encompassed within the digital platform's purview. This view is affirmed by an industry expert, who states:

> *"[...] and if some tools on the digital platform can help to analyse and evaluate, for example, an academic research technology's market readiness, these are undoubtedly invaluable assets. Still, we have to acknowledge that the road from early-stage research to successful commercialisation can often be quite complex and arduous. It potentially requires external expertise, specialised facilities, […]and dedicated programs that may fall outside the digital platform's core scope and functionality alone, at least for now!" (M-1)*

Consequently, a holistic approach combining the platform's capabilities with complementary support structures may be required to comprehensively address the challenges of transitioning academic research into market-ready products or solutions.

**The relational dimension (identification),** as a critical element of this dimension, refers to the sense of belonging and shared identity that partners develop within the UIC ecosystem. This sense of identification fosters trust, commitment, and a shared understanding of goals and values, which are crucial for effective collaboration. Identification is essential for bridging the cultural divide between academia and industry, which often have different mindsets, priorities, and organisational cultures, creating barriers to effective communication and collaboration. Thus, partners can develop a shared understanding of each other's perspectives, motivations, and challenges, enabling them to work together more effectively, as commented by one of the university experts:

> *"So, feeling part of a group is fundamental internally, as in a university, for instance […], and externally for long-term partnerships. The digital platform could be influential in promoting this. […] I can imagine having a central hub where academia and industry can jointly publish success stories, collaborate on outputs, and virtually celebrate milestones together. This shared sense of ownership and achievement could go a long way in developing a unified identity within the ecosystem." (U-18)*

This leads to an overarching DR that lays the foundation for addressing the specific barrier related to identification within the relational dimension as follows:

> *DR5: The iUIC platform should incorporate features and mechanisms that promote a sense of belonging and shared identity among partners within the UIC ecosystem, thereby fostering trust, commitment, and a shared understanding of goals and values.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.5:**

Table 5.5: A Summary of Data Analysis on the Relational Dimension (Identification)

| 1st Order Coding<br>Concepts \| Drivers | 1st Order Coding<br>Concepts \| Barriers | 2nd Order<br>Coding \| Themes | Aggregate<br>Dimension |
|---|---|---|---|
| ▪ N/A | ▪ Experiencing a lack of a sense of belonging and identification (U \| M) | Identification | Relational Dimension |

A lack of a sense of belonging and identification, especially among universities and their in-house intermediary organisation, needs to be addressed to facilitate effective collaboration within the UIC ecosystem. The digital platform can help bridge the cultural divide between academia and industry by creating virtual spaces or forums for partners to interact and collaborate. These spaces can serve as platforms for open dialogue, knowledge sharing, and collaborative problem-solving, enabling partners to better understand each other's perspectives and foster a sense of shared identity and belonging within the UIC ecosystem.

*DR5.1: The iUIC platform should provide virtual spaces or forums for partners to interact, share experiences, and engage in collaborative activities, fostering a sense of community and shared purpose within the UIC ecosystem.*

**The relational dimension (social norm),** as a critical element of this dimension, refers to the shared expectations, values, and behaviours that guide interactions within the UIC ecosystem. Social norms shape partners' motivations, goals, and attitudes, ultimately influencing their willingness to engage in collaborative KT/TT activities. It is crucial to align academic and industry partners' diverse perspectives and priorities. By recognising and embracing social norms that promote collaboration, the ecosystem can foster an environment conducive to productive partnerships.

*"[…] because education institutions and businesses often expect different things, which can make it challenging for them to work together, […] if we really try to share what we know and make things on such digital space, that should help everyone, we can get past these differences and work well together." (I-10)*

This leads to an overarching DR that lays the foundation for addressing the specific drivers and barriers related to social norms within the relational dimension as follows:

*DR6: The iUIC platform should facilitate the recognition and promotion of social norms that encourage and support such activities, fostering an environment conducive to productive collaborations.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.6:**

Table 5.6: A Summary of Data Analysis on the Relational Dimension (Social Norm)

| 1st Order Coding Concepts \| Drivers | 1st Order Coding Concepts \| Barriers | 2nd Order Coding \| Themes | Aggregate Dimension |
|---|---|---|---|
| ▪ Focusing on gaining relevant practical/industry experience for academics (U)<br>▪ Seeking potential reputational gain proximity (U \| M \| I)<br>▪ Engaging in community and social-focused projects (U \| M \| I) | ▪ Offering insufficient university rewards for accomplishments (U)<br>▪ ~~Coping with inconsistent industry funding (U)~~<br>▪ ~~Balancing time constraints and heavy workloads (U)~~<br>▪ ~~Undergoing a lack of teamwork within the university (U)~~<br>▪ Enhancing inadequate interpersonal skills of academics (U \| I)<br>▪ ~~Confronting individualistic academic culture (I)~~<br>▪ ~~Adapting to build collaboration in new settings (M)~~ | Social Norm | Relational Dimension |

The focus on securing practical, industry-related experience for academics indicates their eagerness to be involved in joint ventures that offer real-world industry insights. Digital platforms that showcase and streamline access to such collaborative ventures align with the academic sector's emphasis on practical experience. These platforms can inspire academic partners to participate in UIC initiatives by facilitating this alignment. Fulfilling academics' quest for immersive industry experiences not only meets their professional development needs but also strengthens the spirit of collaboration within the UIC setting.

*DR6.1: The iUIC platform should incorporate features highlighting and promoting collaborative opportunities for academics to gain practical, industry-relevant experience, such as internships, project-based collaborations, or industry-sponsored research initiatives.*

Pursuing reputational enhancement often motivates universities, industry players, and government or public sector entities to enter partnerships. Such collaborations promise to bolster the standing and prestige of the involved parties, a university expert stated:

*"Usually, the goal is to improve our reputation and show how our research can make a real difference. […] and if we can use the platform to highlight our works and partnerships with businesses. […] but you know what else is important? Recognising the people behind them. This can encourage more involvement in the digital world" (U-5)*

A digital platform that highlights and honours the triumphs and efforts of its partners can foster a culture that values and seeks reputation gains through university-industry-government (UIG) collaboration. Formal recognition, such as awards or feature spotlights, serve not only to encourage entities to participate in collaborative endeavours but also to underscore the significance and honour associated with UIG partnerships.

*DR6.2: The iUIC platform should incorporate features that recognise and celebrate successful collaborations, achievements, and partners' contributions, fostering a sense of reputational gain and promoting the social norm of engagement for potential reputational benefits.*

Participation in community and socially-oriented initiatives signifies the commitment of stakeholders from academia, industry, governments, and the public sector to engage in collaborative efforts that yield communal benefits and tackle societal challenges. Thus, a digital platform supports the common goal of undertaking activities that benefit society as a whole. This enhancement not only streamlines the process of discovering prospective

collaborations but also underscores the significance of confronting societal concerns through unified efforts. Consequently, this could draw in entities prioritising such community values, fostering a more robust collaboration network.

*DR6.3: The iUIC platform should provide a dedicated space or feature highlighting and promoting community-focused and socially relevant collaborative projects, enabling partners to easily identify and engage in initiatives that align with their social norms and values.*

Moreover, the perception that academic achievements in the UIC settings are undervalued can discourage academics from engaging in such collaborations. To tackle this issue, a digital platform aimed at facilitating UIC should integrate features that spotlight and commend the successes and contributions of collaborators. This can address the feelings of insufficient institutional recognition and encourage academics to collaborate more eagerly.

*DR6.4: The iUIC platform should include features that recognise and celebrate successful collaborations, achievements, and contributions of academic partners, such as an achievement showcase, awards, or public acknowledgments, to address the perceived lack of sufficient rewards and incentives for UIC accomplishments.*

Improving the interpersonal skills of academics is crucial for successful collaboration within the UIC ecosystem. Strong communication, teamwork, and networking abilities are essential for fostering productive partnerships. A university expert echoed this as:

*"Some of us may need to improve interpersonal skills, as a lack of such can limit our effectiveness when collaborating with businesses. I believe a platform offering development resources could foster these skills […], even lead to more successful outcomes." (U-3)*

Certain academic individuals may struggle with these skills, potentially impeding their engagement in such effective collaborations. To mitigate this, the digital platform should integrate functionalities that enhance communication, facilitate networking opportunities, and promote the development of these vital interpersonal skills.

*DR6.5: The iUIC platform should offer virtual collaboration spaces, mentoring programs, training resources, or other interactive features designed to enhance the interpersonal and collaboration skills of academic and industry partners, enabling them to overcome potential skill gaps and engage in more effective UIC collaborations.*

Hence, the digital platform is a tool to promote social norms supporting UIC. However, additional measures are necessary for a robust shared understanding of these norms among partners. These include cross-organisational training, clear communication protocols, and developing an inclusive, collaborative culture within the UIC ecosystem. Addressing the challenge of inconsistent industry funding transcends the platform's functionality and may require institutional or governmental policy interventions.

*“Again, […] we cannot always depend on industry funding, and as academics, we are often too preoccupied, leading to issues that the online tool alone cannot resolve. So, […] tackling these*

*problems may require the implementation of new policies or adjustments in the allocation of resources by educational institutions or the government." (U-15)*

Similarly, the issue of balancing time constraints and heavy workloads, while partly mitigated by the platform's time management features, calls for broader academic policy changes and resource reallocation. The platform's capacity to provide virtual collaboration spaces does not alone solve the lack of teamwork within universities; this is a more profound cultural and organisational concern. This was also commented on by one of the participants:

*"Sure, […] it gives us good online places and stuff, but to really work well as a team, we need big changes in how we do things, not just new tech." (U-15)*

Changes to the individualistic culture prevalent in academia are beyond the platform's reach, requiring widespread institutional and cultural shifts, even though the platform can encourage collaborative behaviours and highlight the benefits of such collaborations. Lastly, adapting to new collaborative environments is not just about accessing the platform's resources and guidance; it also involves individual and organisational commitment to embrace support mechanisms and training tailored to these new settings.

**The relational dimension (mutual obligations)** relates to each partner's agreed-upon expectations and responsibilities within the UIC ecosystem. These obligations set the framework for governing interactions and behaviours within the collaboration. Whether formal or informal, mutual obligations are vital for fostering trust and commitment- critical elements for the success of long-term collaborative relationships. This is expressed by one of the university experts:

*"As it is obvious that a well-defined collaboration framework with clear mutual expectations is important for aligning behaviours and preventing misalignments across the ecosystem, digitalisation can significantly further this by providing a centralised space to document and manage partners' roles, responsibilities, resource sharing, IP agreements, funding commitments, and milestones, etc. […] that is true but having these mutual obligations transparently outlined within the platform develops accountability and commitment." (U-11)*

This leads to an overarching DR that lays the foundation for addressing the specific drivers and barriers related to mutual obligations within the relational dimension as follows:

*DR7: The iUIC platform should facilitate the establishment and maintenance of mutual obligations between academic and industry partners, fostering a collaborative environment built on trust, commitment, and shared responsibility.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.7:**

Table 5.7: A Summary of Data Analysis on the Relational Dimension (Mutual Obligations)

| 1st Order Coding Concepts \| Drivers | 1st Order Coding Concepts \| Barriers | 2nd Order Coding \| Themes | Aggregate Dimension |
|---|---|---|---|
| ▪ Encouraging committed academics (U) | ▪ Securing dedicated resources (U \| I)<br>▪ ~~Improving poor environmental settings (U)~~<br>▪ Recruiting competent personnel when needed (U) | Mutual Obligations | Relational Dimension |

To foster a thriving UIC ecosystem, it is imperative that the digital platform not only facilitates but also actively encourages scholars to invest their knowledge and collaborate within the UIC setting. This can be realised through a thoughtfully designed incentive mechanism that intertwines with academics' intrinsic and extrinsic motivations. Such a mechanism may encompass avenues for career advancement, public acknowledgment of their contributions, enhanced access to research resources and funding, and the integration of engagement metrics into their performance and promotion evaluations. By aligning these incentives with established KPIs, the digital platform can serve as a mechanism for academics to place a higher emphasis on and energetically participate in UIC endeavours.

*DR7.1: The iUIC platform should provide incentives and recognition mechanisms to encourage and reward the active participation of academics in UIC activities.*

Securing dedicated resources is often a barrier to successful UIC. A digital platform could make managing the needed intangible and tangible resources for such collaborations easier. Intangible resources play a crucial role in facilitating knowledge-based activities and fostering innovation. These include IPs such as patented technologies, copyrighted research publications, or trademarked product names developed by academia or industry. Additionally, access to data repositories containing organised and relevant datasets, knowledge bases offering domain-specific expertise and best practices, and collaborative networks enabling cooperation and resource sharing among stakeholders can significantly enhance KT/TT-UIC activities, as expressed by an industry expert:

*"I can say that such a digital platform can make it much easier for universities and us [industry organisations] to work together, I mean […]. It can help everyone use what they know and what they have better, […] it's like giving us a shared place to share ideas, maybe special equipment and skilled people, […] yes, and buy or rent things together to save money […]" (I-5)*

Thus, the digital platform can promote the sharing and combining ideas from different sources, provide valuable information and insights, and foster effective collaboration between academia and industry. On the other hand, tangible resources, such as funding opportunities, research grants, specialised equipment, laboratory facilities, and personnel with specific expertise, are also essential for successful KT/TT-UIC activities. The digital platform can provide a centralised repository or marketplace for various funding sources, enable resource sharing and pooling mechanisms (i.e. collaborative procurement or resource pooling funds), and facilitate efficient utilisation of existing infrastructure and equipment across different institutions and organisations.

*DR7.2: The iUIC platform should facilitate the identification, allocation, and management of both tangible resources (e.g., funding, infrastructure, equipment, personnel) and intangible resources (e.g., IP, data repositories, knowledge bases, collaborative networks) for KT/TT-UIC activities.*

Recruiting competent personnel with the necessary skills and expertise presents a significant challenge for universities. As a university expert comments it:

> *"Universities face a challenge in recruiting skilled staff, within the limitations of employment policies. A digital platform could offer a solution by creating a talent ecosystem linking academia and industry. […] I mean this platform can have a big list of job seekers' details as candidate profiles and smart features to match the right people with the right jobs, […] as this could make hiring easier and follow the rules, helping universities find the expertise they need." (U-11)*

So, even though it is critical to adhere to the organisational policies that govern the employment process, to aid in this endeavour, the digital platform should include a comprehensive talent pool or database that includes professionals from both academia and industry. It should also provide a matchmaking feature that recommends suitable candidates by matching their qualifications with the project's specific requirements.

> *DR7.3: The iUIC platform should provide a talent pool and matchmaking functionality to connect UIC projects with suitable personnel from academia and industry.*

However, in addressing the challenge of improving poor environmental settings, digital platforms have limited capacity. They are unable to directly tackle physical or organisational environmental issues, which are often influenced by factors such as infrastructure, culture, and policies. To effectively address these settings, interventions and other organisational or institutional initiatives may be better suited for such a barrier.

### 5.2.3 Design Requirements: Cognitive Dimension

The cognitive dimension encompasses resources that provide shared representations, interpretations, and systems of meaning among parties. It involves factors such as a common understanding and perspective on critical issues, shared cultural values and beliefs that shape assumptions, and an alignment on overarching goals and desired outcomes that guide the collaboration.

**The cognitive dimension (shared culture)** refers to the shared values, beliefs, and understandings that shape the interactions and relationships between academic and industry partners. It encompasses the mutual recognition of each other's priorities and perceptions and the alignment of expectations and interpretations around various aspects of the collaboration. A shared culture is crucial for successful UICs, enabling partners to navigate the inherent differences in their respective cultures, priorities, and perspectives. By doing so, the digital platform can bridge the gap between academia and industry, fostering a collaborative environment built on mutual understanding, aligned expectations, and effective communication. Industry actors emphasised:

> *"Even with the best intentions, without a shared understanding facilitated, it's easy for misalignments and misinterpretations to derail even the most promising collaborations. And […] I can imagine that such a digital platform can provide tools and spaces for us to explore each other's cultures, openly discuss their perspectives, and find common ground. A shared understanding that it is developed, enabled by the platform, is key to truly fruitful collaborations." (I-5)*

This leads to an overarching DR that lays the foundation for addressing the specific drivers and barriers related to mutual obligations within the relational dimension as follows:

*DR8: The iUIC platform should facilitate establishing and maintaining a shared culture that fosters mutual understanding, aligns expectations, and promotes effective communication between academic and industry partners.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.8:**

Table 5.8: A Summary of Data Analysis on the Cognitive Dimension (Shared Culture)

| 1st Order Coding Concepts \| Drivers | 1st Order Coding Concepts \| Barriers | 2nd Order Coding \| Themes | Aggregate Dimension |
|---|---|---|---|
| ▪ N/A | ▪ Communicating research values to attract potential investors (U)<br>▪ Raising self-awareness of university facilities and expertise (U)<br>~~▪ Lacking shared values among partners (I)~~<br>~~▪ Clarifying interpretations of revenue and impact in university-intermediary (M)~~<br>~~▪ Correcting academics' misconceptions of technology readiness level (TRL) (I)~~ | Shared Culture | Cognitive Dimension |

Articulating the significance and implications of academic research is crucial for attracting industry investment and fostering collaborations. A digital platform can significantly enhance this process by offering designated areas or functionalities where researchers and universities can comprehensively showcase their resources, expertise, and ongoing research projects and findings. Moreover, the platform should empower them to identify and exhibit their competitive research priorities at various levels, such as institutional, regional, or sector-specific, while considering both local and global contexts to align with the interests and needs of industry partners, considering specific geographic regions or sectors. It also elevates the process of raising self-awareness of university facilities and expertise, as universities often struggle to effectively communicate their available facilities, expertise, and research capabilities to potential industry partners. Accordingly, this increased visibility facilitates a better understanding of their potential for partnerships, thereby promoting collaborations that address the demands and opportunities in local societal needs and global contexts.

*DR8.1: The iUIC platform should provide dedicated spaces for researchers and universities to comprehensively showcase their research, expertise, facilities, and capabilities, tailored to align with industry interests and priorities across regions and sectors, locally and globally, fostering mutual understanding, aligning expectations, and enhancing communication between academia and industry for effective collaborations.*

However, some barriers may not be directly mitigated by the features of a digital platform. As stated by one of the participants:

*"[...] I mean, even with the best digital platform, if we don't shift our mindsets on how to share core values and goals with our academic partners, the collaboration is bound to face roadblocks." (I-13)*

A significant barrier to successful collaboration is the absence of shared values among partners. The digital platform could offer a suite of tools and mechanisms designed to facilitate alignment and understanding. These tools may include interactive workshops, which can bring partners together to discuss and define common values and goals in a dynamic and engaging environment. Negotiation frameworks provided by the platform can guide partners through reconciling differing priorities and objectives, ensuring that each partner's needs and values are acknowledged and respected. Additionally, collaborative decision-making tools can help partners make joint decisions effectively, incorporating everyone's input and fostering shared ownership of the collaboration's direction. These tools can be complemented by features such as regular check-ins, progress tracking, and feedback systems, which help maintain alignment and adapt to evolving understandings as the partnership grows. Nonetheless, though digital platforms can serve as the foundation for partners to build a robust and value-aligned collaboration, ultimately leading to more successful outcomes and sustained collaborations, further efforts and additional measures must be implemented over time to cultivate shared values within such a heterogeneous ecosystem. Experts affirmed this view:

*"While such a digital platform can provide beneficial tools, some fundamental challenges require more than just technology. I think […], but you know, collaborative decision-making tools can help partners make joint decisions effectively, incorporating everyone's input and fostering shared ownership of the collaboration's direction, but even with such tools, we still need to address the absence of shared values among partners." (I-3)*

In another instance, there are differing interpretations of revenue and impact within the university-intermediary dynamic (such as an in-house intermediary), particularly with entities like technology transfer offices. This issue is intrinsic to the relationship between universities and intermediaries and might not be resolved through digital platform design elements. Nevertheless, the platform could be supportive by enhancing communication and fostering transparency within such a heterogeneous ecosystem.

Correcting academics' misconceptions about the TRL is also a significant barrier. Although this is an essential issue regarding TT and commercialisation activities, it might be more effectively addressed through educational programs and training initiatives instead of direct intervention via the digital platform. Industry partners could also play a role by sharing their practical insights and experience with TRL assessments. Even so, the platform could act as a bridge, providing resources or allowing academics to share information that could make the concept of TRL more transparent to them. To further assist, the platform could incorporate tools such as TRL calculators, guidelines, and case studies to help academics accurately evaluate and understand the development stage of their technologies.

**The cognitive dimension (shared goals)** is critical in uniting academic and industry partners by synchronising their objectives, priorities, and desired outcomes. This alignment process involves cultivating a shared understanding and consensus on the broad ambitions of the partnership, as well as outlining specific targets and milestones that both parties aim to reach. Shared goals are the foundation for successful UICs, setting a unified course and fostering a collective sense of purpose. They are the compass that guides the collaborative journey,

ensuring that all participants are moving in the same direction towards a common target. The development and synchronisation of these shared goals can be complex, as it requires bridging the gap between the often-divergent agendas of academic institutions, which may focus on theoretical advancements and long-term research, and industry entities, which typically prioritise practical applications and market-driven results. Nevertheless, when these distinct perspectives are harmonised, the potential for innovation and progress is significantly amplified.

A digital platform should provide tools and frameworks that help clarify and communicate shared goals. Features such as goal-setting templates, progress tracking, and collaborative workspaces can enable partners to articulate their vision, establish common objectives, and monitor their advancement towards these goals transparently and structured. Moreover, such a platform can offer continuous dialogue and feedback mechanisms, which are essential for adapting to new insights and maintaining alignment amidst the evolving landscape of academic research and industry demands towards achieving mutually advantageous results. Correspondingly, a university expert noted:

> *"Aligning our goals is crucial for a successful collaboration, but I think it's not always easy given the different priorities of academia and industry. […], yeah, that is why a digital platform with goal-setting templates maybe and collaborative workspaces could help us articulate a shared vision and establish common objectives that satisfy both parties." (U-3)*

This leads to an overarching DR that lays the foundation for addressing the specific drivers and barriers related to mutual obligations within the relational dimension as follows:

> *DR9: The iUIC platform should facilitate establishing and aligning shared goals between academic and industry partners, enabling effective collaboration and reducing potential misunderstandings.*

**To achieve this overarching DR, the following sub-requirements can be derived from the identified drivers and barriers, as presented in Table 5.9:**

Table 5.9: A Summary of Data Analysis on the Cognitive Dimension (Shared Goals)

| 1st Order Coding Concepts \| Drivers | 1st Order Coding Concepts \| Barriers | 2nd Order Coding \| Themes | Aggregate Dimension |
|---|---|---|---|
| ▪ N/A | ▪ Aligning research goals and reducing misunderstandings (U \| I)<br>~~▪ Addressing the lack of practical KPIs in universities (U \| M \| I)~~<br>~~▪ Encountering the absence of a clear vision in universities and in-house intermediaries (M \| I)~~<br>▪ Managing differing interpretations of time-frame (U \| M \| I) | Shared Goals | Cognitive Dimension |

Misalignments in goals and expectations are common barriers that can impede the progress of such collaborations. To overcome these challenges, leveraging a digital platform can be a game-changer. Digital platforms can act as enablers, offering a suite of collaborative tools and mechanisms specifically designed to foster a harmonious alignment of goals within the UIC ecosystem, as stated by one of the industry experts:

*"[…] we need to create a shared space where all stakeholders can openly discuss concerns, align expectations, and develop a common understanding of each other's goals and constraints [….], I think such a digital tool can help us do that." (I-10)*

These tools can facilitate co-creating a clear and detailed research agenda, allowing partners to articulate, refine, and agree upon their research goals, key milestones, and the outcomes they wish to achieve. Moreover, such platforms can provide real-time tracking and management capabilities to adjust to changes or new insights as the research evolves and reduce the likelihood of misunderstandings. A well-structured digital platform can be the foundation for a shared understanding, enabling partners in UICs to work cohesively towards common objectives. This streamlines the collaborative process and enhances the effectiveness and impact of their joint research endeavours.

*DR9.1: The iUIC platform should provide tools and mechanisms for academic and industry partners to collaboratively define, align, and track their research goals, milestones, and desired outcomes, fostering a shared understanding and reducing potential misinterpretations.*

In the UIC setting, divergent perceptions of time-frames, deadlines, and milestones between academic and industry partners can lead to significant misalignment, fostering misunderstandings and potential conflicts that may risk the collaboration's success. To address this, a digital platform can serve as a unifying solution, smoothing out inconsistencies in time-frames, deadlines, and milestones. It enables partners to collaboratively establish and adapt project timelines, creating a cohesive and shared understanding. An industry expert noted:

*"Time is of the essence in the corporate world, […]. A digital platform that enables collaborative timeline planning and real-time progress tracking would be game-changing; it ensures we're all working towards the same milestones and deadlines" (I-13)*

So, with tools for interactive planning, real-time progress tracking, and milestone synchronisation, the platform ensures seamless communication and coordination. Automated alerts and reminders keep all parties on track, facilitating a harmonious and efficient partnership focused on achieving collective goals.

*DR9.2: The iUIC platform should provide tools and features that enable academic and industry partners to align their interpretations of time frames, deadlines, and milestones, addressing differing interpretations of time frames.*

Addressing the absence of practical KPIs in universities is essential, yet defining and aligning KPIs requires stakeholder engagement and must consider various factors such as research areas, project goals, and institutional policies. While a digital platform could offer features to aid in documenting and disseminating KPIs, establishing and monitoring should be managed through institutional procedures or specialised performance management tools.

In the same way, cultivating a clear vision and strategic direction is fundamental for fruitful collaboration. However, this process demands comprehensive stakeholder involvement, strategic planning, and decision-making beyond what a digital platform can provide. Elements like institutional priorities, industry trends, resource distribution, and long-term planning are best tackled through thorough strategic planning and governance within

the organisations. The digital platform could be a repository for storing and sharing visions and strategies. However, creating and delineating these elements are more effectively carried out via strategic initiatives or workshops with stakeholders from academia and industry. Universities have also confirmed and endorsed this perspective, as follows:

> *"While a digital platform can assist us in documenting and sharing our KPIs, the process of shaping some of them requires extensive involvement with stakeholders from both academia and industry. I think […]and such a platform should seamlessly integrate with our institutional procedures for KPIs establishment and monitoring. At the same time, this integration may be a subsequent and advanced step, given its novelty, once the ecosystem can employ and adjust to such digitalisation." (U-15)*

To maximise its effectiveness, the digital platform should be designed to support specific, actionable goals such as aligning objectives, clarifying misunderstandings, and managing timelines. This approach ensures the platform adds value without overstepping on areas requiring broader organisational procedures or specific tools.

To conclude, each table in this section provides a detailed summary of how the DRs are derived from empirical findings of drivers and barriers within the UIC setting, which are also mapped to their corresponding theoretical lenses.

Additionally, **as presented in Appendix B**, this section finishes with a summary of these DRs and demonstrates how they align with the related dimensions of SC theory.

## 5.3 FORMULATING TENTATIVE DESIGN PRINCIPLES IN RESPONSE TO DESIGN REQUIREMENTS

By translating experts' insights from the interview findings, a total of 30 DRs, presented in Table B.1, were derived through the SC theory lens, specifically focusing on the related drivers and barriers to the KT/TT activities within the UIC setting. These DRs serve as the foundational elements for conceptualising the UIC IT artifact, where principles are formulated to guide such a design. Following Chandra, Seidel, and Gregor (2015) and Gregor, Chandra Kruse, and Seidel (2020), design principles (DPs) were formulated in this phase in response to the DRs.

A principle can be referred to as "a fundamental rule or law, derived inductively from extensive experience and/or empirical evidence, which provides design process guidance to increase the chance of reaching a successful solution" (Fu, Yang & Wood, 2015, p. 2). Regarding DSR, DPs are defined as prescriptive statements detailing what and how to construct an artifact to meet specific design goals. DPs merge specifications that clarify what users should be able to accomplish with an artifact and the necessary features that the artifact must include to support these activities, in which simply "design principles about user activity and an artifact" (Gregor, Chandra Kruse & Seidel, 2020, p. 1628).

It is essential to highlight that the DPs were specifically constructed for this investigation to address the limitations of existing methodologies in identifying specific requirements within the UIC context. This development demonstrates a substantial advancement in the methods and practical applications within the field of IS, thereby enhancing both theoretical and empirical research contributions.

The format used to structure each DP is as follows: "Example: Assemble a window with a frame and transparent material [about the rule] to fill the frame [about an artifact function], so people can see through it [about user activity]" (Gregor, Chandra Kruse & Seidel, 2020, p. 1629). Accordingly, the statement is broken down into three key components: the rule, the artifact function, and the user activity, such as DP11: The iUIC platform should incorporate a practical experience module [about the rule] to enable engagement in real-world projects and integrated learning [about an artifact function], thereby allowing stakeholders including students and staff to foster cultural convergence, develop skills, gain practical knowledge, and transfer knowledge within the UIC ecosystem [about user activity]. Thus, building from the DRs and based on these assumptions, a set of 11 DPs is formulated.

**This process commenced with the formulation of the first DP, known as DP1, which sets the foundational principles for the platform's functionality and personalised user interfaces in terms of usability and engagement as follows:**

*DP1: The iUIC platform should offer a highly personalised and user-friendly interface to enable stakeholders to tailor their experience, preferences, and workflows to their specific needs, thus fostering usability and engagement within the UIC ecosystem.*

In the heterogeneous UIC ecosystem, each with unique requirements and workflows, personalisation and user-friendliness interfaces are critical for promoting engagement, productivity, and overall satisfaction. A more intuitive and effective collaborative environment is created by tailoring the platform to meet stakeholders' specific needs and contexts. Stakeholders benefit from a user-centric interface that provides access to the most relevant tools, services, features, and resources for their roles. Such an engaging interface supports active participation and sustained involvement by minimising barriers to adoption and enhancing communication, collaboration, and knowledge sharing. Additionally, these qualities advance accessibility and inclusivity, making the platform approachable and usable for stakeholders with varying abilities and technological proficiency.

**Proceeding with the formulation of DP2, it is articulated to specifically enhance practicality in terms of flexibility and adaptability by addressing the evolving needs of the UIC ecosystem and related collaborative activities, as follows:**

*DP2: The iUIC platform should offer flexible and adaptable collaboration activities and structures to enable stakeholders to dynamically configure and modify collaboration models and project structures, thus fostering adaptability to evolving UIC ecosystem requirements.*

Stakeholders' collaboration needs and requirements evolve over time, which requires a platform to support flexible and adaptable collaboration activities. This adaptability ensures that stakeholders can effectively respond to emerging challenges and opportunities. The platform must also offer the flexibility to tailor various UIC models (e.g., the triple helix model) and project structures, such as collaborative/joint projects involving multiple partners. An argument here is that to meet the various requirements within the UIC setting effectively, it is essential to avoid a one-size-fits-all approach when designing such a platform. Further, the platform must support agility and responsiveness to foster an innovative ecosystem in a rapidly changing environment. This will enable stakeholders to dynamically adapt their collaboration models and collaborative KT/TT activities within the UIC setting. Such flexibility is crucial for timely adaptation and efficient decision-making.

**Continuing to DP3, it is stated to address the enhancement of matchmaking capabilities within the platform, aimed at efficiently connecting users with appropriate resources, partners, or opportunities, which enhances collaboration and ecosystem interactions in terms of precision and relevance, as follows:**

*DP3: The iUIC platform should incorporate matchmaking capabilities to enable stakeholders to discover and connect with suitable partners and resources based on shared interests and projects, fostering effective collaboration and resource utilisation within the UIC ecosystem.*

The UIC ecosystem comprises stakeholders with varying interests, expertise, and resource needs, where matchmaking capabilities are crucial for facilitating effective collaboration and optimal resource utilisation. By matching stakeholders based on shared interests and project requirements, the platform can enhance collaboration productivity and success, bringing together individuals and groups with compatible goals and complementary skills to foster efficient use of collective knowledge and resources. Effective matchmaking also expands stakeholders' access to specialised expertise and resources beyond their immediate/local networks; it can also broaden the scope for potential collaborations and facilitate KT/TT-UIC activities across different domains/industries/sectors. Matchmaking features promote innovation and enable the exchange and integration of diverse ideas across expert communities within the UIC setting. Additionally, the platform can significantly reduce the time and effort required to initiate and establish collaborations, thereby boosting productivity and accelerating innovation within the UIC ecosystem.

**Following that, DP4 is formulated with the aim of enhancing the platform's contribution recognition and incentivisation mechanisms. Specifically, it focuses on developing systems to acknowledge and reward users for their active participation and valuable contributions to encourage sustained engagement and productivity in terms of both recognition and reward structures, as follows:**

*DP4: The iUIC platform should provide mechanisms for contribution recognition and incentivisation to enable stakeholders to showcase accomplishments and be rewarded for their contributions, thereby fostering motivation and engagement within the UIC ecosystem.*

Recognising and rewarding stakeholder participation, contributions, and achievements is essential for fostering motivation, engagement, and sustained commitment within the UIC ecosystem. When stakeholders feel valued and appreciated, they are more likely to stay actively involved and contribute significantly to collaborative successes. As for such a platform to provide mechanisms for stakeholders to showcase their accomplishments, this promotes a culture of celebration and recognition within and between organisations, encouraging them to strive for excellence and take pride in their achievements. Incentives and rewards motivate stakeholders to actively participate, contribute their expertise, and excel in their collaborative efforts, which can enhance productivity, innovation, and overall success within the UIC setting. Additionally, recognition and rewards help build a strong sense of cooperation and communication within the UIC ecosystem, which contributes to encouraging knowledge sharing and collaborative learning.

**Moving on to DP5, it is detailed as focusing on optimising multipurpose communication channels to enhance accessibility and usability across diverse user groups within the UIC ecosystem, as follows:**

*DP5: The iUIC platform should provide multipurpose communication and interaction channels to enable stakeholders to seamlessly communicate, collaborate, and coordinate across various modes, thereby fostering effective communication and coordination within the UIC ecosystem.*

Effective communication and interaction are crucial for successful collaboration within the UIC ecosystem. By establishing multipurpose communication channels, the platform enables seamless communication and coordination among stakeholders. The UIC ecosystem, comprising stakeholders with diverse communication preferences and requirements, would benefit from offering a variety of communication channels to promote engagement through preferred modes and mediums. This facilitates cross-cultural communication to bridge potential cognitive or cultural differences and foster mutual understanding and effective coordination within the UIC setting. Additionally, this helps keep all stakeholders aligned and well-informed throughout the collaboration lifecycle, which is crucial for the success of UIC projects and initiatives.

**Next, the formulation of DP6 is presented, emphasising the development of customisable features that enable organisations to adapt the platform for digital co-creation and open innovation practices according to their specific needs, as follows:**

*DP6: The iUIC platform should implement digital co-creation and open innovation practices to empower stakeholders to develop innovative solutions collaboratively, thereby fostering innovation and collaborative problem-solving in addressing challenges across UIC ecosystems.*

Digital co-creation and open innovation practices (e.g., co-creation workshops, online innovation labs, and collaborative hackathons for students) help drive innovation and foster collaborative problem-solving within the UIC ecosystem. By doing so, the platform leverages the collective intelligence and diverse perspectives of stakeholders, which leads to developing more innovative and impactful solutions. This also facilitates knowledge sharing from various sources among stakeholders, evolving to the exchange of tangible and intangible resources, such as expertise and best practices, towards continuous holistic learning and growth within the UIC setting.

**Moving forward to DP7, it is designed to enhance compatibility with IT infrastructure to provide efficient data flow and integration with project and time management tools, as follows:**

*DP7: The iUIC platform should provide project and time management tools to enable stakeholders to plan, organise effectively, and track project timelines, milestones, and resource allocations, thus fostering efficient management of KT/TT-UIC activities within the UIC ecosystem.*

Broadly, practical project and time management are essential for the successful execution and coordination of collaborations and projects. As for a digital platform, providing tools for planning, organising, and tracking projects helps stakeholders streamline processes, minimise delays, and ensure timely outcomes. Given that UIC projects often involve multiple stakeholders from various backgrounds, organisations, and locations, these tools are critical in facilitating efficient coordination and communication, ensuring alignment with project timelines, milestones, and resource allocations. Additionally, such tools aid in optimising varied resources such as facilities and funding. It also helps to minimise waste and enhance the effectiveness of resource allocation to meet project objectives. Moreover, this approach enables stakeholders to detect potential risks or issues early, allowing mitigation strategies and timely adjustments towards continuous improvement within the UIC ecosystem.

**Subsequently, DP8 aims to create a centralised data repository to boost the management and collaboration of knowledge and resources, as follows:**

*DP8: The iUIC platform should establish a centralised repository for relevant data, information, and knowledge resources to enable stakeholders to access, contribute to, and leverage a comprehensive knowledge base, thereby fostering efficient collaborative knowledge and resource management within the UIC ecosystem.*

To foster an innovative ecosystem, it is vital to have access to relevant data, information, and knowledge resources to inform decision-making within such an ecosystem. A centralised repository on the platform is a source of reliability, trust, and time efficiency regarding the effort required to search for and consolidate information from multiple sources. This centralisation enables heterogeneous stakeholders with diverse cultures across various domains to enrich the knowledge base and facilitate the dissemination of best practices, lessons learned, and innovative approaches within the UIC setting. Efficient sharing and knowledge management increase productivity, reduce duplication of efforts, and advance problem-solving. Additionally, as the UIC ecosystem often bridges academia and industry- each with distinct knowledge management practices- a centralised repository helps bridge these gaps, facilitating efficient sharing and knowledge management and fostering a mutual understanding within the UIC setting.

**Following DP8, DP9 is described to address the integration of real-time analytics to provide actionable insights to all stakeholders to enhance decision-making, as follows:**

*DP9: The iUIC platform should incorporate advanced analytics and reporting capabilities to enable stakeholders to gain insights, track progress, provide feedback, and make data-driven decisions, thereby fostering effective decision-making and promoting continuous collaborative growth.*

Effective decision-making within the UIC ecosystem depends on access to accurate and timely data alongside analytical capabilities to derive insights. The platform enhances this by establishing a continuous feedback mechanism with advanced analytics and reporting features to empower stakeholders to base decisions on data-driven insights that improve operations, assess the impact of changes, and guide future initiatives. These capabilities are crucial for tracking progress and monitoring performance indicators, which evaluate the effectiveness of such collaborations. Real-time visibility into various metrics through these tools enables practical identification of issues, obstacles, or opportunities for improvement. Pursuing continuous improvement is vital within the UIC setting to allow stakeholders to learn from experiences, adapt strategies, and improve processes. Additionally, considering the diverse data analysis and reporting needs of various stakeholders within the UIC ecosystem, the platform offers customised dashboards, flexible reporting options, and integration capabilities for multiple data sources to ensure access to the customised insights they need.

**After that, DP10 is formulated to emphasise practical experience opportunities for various stakeholders by implementing a system that supports continuous engagement and effective knowledge transfer within the UIC ecosystem, as follows:**

DP10 develops a practical experience module within the iUIC platform to facilitate participation in real-world projects and integrated learning opportunities, enabling stakeholders, including students and staff, to enhance cultural convergence, develop skills, acquire practical knowledge, and facilitate KT/TT-UIC activities.

*DP10: The iUIC platform should incorporate a practical experience module to enable engagement in real-world projects and integrated learning, thereby allowing stakeholders, including students and staff, to foster cultural convergence, develop skills, gain practical knowledge, and transfer knowledge within the UIC ecosystem, as follows:*

This supports work-integrated learning and practical experiences, crucial for bridging theoretical knowledge with real-world applications. These opportunities help stakeholders, including students, develop valuable skills, adapt to diverse work environments, and stay aligned with industry needs. This emphasises the importance of cultural exchange and sensitivity to foster effective collaboration by facilitating an understanding of different cultural contexts and providing resources to enhance awareness of diverse norms. Thus, it promotes respectful dialogue and mutual appreciation, essential to innovative solutions and productive communication. The platform serves as a centralised hub for accessing learning resources, internships and mentorships, which, over time, enhance collaboration and knowledge sharing across the ecosystem. This integrated approach fosters personal and professional development and ensures long-term, sustainable collaborations within the dynamic UIC ecosystem.

**Finally, DP11 is outlined as aiming to enhance data security measures techniques to ensure user privacy while also expanding the platform's scalability to accommodate an increasing number of users and more complex data sets, as follows:**

*DP11: The iUIC platform should integrate scalability and high performance with compliance and security measures to support growth and adapt to evolving requirements in a secure environment, thereby fostering trust, ensuring sustainability, and achieving regulatory compliance.*

Scalability and security are vital for digital platforms, particularly multi-sided ones such as the iUIC platform, to support the evolving nature of such an ecosystem. As the platform accommodates a growing number of stakeholders, projects, and data volumes, it must maintain consistent performance along with security measures to protect sensitive data and intellectual property. To effectively manage scalability, the platform leverages advanced infrastructure that dynamically adjusts resources based on real-time needs. For security, the platform integrates strict measures, including access controls, advanced encryption, and secure communication protocols, to prevent unauthorised access and data breaches. This dual focus ensures the platform's reliability and efficiency as it scales and builds a foundation of trust, making it a secure environment for the UIC ecosystem to collaborate seamlessly and safely.

To conclude, as presented in Table B.2, this section finishes with a summary of these DPs, which were further updated during the next phase of the DSR process.

## 5.4 MAPPING DESIGN PRINCIPLES TO CORRESPONDING DESIGN REQUIREMENTS

Table 5.10 presents a detailed matrix illustrating the relationship between the DRs and the DPs formulated from these requirements. This visual representation matrix is a foundational tool to ensure that each DP is directly aligned with the corresponding DRs to provide a purpose-driven development process. Moving forward into the next DSR phase, this alignment will be thoroughly developed and then evaluated through a continuous analysis of the knowledge represented in the instantiation of these principles, leading to a demonstration of the digital platform prototype and its design features (DFs).

Table 5.10: Matrix of DPs and Corresponding DRs

| Corresponding DRs | Design Principles (DPs) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | DP1 | DP2 | DP3 | DP4 | DP5 | DP6 | DP7 | DP8 | DP9 | DP10 | DP11 |
| **DR1** | X | X | | | X | X | | X | X | | X |
| **DR1.1** | X | X | | | X | X | | X | X | | X |
| **DR1.2** | X | X | | | X | X | | X | X | | X |
| **DR2** | X | X | | | X | | | X | X | | X |
| **DR2.1** | X | X | | | X | | | X | X | | X |
| **DR2.2** | X | X | X | | X | | | X | X | | X |
| **DR2.3** | X | X | X | | X | | | X | X | | X |
| **DR2.4** | X | X | | | X | | X | X | X | | X |
| **DR3** | X | | | | X | | | X | X | | X |
| **DR4** | X | | X | | X | | | X | X | | X |
| **DR4.1** | X | | X | | X | | | X | X | | X |
| **DR4.2** | X | | X | X | X | | | X | X | | X |
| **DR4.3** | X | | X | | X | | | X | X | | X |
| **DR5** | X | | | | X | | | X | X | | X |
| **DR5.1** | X | | | | X | X | | X | X | X | X |
| **DR6** | X | | X | | X | | X | X | X | | X |
| **DR6.1** | X | | X | | X | X | X | X | X | X | X |
| **DR6.2** | X | | X | X | X | | X | X | X | | X |
| **DR6.3** | X | | X | | X | X | X | X | X | X | X |
| **DR6.4** | X | | X | X | X | | X | X | X | | X |
| **DR6.5** | X | X | X | | X | X | X | X | X | | X |
| **DR7** | X | X | | | X | X | X | X | X | | X |
| **DR7.1** | X | X | | X | X | X | X | X | X | | X |
| **DR7.2** | X | X | X | | X | X | X | X | X | | X |

| Corresponding DRs | Design Principles (DPs) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | DP1 | DP2 | DP3 | DP4 | DP5 | DP6 | DP7 | DP8 | DP9 | DP10 | DP11 |
| **DR7.3** | X | X | X | | X | X | X | X | X | X | X |
| **DR8** | X | | | | X | | | X | X | | X |
| **DR8.1** | X | | | | X | | | X | X | X | X |
| **DR9** | X | | | X | X | | | X | X | | X |
| **DR9.1** | X | | X | X | X | | X | X | X | | X |
| **DR9.2** | X | | X | X | X | | X | X | X | | X |

## 5.5 CHAPTER SUMMARY

Given these considerations, Chapter 5 represents a critical shift in the thesis, moving from theoretical exploration to practical application within the UIC setting. This chapter demonstrates the second phase of the DSR process and suggests solutions to address the challenges identified in the previous chapter. It has proposed a novel digital platform intermediary to enhance KT/TT-UIC activities. It explores the role of intermediaries within the UIC setting and identifies such fundamental requirements for the proposed platform, categorising these requirements based on empirical findings from the UIC ecosystem. These findings were analysed through the lens of SC theory, specifically examining the structural, relational, and cognitive dimensions. After that, the chapter has further formulated tentative DPs, carefully aligning each principle with specific DRs to address real-world UIC challenges effectively. A comprehensive mapping of these DPs to corresponding DRs has been presented, providing a clear foundation for the platform's development. This approach highlights the practical implications of the research and establishes a solid framework for creating a purpose-driven digital platform intermediary to address the study's aims, progressing into the subsequent DSR phases of development and evaluation in the following chapters.

# 6 DSR | DEVELOPMENT

Chapter 6 describes the third DSR phase, which focuses on the practical application of DSR through the development and instantiation of a prototype digital platform within the UIC setting. It details the transition from theoretical design to practical implementation, specifically targeting the development of the suggested solution.

The chapter begins with an introduction that sets the objectives and scope for the development phase of the prototype, providing a foundation for this critical phase of the research. A detailed overview of the digital platform is given, including a comprehensive description of the IUIC dashboard and the service request functionalities (Section 6.1) and (Section 6.1.2), respectively. Central to this chapter, the instantiation of the proposed design features within the prototype illustrates how each contributes to enhancing the platform's functionality and user experience. These features include a personalised and user-friendly interface (Section 6.2.1), flexible and adaptable collaboration models (Section 6.2.2), enhanced matchmaking capabilities (Section 6.2.3), recognition and incentivisation of contributions (Section 6.2.4), multipurpose communication channels (Section 6.2.5), digital co-creation and open innovation (Section 6.2.6), project and time management tools (Section 6.2.7), integrated knowledge and document management with advanced analytics capabilities (Section 6.2.8), practical experience opportunities (Section 6.2.9), and scalability, performance, and compliance (Section 6.2.10).

The chapter highlights the key achievements and insights gained from developing and instantiating the prototype (Section 6.3). This summary emphasises how each design feature meets the unique needs of the UIC ecosystem. It places the development phase within the broader context of the DSR and sets the stage for the subsequent phase of evaluation and examination.

## 6.1 PROTOTYPE DEVELOPMENT: OVERVIEW OF THE DIGITAL PLATFORM

The iUIC platform used here is strategically designed as a multi-sided marketplace. It acts as a socio-technical intermediary, accommodating both social dimensions and technological functionalities to connect various stakeholders within the UIC setting. The 'iUIC' stands for 'Innovative University-Industry Collaboration', which highlights its role in fostering a cooperative landscape that promotes active collaboration, optimises resource sharing, and facilitates mutual benefits among all participants in the UIC ecosystem. The primary goal of the iUIC platform is to significantly enhance and streamline sustaining collaborative efforts among these organisations for successful and efficient Kt/TT-UIC activities. Specifically targeting the broad UIC ecosystem, the platform includes universities, various agencies such as government bodies, businesses, and non-profit organisations, and also engages individual stakeholders. It should significantly enhance operational efficiency while carefully respecting and maintaining the organisations' established internal policies and workflows and ensuring that no existing systems or practices are inadvertently disrupted, overlapped, or interfered with.

The digital platform prototype utilises a cohesive technology stack designed for seamless user experience and efficient back-end management, enhancing performance, simplifying development, and boosting user engagement. Each component is selected for integration capability and individual performance, forming an effective digital solution. On the backend, Laravel is used for its simplicity, flexibility, and comprehensive

features like routing, sessions, and authentication, adhering to the MVC pattern for easier maintenance and scalability. Composer, as the PHP dependency manager, ensures consistency and updates for PHP packages. Besides, front-end development involves HTML and CSS for structured, visually appealing interfaces, while JavaScript enables interactive elements and real-time updates. Bootstrap enhances responsiveness across devices, and jQuery simplifies DOM manipulation and event handling. NPM/Yarn are used to manage JavaScript libraries and streamline development. Blade, Laravel's templating engine, facilitates dynamic HTML template integration. As for data management, MySQL serves as a reliable and scalable relational database, handling complex queries and large data volumes crucial for platform performance and scalability.

### 6.1.1 The iUIC Dashboard: An Overview

**iUIC Dashboard**: A personalised interface for each user category provides access to tailored services, profile management, and advanced communication tools designed to enhance user engagement and productivity on the platform. This includes an expandable sidebar with multiple sub-options for improved navigation and usability. The interface is available exclusively to registered users, as illustrated in Figures 6.1 and 6.2, where the captions are clearly tailored to the categories of University or Industry. Other figures without specific captions represent features that are generally available on the platform for both University and Industry users. The core features include the following:

- **Statistics**: Delivers financial analysis and performance insights/indicators.
- **Communication Hub**: Supports real-time communication via chatbox.
- **Requests Management, including**:
    - **My Requests**: Manage and view submitted requests.
    - **Received Requests**: Monitor, respond, and manage options like accept, reject, or inquire about incoming requests.
    - **Drafts**: Save and manage drafts of unfinished or cancelled requests.
- **Favourites**: Bookmark preferred tools and services for quick access.
- **Services**: Offers a collection of services specifically tailored to match user preferences and categories, using dynamic forms for efficient collaborations, including:
    - **Add Services:** Enables users within the UIC ecosystem of the platform to add new services as needed to their dashboard, thereby enhancing visibility for both their services and their roles as providers.
    - **Request Services:** Enables a user (a service seeker) to submit requests for specific services, such as consulting, using dynamic, user-friendly forms. Once submitted, these requests are automatically dispatched to matching partners.
- **Account Settings:** Control profiles, security settings, and manage user accounts.

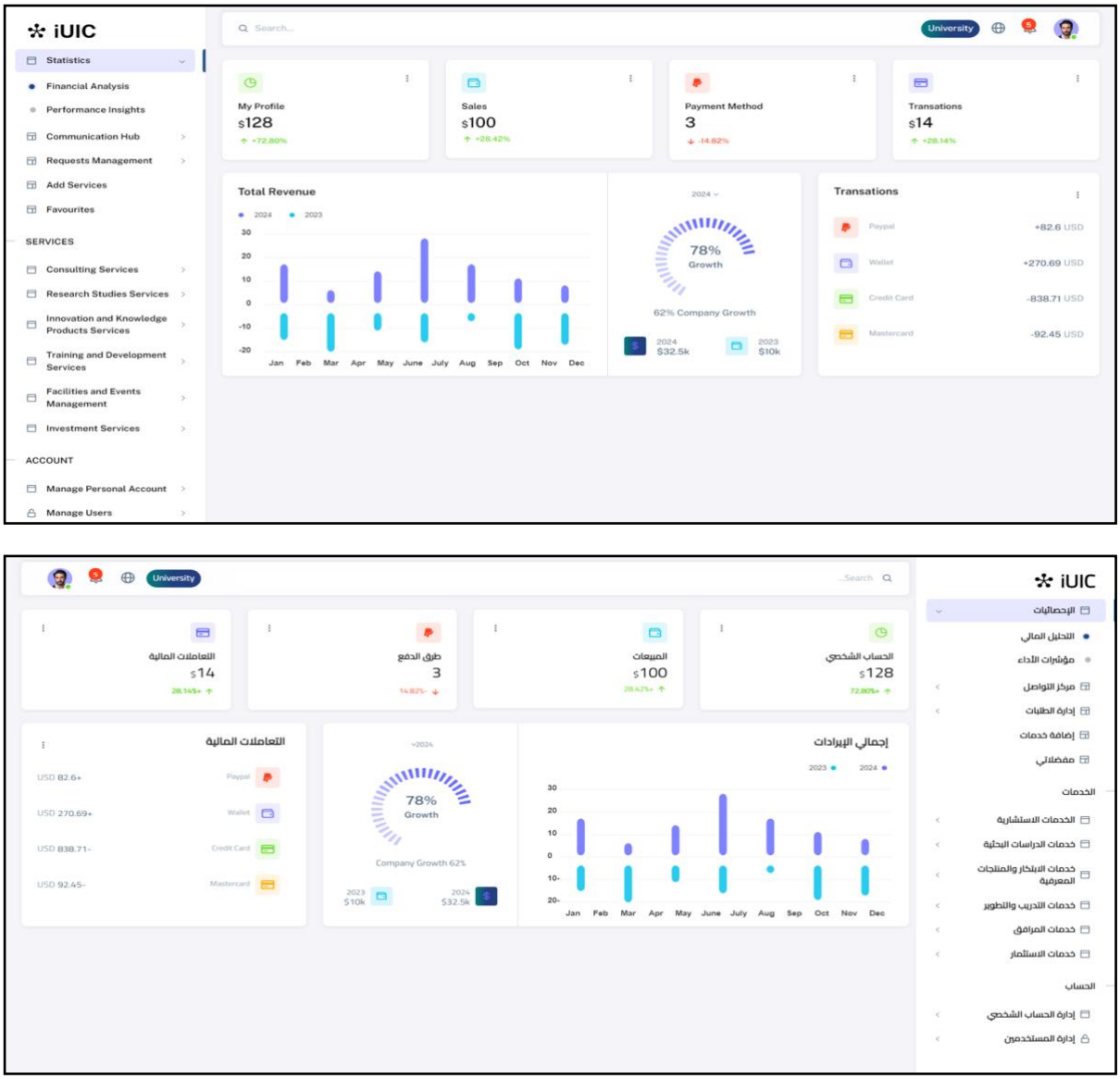



Figure 6.1: The iUIC Dashboard | University (English and Arabic Languages)

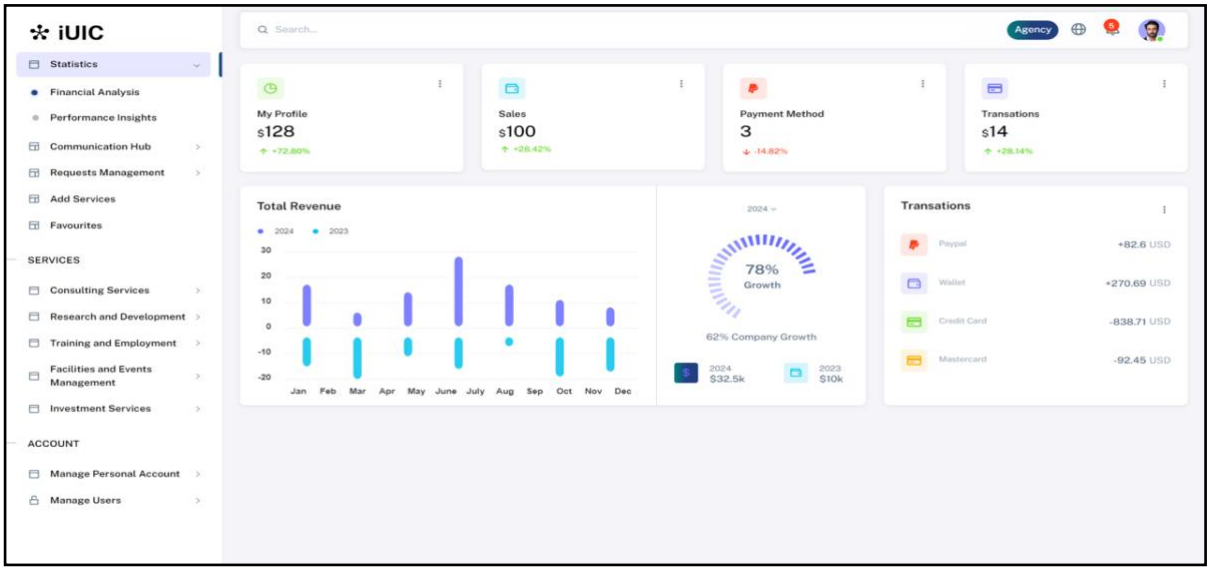
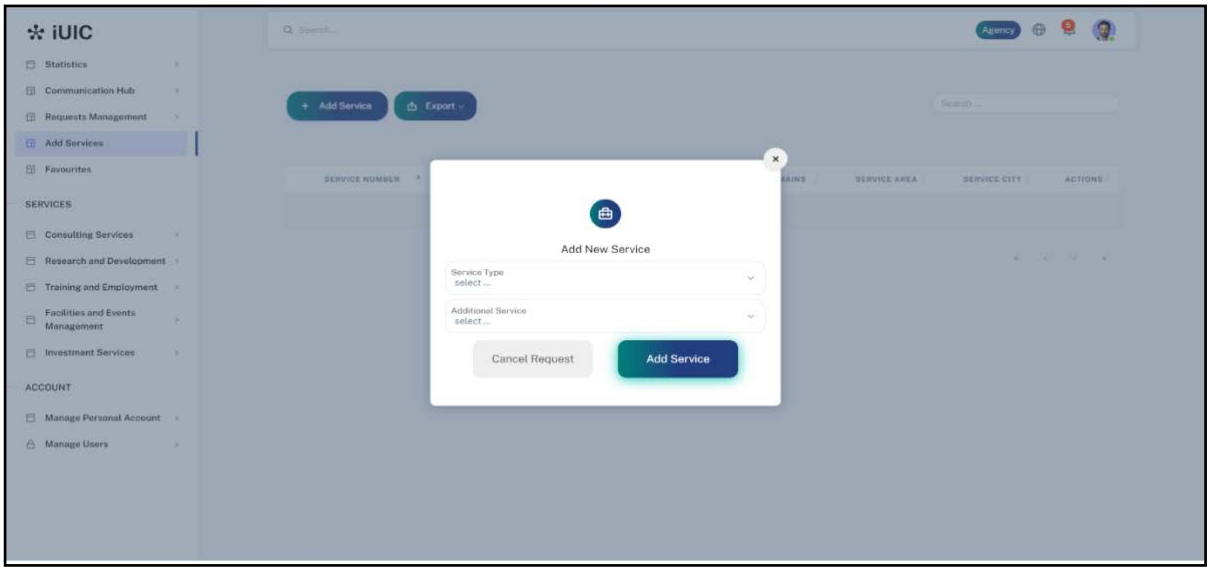



Figure 6.2: The iUIC Dashboard | Industry (English and Arabic Languages)

### 6.1.2 The iUIC Dashboard: Services Requests

The 'Request Services' feature is a key element of the iUIC Dashboard, designed to streamline and optimise the process of requesting and managing services within the UIC ecosystem, exemplifying KT/TT-UIC activities. Currently, as the system is in its prototype phase, only the consulting service is available within the service request features on the dashboard. It is essential for users, who are assumed to be already registered on the platform, to use this feature to submit and customise their requests for specific services, such as consulting, by using dynamic, user-friendly forms that enhance the user experience.

For these forms to be operational, service providers must already add such service features to their dashboards. This enables providers to engage in and manage collaboration activities effectively. Once a service request is submitted, it is automatically dispatched to matching partners per the requirements specified in the request form to facilitate seamless interactions within the UIC setting, as illustrated in Figure 6.3.



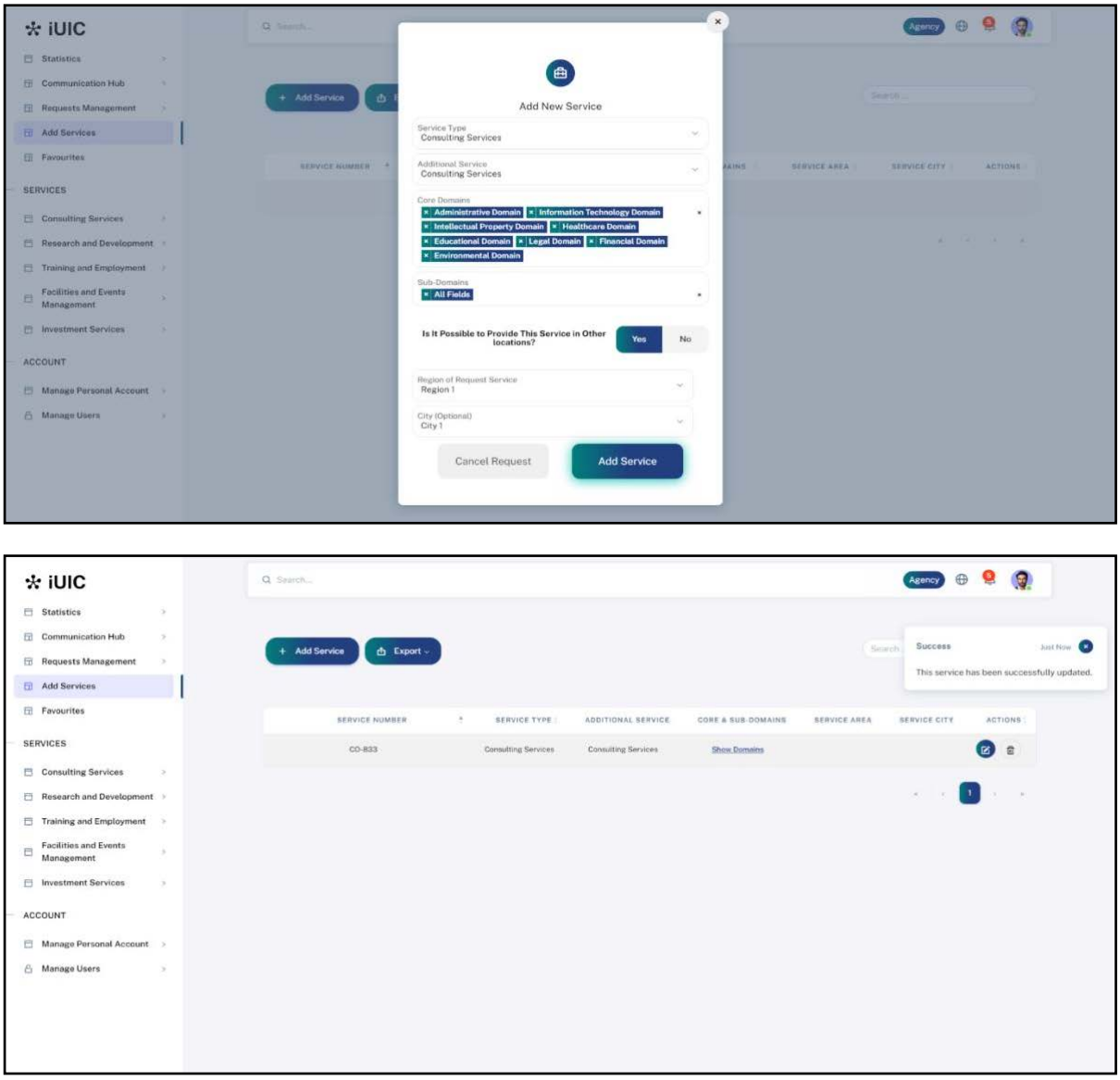



Figure 6.3: Screenshots of the 'Add Service' Feature for the Consulting Service Request by a Service Provider

The consulting service request form on the dashboard is organised into two main sections: service specifications and consultation details. The service specifications section allows users to customise their request by selecting areas of expertise, choosing between different types of providers, determining the number of providers, specifying the service delivery mode, and setting budget constraints to match their needs. The consultation details section captures essential information such as the consultation topic, description, objectives, and timeframe to ensure the consultation is effectively focused and organised. This structured approach facilitates a smooth and efficient consulting process tailored to the users' requirements, as illustrated in Figures 6.4, 4.5, and 4.6.

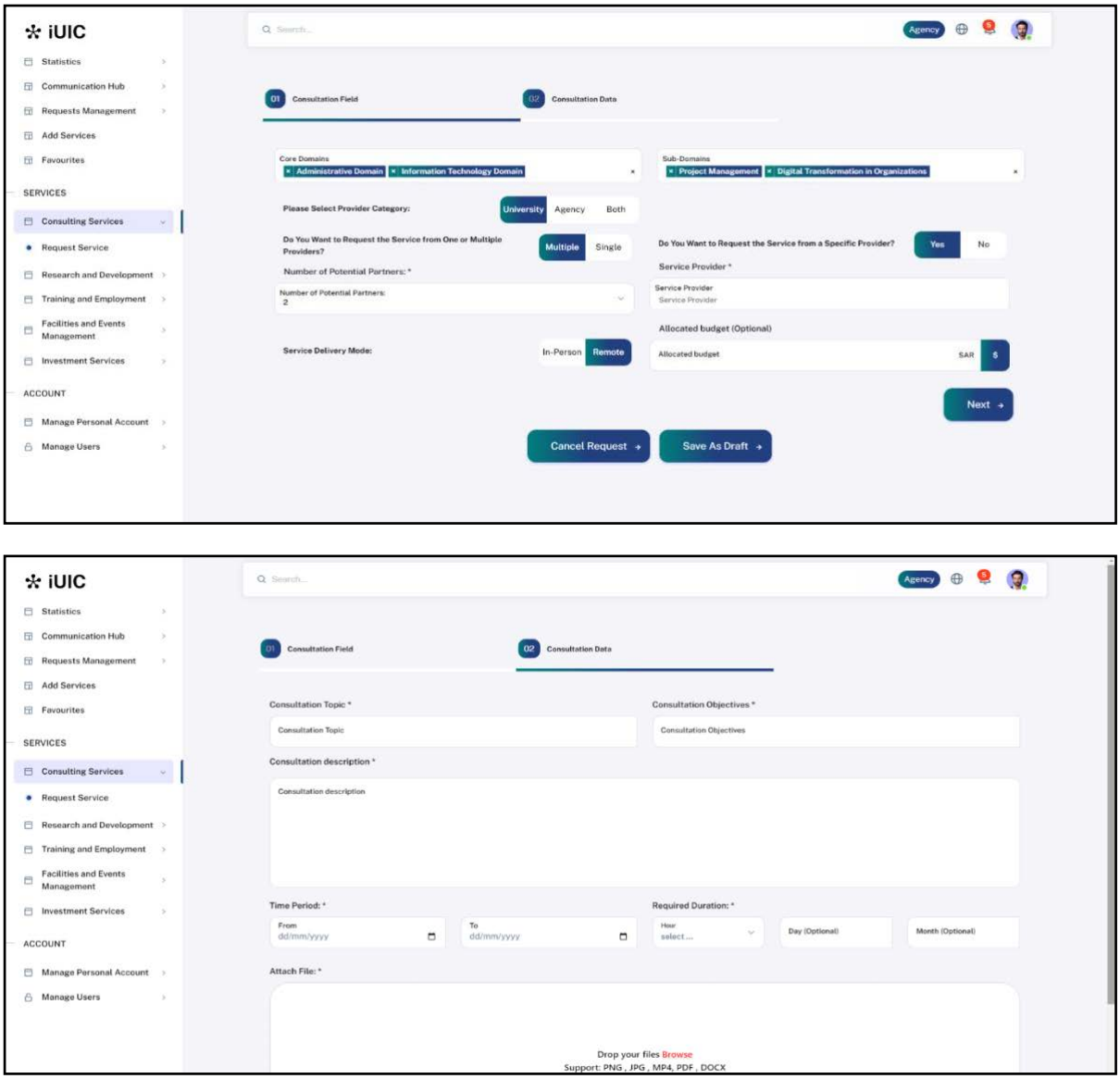



Figure 6.4: Screenshots of the Consulting Service Request Form

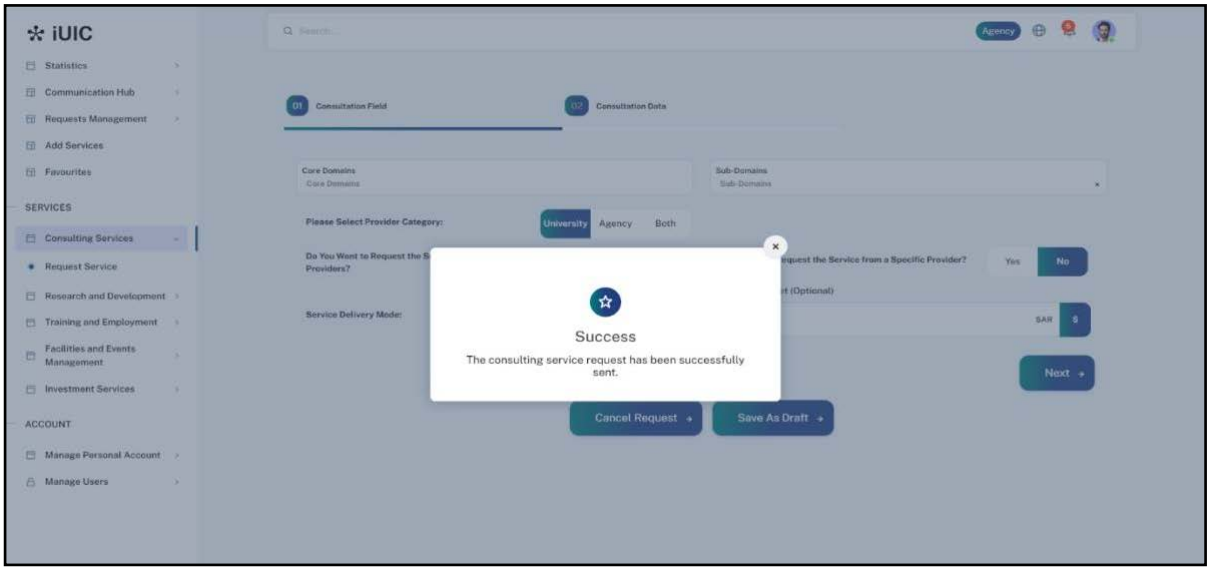



Figure 6.5: A Screenshot Following the Submission of the Consulting Service Request by a Service Seeker

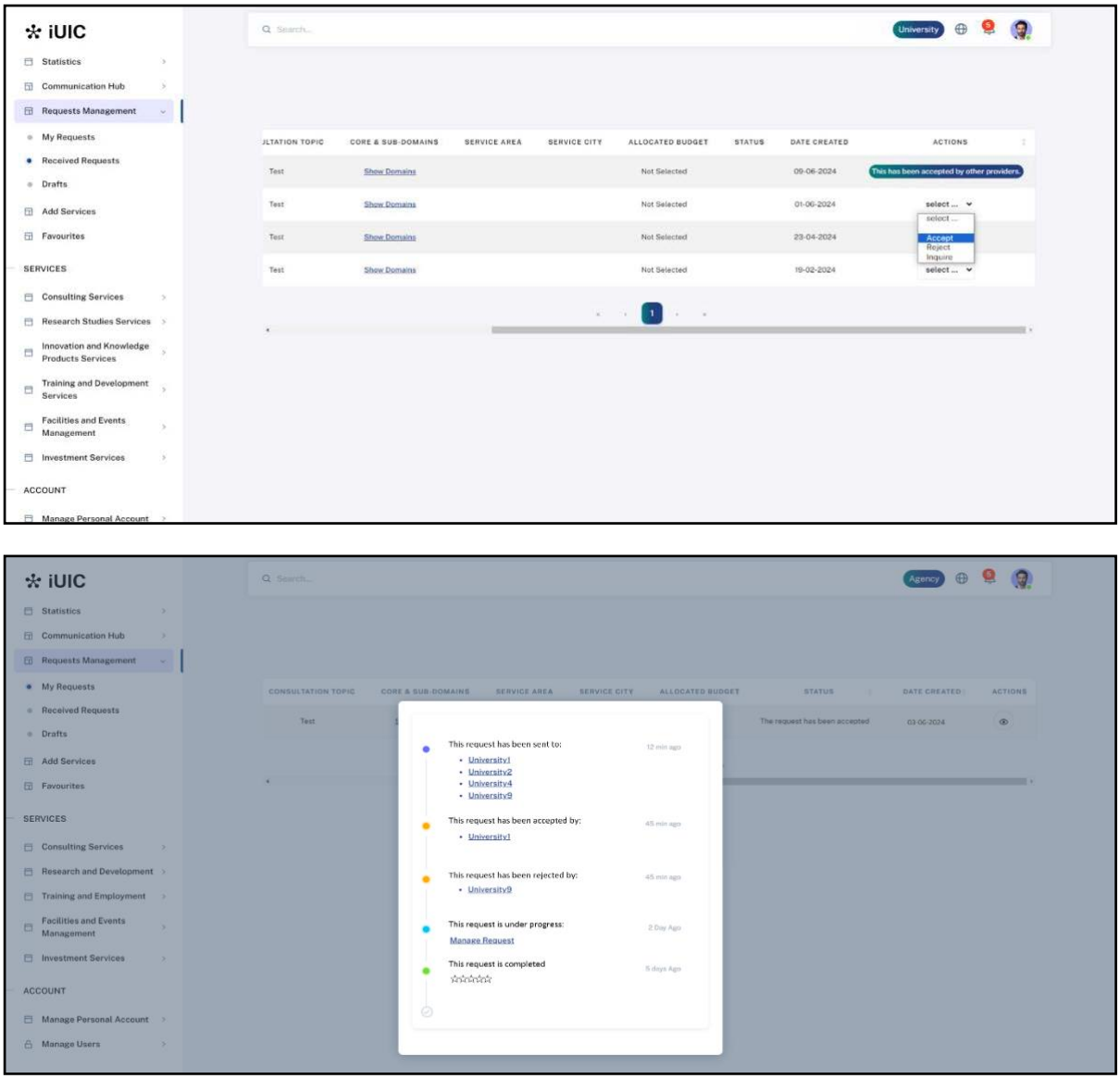



Figure 6.6: A Screenshot Following the Acceptance of the Consulting Request

The dashboard enhances efficiency by streamlining request management, thus improving workflow and response times. The “Requests Management” feature is designed to efficiently handle and track all user-related requests, including sections for my requests, received requests, and drafts. 'My Requests' allows service seekers to track and manage both active and past requests, as illustrated in Figure 6.7. 'Received Requests' enables service providers to oversee incoming requests with options to accept, reject, or request further information, as shown in Figure 6.8. 'Drafts' provides a space to save and manage drafts of unfinished or previously cancelled requests for future use, as demonstrated in Figure 6.9. Further details are provided in the subsequent sections and figures of this chapter.

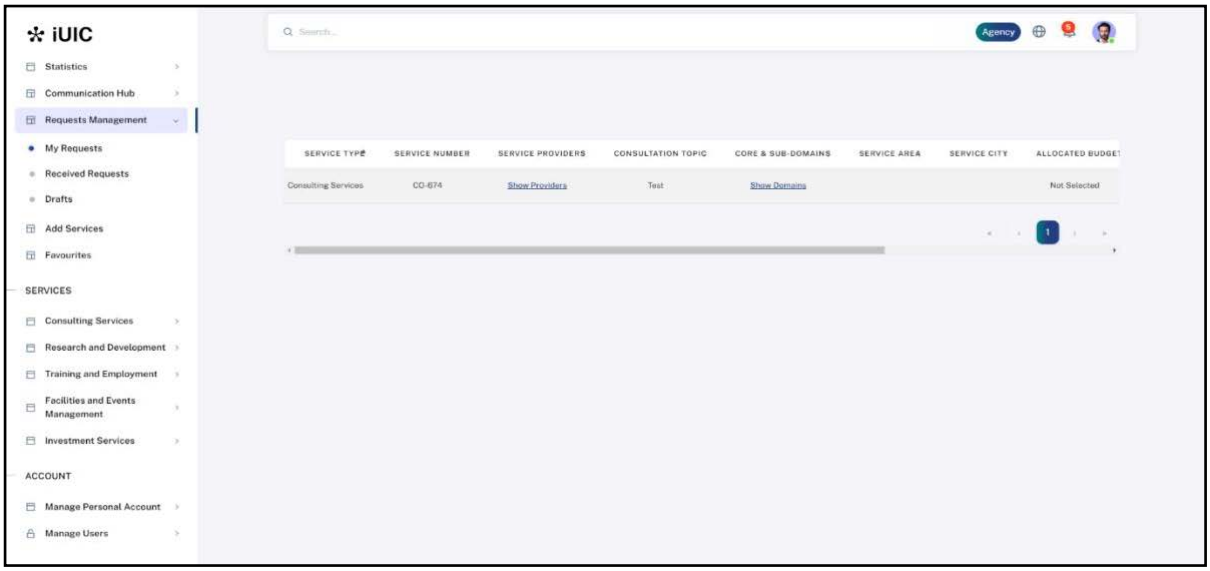



Figure 6.7: A Screenshot for Requests Management | My Requests

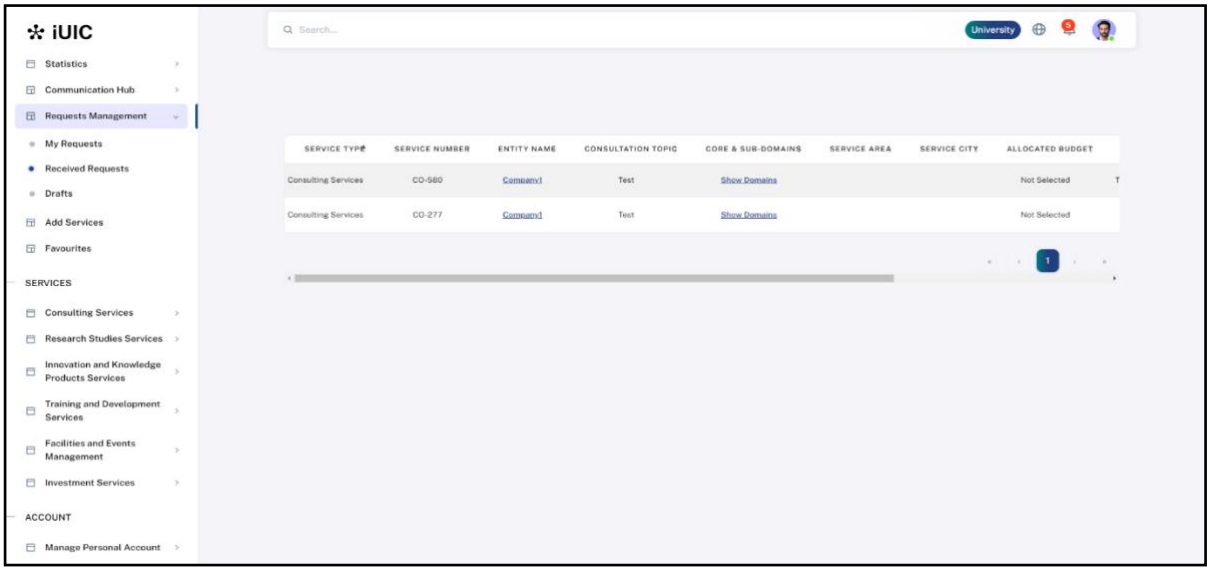



Figure 6.8: A Screenshot for Requests Management | Received Requests

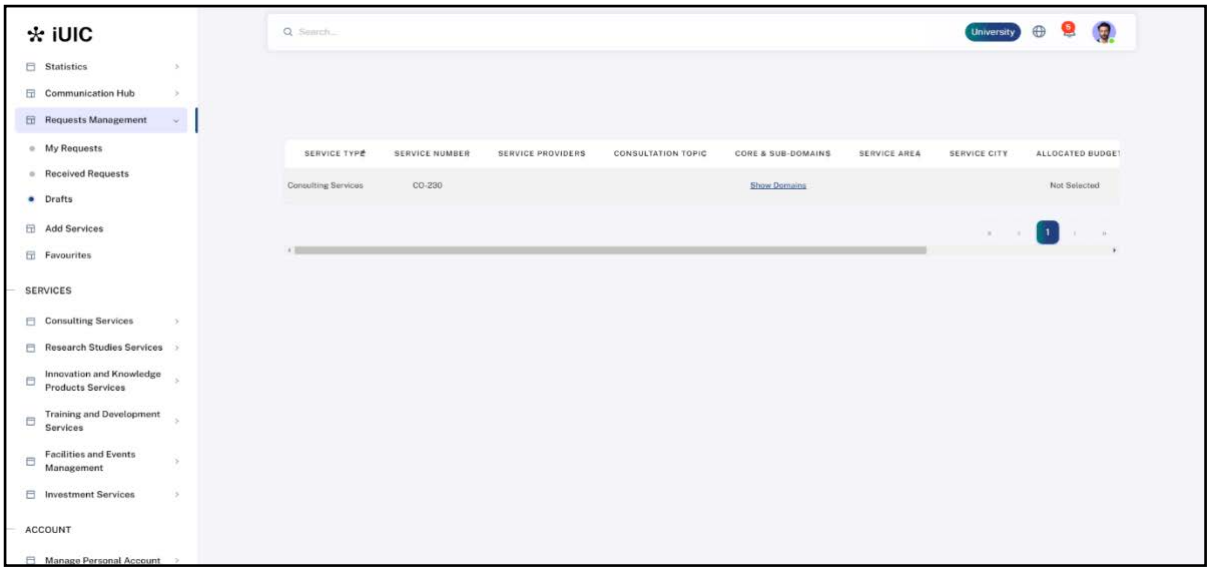



Figure 6.9: A Screenshot for Requests Management | Drafts

Figure 6.10 showcases a cross-functional process flow diagram that delineates the key phases of UIC collaboration in managing a "consulting services request." This diagram emphasises the integrated approach across different functional areas, serving as a quick reference to understand the streamlined process used in delivering consulting services. As part of the dashboard setup, it is recommended to add specific services, such as consulting services, to efficiently list and manage offerings as service providers of such services. A user, who could be a university or industry actor, can initiate the pre-collaboration phase by submitting a service request through the dashboard and filling out the request form. Once a request is submitted, it can be either accepted or rejected by a provider. Upon acceptance, both parties enter the collaboration phase, managing and tracking the request; this can be viewed via 'Requests Management' in their dashboard. Once the requirements are fulfilled, they transition into the post-collaboration phase by rating each other and submitting all required documents.

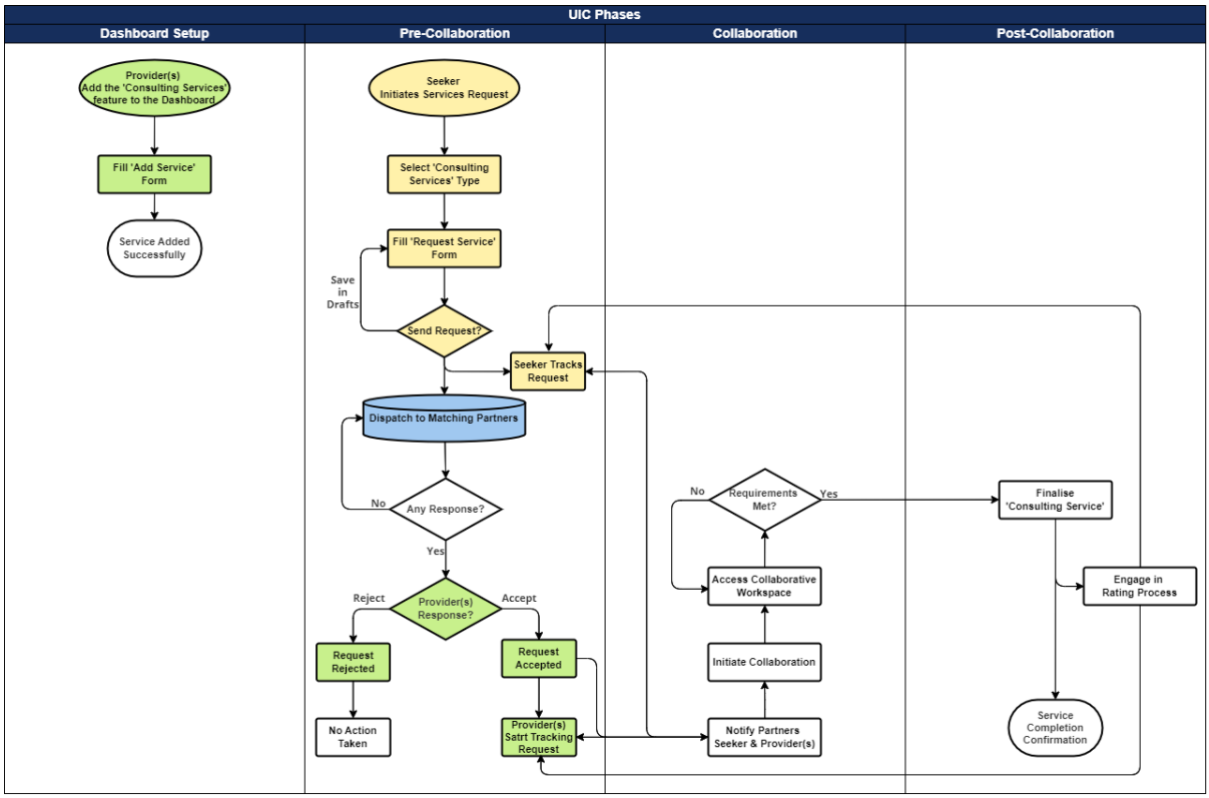



Figure 6.10: A Brief Cross-Functional Process Flow Diagram for Consulting Services

## 6.2 PROTOTYPE DEVELOPMENT: INSTANTIATION OF PROPOSED DESIGN USING DESIGN FEATURES

In the second phase of the DSR, developing "iUIC", a digital platform-based intermediary, is pursued. This development is guided by the established DRs and DPs, aligning with the mapping between these DRs and DPs, illustrated in Table B.2. These foundational elements are transformed into tangible design features (DFs) to facilitate the prototype's development. Meth, Mueller, and Maedche (2015) characterise DFs as essential links that bridge the gap between theoretical DPs and DRs and the practical realisation of the artifact. Given the abstract nature of DPs and DRs, DFs are crucial in materialising these concepts into the operational design. DFs are

proposed based on DPs and DRs. These proposed DFs are then implemented as a digital platform prototype and evaluated through a structured argumentative process incorporating subject matter experts' feedback to ensure each implemented DF aligns with the theoretical foundations and effectively addresses practical considerations and user needs within the UIC setting.

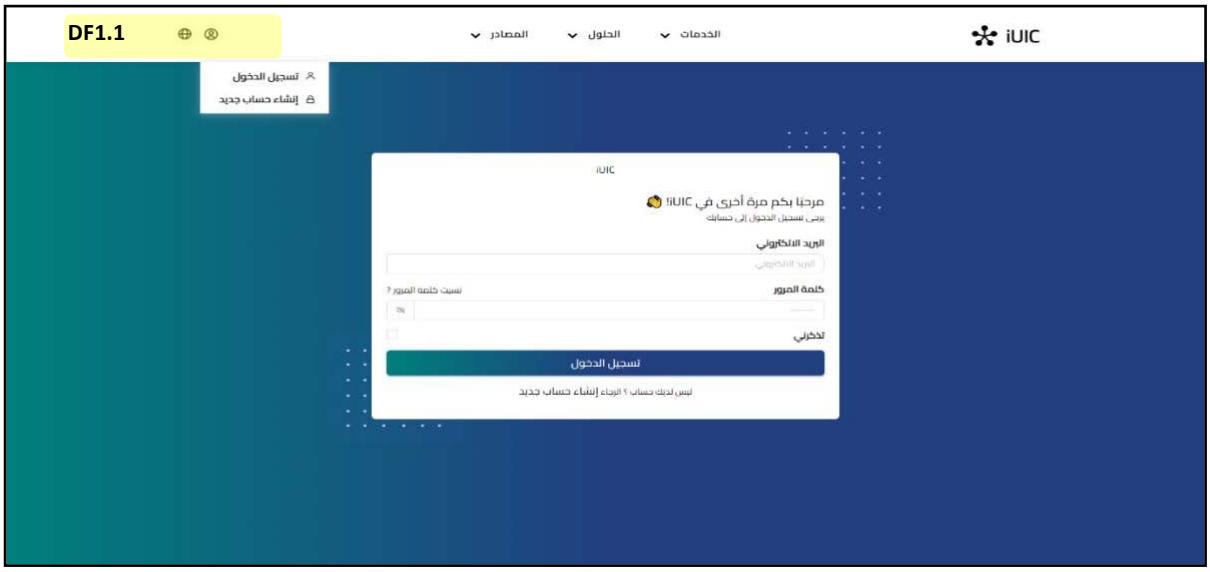
For a visual demonstration, screenshots in subsequent figures show how DPs are instantiated by implementing DFs within the platform, highlighting the practical application. By doing so, visual representation illustrates the tangible outcomes of translating the DRs and DPs into an artifact. Furthermore, demonstrative and prototype instantiation serve two essential functions: they validate the concept by showing how it works in practice and often provide a clear and straightforward illustration. By displaying screenshots from a prototype, this method helps translate abstract theories into concrete examples, enhancing comprehension and demonstrating real-world applicability (Gregor et al., 2007; Peffers et al., 2007; Vaishnavi & Kuechler, 2015). To initiate the development process, DFs are organised into ten broad categories comprising 26 sub-features, which serve as the foundational structure of the digital platform's design.

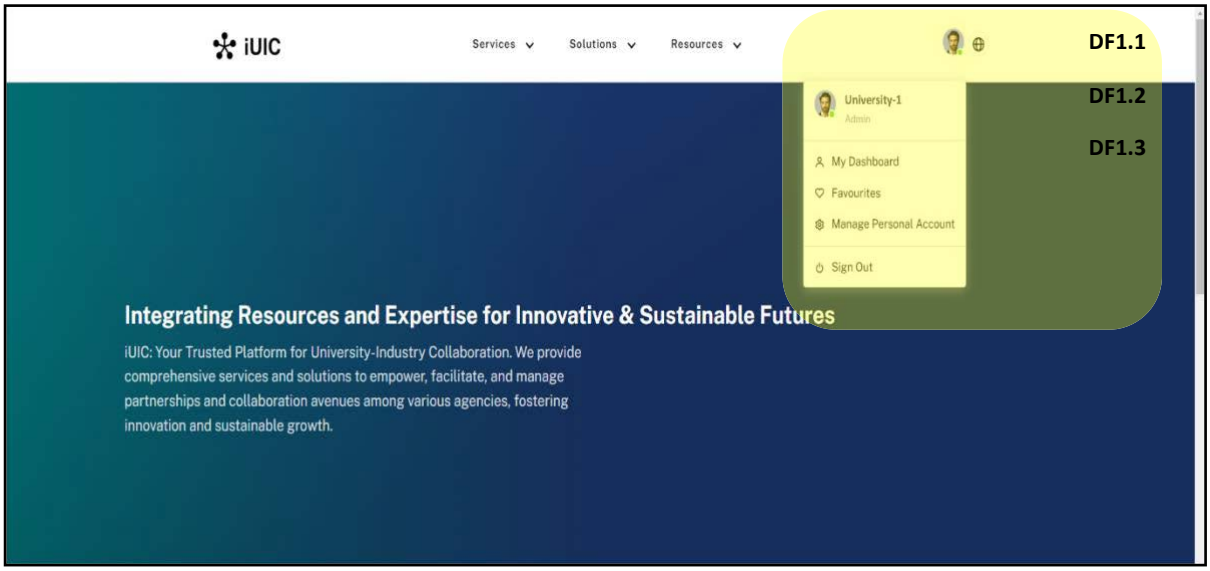
### 6.2.1 DF1- Personalised and User-Friendly Interface

Starting with **DF1**, the platform focuses on developing a personalised and intuitive interface to enhance user engagement and simplify navigation. This facilitates exploring the relationship between user preferences and interface customisation. It allows stakeholders to seamlessly explore how their dashboard preferences and configurations enhance their experience and workflows to meet their needs within the UIC setting. This relationship is expected to be most apparent when users can dynamically adjust their dashboard settings and interface configurations within the platform. To support this dynamic adjustment, a high degree of interactivity is essential to meet the criteria of DP1. The features incorporated into the UIC interface, as part of DF1, include personalised user profiles and settings (DF1.1), customisable dashboards based on the UIC category (DF1.2), and role-based access controls within each super-user account (DF1.3), as illustrated in Figure 6.11.

DF1.1 offers a dynamic user customisation framework within the UIC ecosystem, allowing participants to create detailed profiles that align with their preferences, roles, and needs. Users can switch between English and Arabic to enhance customisation accessibility and flexibility. Also, upon registration, users select from categories like (i) “Universities” for academic institutions looking to engage in collaborative activities, (ii) “Agencies: for government bodies, private sector firms, non-profit organisations, and any other entities interested in fostering such collaborations, and (iii) "Individuals" for experts seeking to contribute independently ("Individuals" category has not been activated in this prototype). This helps adapt the initial setup and dashboard configurations to their intended goals. The platform's “account settings” further enhance customisation by enabling users to update information, adjust notification preferences, and manage registered user access within their organisation. This includes assigning roles and managing permissions, so each user has the appropriate level of access based on their responsibilities. These features also integrate with DF1.3 to support advanced role-based access controls, reinforcing security and functionality. The "manage users" functionality in the account settings directly supports this feature, as super-users define and manage access levels and permissions for different team members (if needed) based on their role in the project and maintaining security while facilitating collaboration. DF1.2 offers

flexible dashboards that users can modify in real-time, so stakeholders can add, remove, or rearrange “services” and information panels to create a workspace that best suits their workflow within the UIC setting.



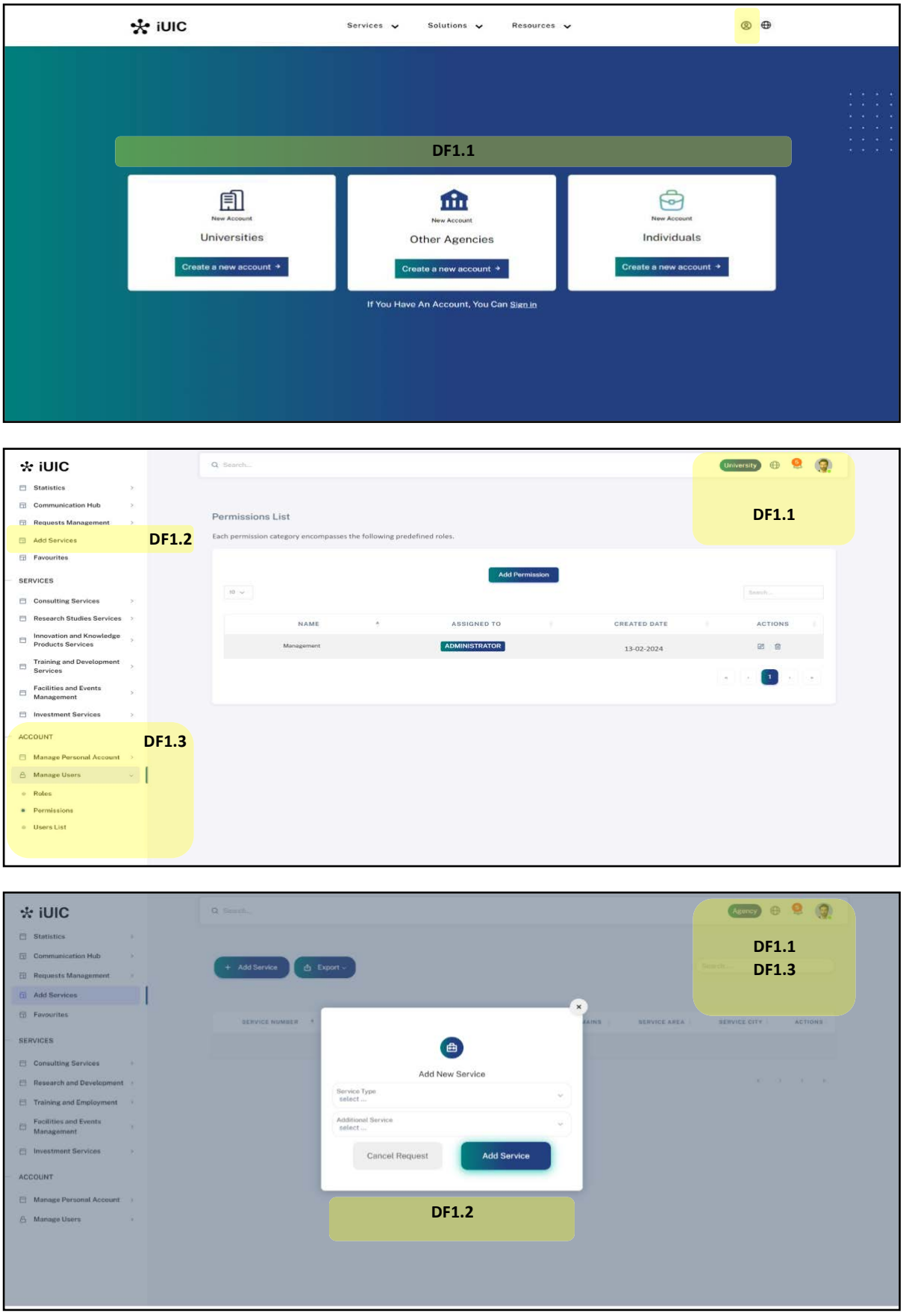



Figure 6.11: DF1- Personalised and User-Friendly Interface

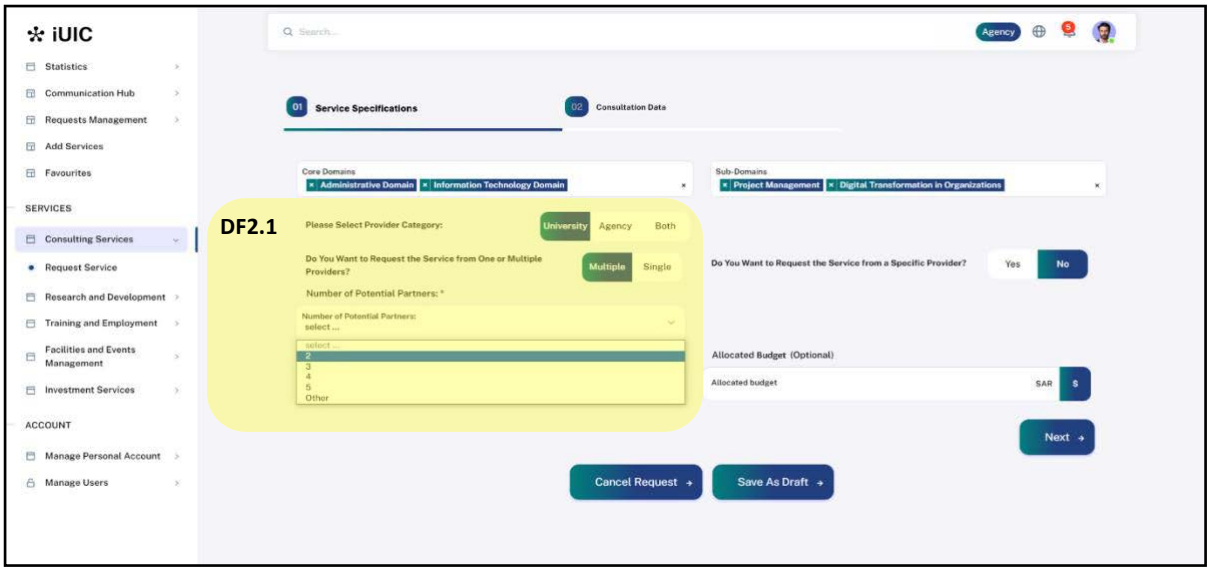
### 6.2.2 DF2- Flexible and Adaptable Collaboration Models

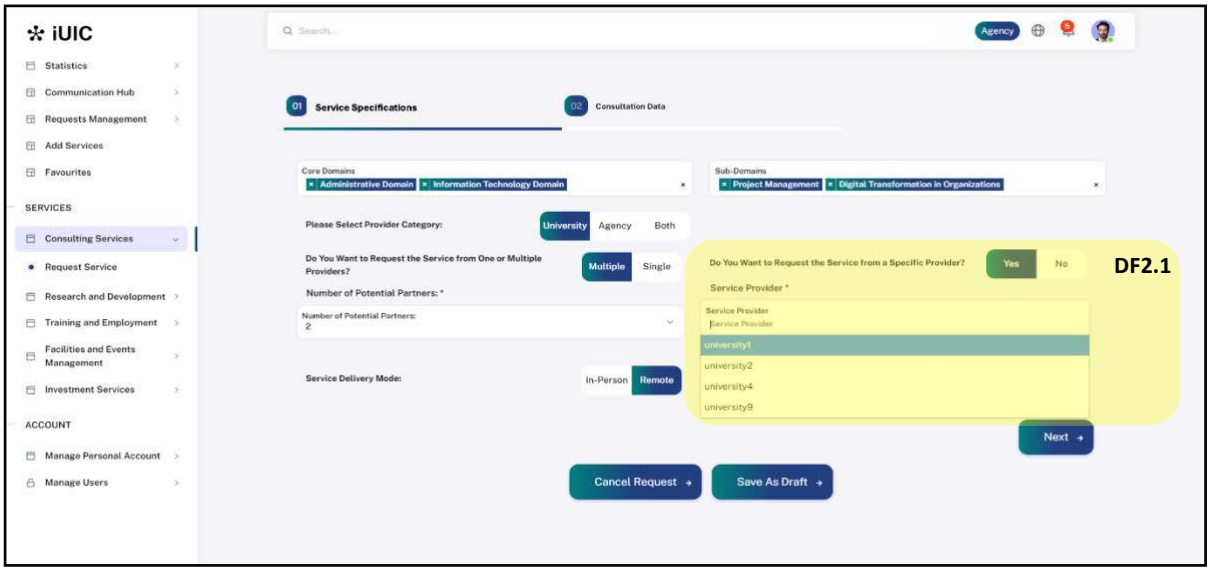
Moving on to DF2, the platform is designed to accommodate the dynamic nature of collaboration within the UIC ecosystem, particularly between service providers and service seekers. This allows stakeholders to configure and modify collaboration models and project structures per evolving requirements and several partners (if needed) towards better practicality and adaptability. The ability for both service providers and seekers to dynamically adjust project templates and forms and track tasks in real-time is critical for maintaining transparency and ensuring alignment with project goals. To support this dynamic adjustment, a high degree of interactivity and flexibility is essential to meet the criteria of DP2. The features incorporated into the UIC platform, as part of DF2, include configurable project templates (DF2.1) and flexible collaboration delivery mode (DF2.2), as illustrated in Figure 6.12.

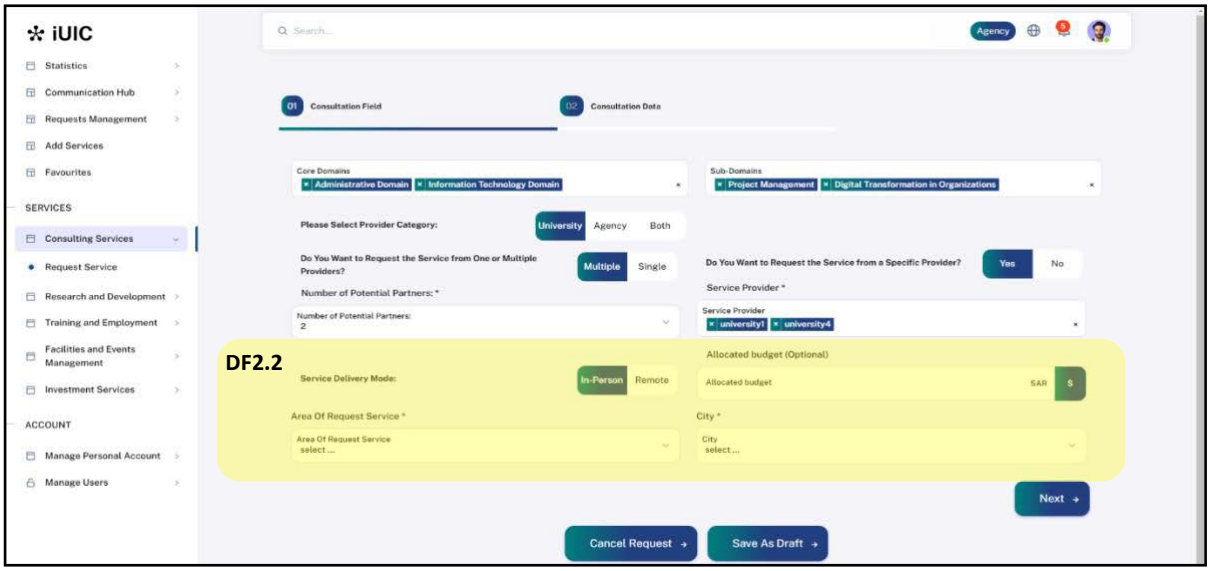
DF2.1 provides customisable project/service templates that stakeholders can modify according to the specific needs of their collaboration and the UIC models. It allows adaptability by creating workflows optimally suited to each project's unique dynamics, facilitating a more organised and efficient collaboration process. DF2.2 supports adaptable and flexible collaboration delivery modes to provide stakeholders with virtual dynamics environments where they can interact, collaborate, and share resources within the UIC setting. They accommodate various collaborations and project requirements, featuring advanced communication tools and real-time editing capabilities.

For example, the prototype is designed to demonstrate effective service delivery within a UIC ecosystem. Initially, the services feature is activated to showcase the platform's capabilities using the "Add Services" and "Request Services" forms to collect detailed information to ensure matchmaking and alignment with user needs. As for "Request Services", this form allows users to select several relevant requirements. Users can also choose the provider category—universities, agencies, or both- enabling targeted service requests to specific project demands. Users can decide whether they need services from a single provider or multiple providers, accommodating the need for broader expertise if necessary. Additionally, there is an option to request services from a specific provider or to remain open to any qualified provider, offering flexibility in provider selection. Moreover, the form includes options for service delivery mode, allowing users to choose between in-person or remote consultations, thus accommodating various user preferences and logistical requirements.

Also, "Add Services" currently supports consulting services. The "Add Services" feature allows users to list and manage their offerings as a “service provider”. This feature enhances ecosystem collaboration and visibility. This enables providers to specify their service type and specialisation areas, as well as the flexibility to offer these services across various locations, extending beyond the initial address to include multiple regions and cities. This adaptability supports the evolving nature of such collaboration activities within the ecosystem.


iUIC
Statistics
Communication Hub
Requests Management
Add Services
Favourites
SERVICES
Consulting Services
Request Service
Research and Development
Training and Employment
Facilities and Events Management
Investment Services
ACCOUNT
Manage Personal Account
Manage Users
Agency
01 Service Specifications
02 Consultation Data
Core Domains
Administrative Domain
Information Technology Domain
Sub-Domains
Project Management
Digital Transformation in Organizations
DF2.1
Please Select Provider Category:
University
Agency
Both
Do You Want to Request the Service from One or Multiple Providers?
Multiple
Single
Do You Want to Request the Service from a Specific Provider?
Yes
No
Number of Potential Partners: *
Number of Potential Partners:
select ...
2
3
4
5
Other
Allocated Budget (Optional)
Allocated budget
SAR
$
Next
Cancel Request
Save As Draft


iUIC
Statistics
Communication Hub
Requests Management
Add Services
Favourites
SERVICES
Consulting Services
Request Service
Research and Development
Training and Employment
Facilities and Events Management
Investment Services
ACCOUNT
Manage Personal Account
Manage Users
Agency
01 Service Specifications
02 Consultation Data
Core Domains
Administrative Domain
Information Technology Domain
Sub-Domains
Project Management
Digital Transformation in Organizations
Please Select Provider Category:
University
Agency
Both
Do You Want to Request the Service from One or Multiple Providers?
Multiple
Single
Do You Want to Request the Service from a Specific Provider?
Yes
No
DF2.1
Number of Potential Partners: *
Number of Potential Partners:
2
Service Provider *
Service Provider
university1
university2
university4
university9
Service Delivery Mode:
In-Person
Remote
Next
Cancel Request
Save As Draft


iUIC
Statistics
Communication Hub
Requests Management
Add Services
Favourites
SERVICES
Consulting Services
Request Service
Research and Development
Training and Employment
Facilities and Events Management
Investment Services
ACCOUNT
Manage Personal Account
Manage Users
Agency
01 Consultation Field
02 Consultation Data
Core Domains
Administrative Domain
Information Technology Domain
Sub-Domains
Project Management
Digital Transformation in Organizations
Please Select Provider Category:
University
Agency
Both
Do You Want to Request the Service from One or Multiple Providers?
Multiple
Single
Do You Want to Request the Service from a Specific Provider?
Yes
No
Number of Potential Partners: *
Number of Potential Partners:
2
Service Provider *
Service Provider
university1
university4
DF2.2
Allocated budget (Optional)
Service Delivery Mode:
In-Person
Remote
Allocated budget
SAR
$
Area Of Request Service *
Area Of Request Service
select ...
City *
City
select ...
Next
Cancel Request
Save As Draft

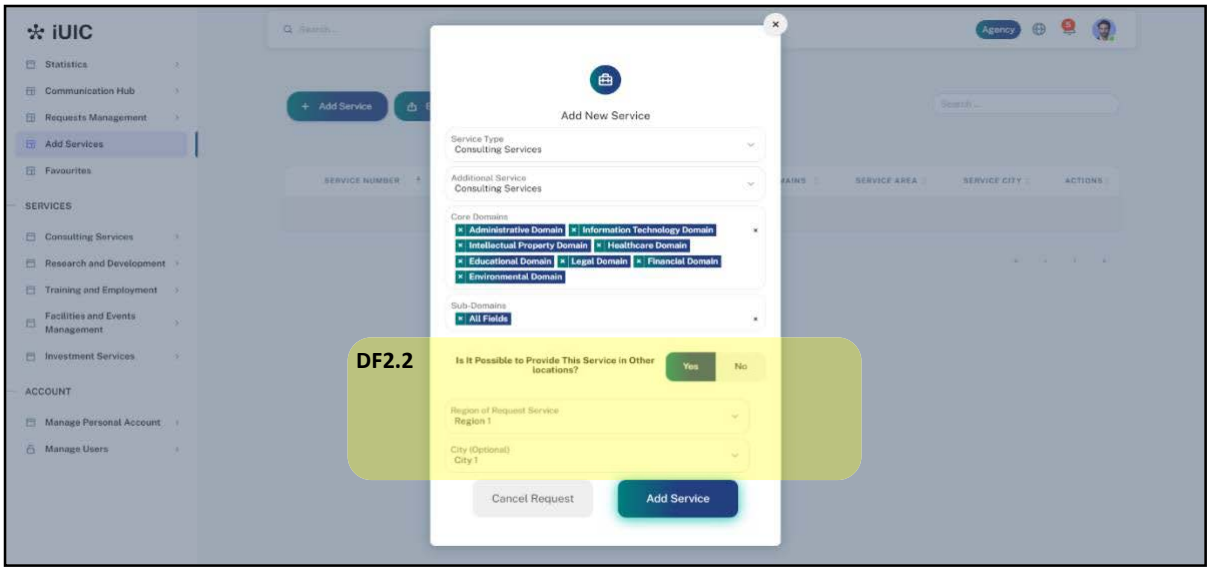



Figure 6.12: DF2- Flexible and Adaptable Collaboration Models

### 6.2.3 DF3- Enhanced Matchmaking Capabilities

Next, DF3 introduces matchmaking capabilities with advanced search and filtering options and virtual workspaces. It also may integrate recommendation engines, besides stakeholder profiling and skill mapping (not available in the prototype), to dynamically enhance user connectivity and interaction. It helps stakeholders discover and connect with suitable partners and resources across the UIC ecosystem, where ease of finding the right connections and resources is expected to enhance collaborative efforts and efficiency significantly. This is also evident in the customisable matchmaking templates used in the project/service (refer to DF2.1). To support this dynamic adjustment, a high degree of interactivity and intelligence is essential to meet the criteria of DP3. The features incorporated into the UIC platform, as part of DF3, include customisable matchmaking templates (DF3.1) and advanced search and filtering options (DF3.2), as illustrated in Figure 6.13.

DF3.1 can be aligned with DF2.1 as well. The service request/add form allows users to specify various requirements, such as core and sub-domains. This ensures that the providers' expertise aligns accurately with the specific demands of each request. DF3.2 enhances the platform by allowing users to efficiently search and filter for potential partners and resources based on specific criteria, thereby streamlining and optimising the discovery process. Additionally, it includes matchmaking tools such as "partners discover" and "opportunities discover," which are designed to facilitate the identification of aligned partners and innovative collaboration opportunities towards boosting the platform’s matchmaking capabilities.

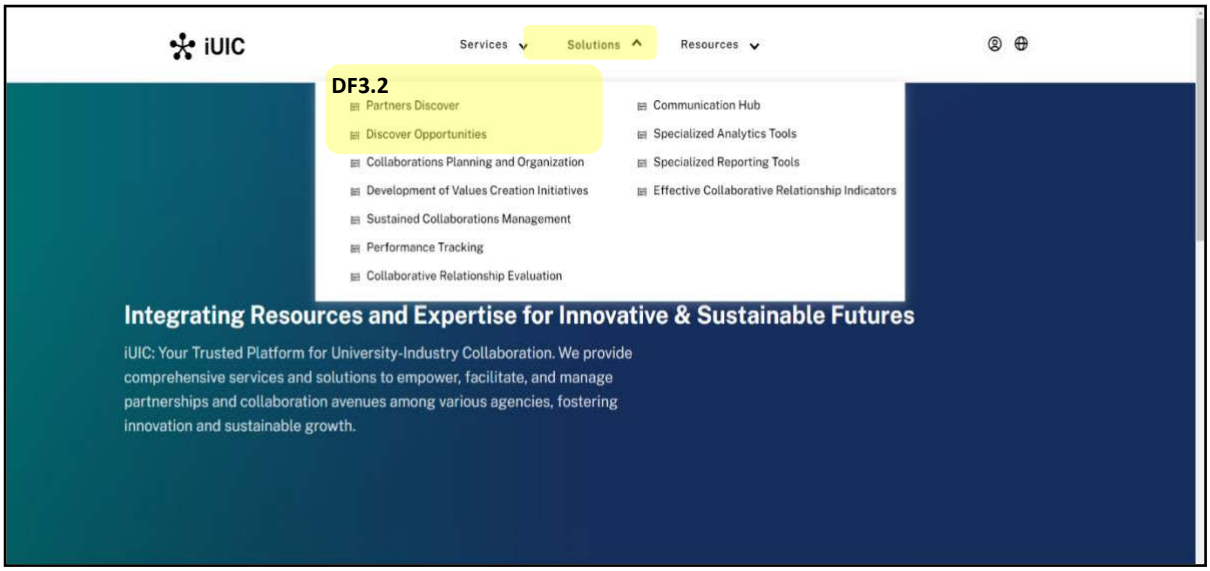



Figure 6.13: DF3- Enhanced Matchmaking Capabilities

### 6.2.4 DF4- Contribution Recognition and Incentivisation

Building upon this, DF4 focuses on recognising and incentivising user contributions. The organisation's portfolio showcases collaboration effectiveness indicators that motivate ongoing engagement and recognise outstanding contributions to encourage active and continuous contributions. This aspect of the platform particularly highlights the direct impact of individual and collective efforts on project outcomes, providing tangible incentives for stakeholders to invest their best efforts. To support this dynamic adjustment, a transparent and scalable recognition system is essential to meet the criteria of DP4. The features incorporated into the UIC platform, as part of DF4, include portfolio showcases (DF4.1), collaboration effectiveness and performance indicators (DF4.2), as illustrated in Figure 6.14.

DF4.1 allows users to create and maintain a digital portfolio highlighting their contributions, projects, and achievements, such as expert communities. Portfolios serve as a personal showcase accessible to other users to promote visibility within the community and enable stakeholders to gain recognition for their individual and collective efforts (refers also to DF3.2). DF4.2 offers detailed metrics of contributions on project success and feedback from the UIC ecosystem that assess the effectiveness of a user's contributions within the UIC settings. By quantifying these metrics, such indicators provide stakeholders with clear insights into their performance, which motivates stakeholders to enhance such collaboration strategies.

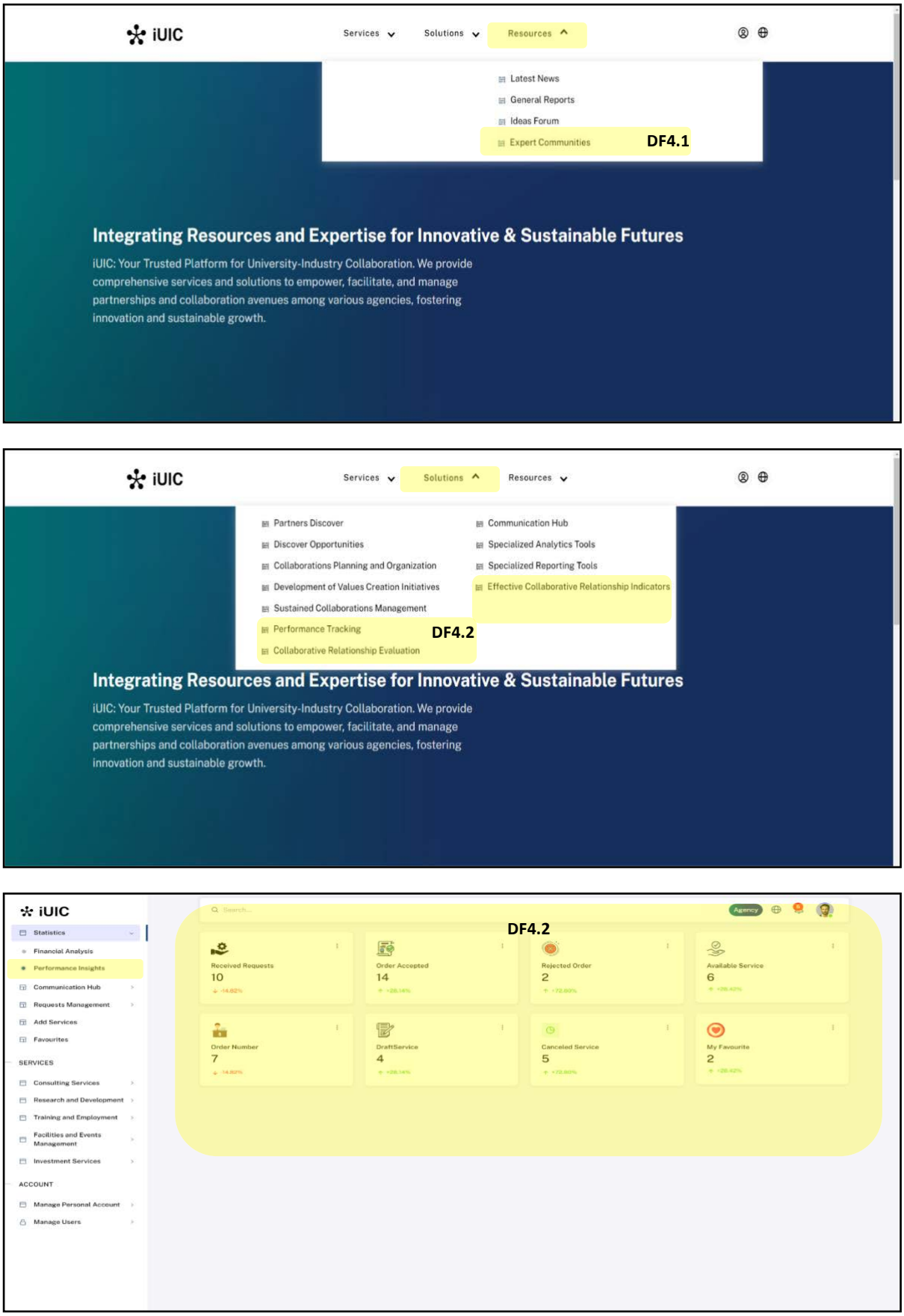
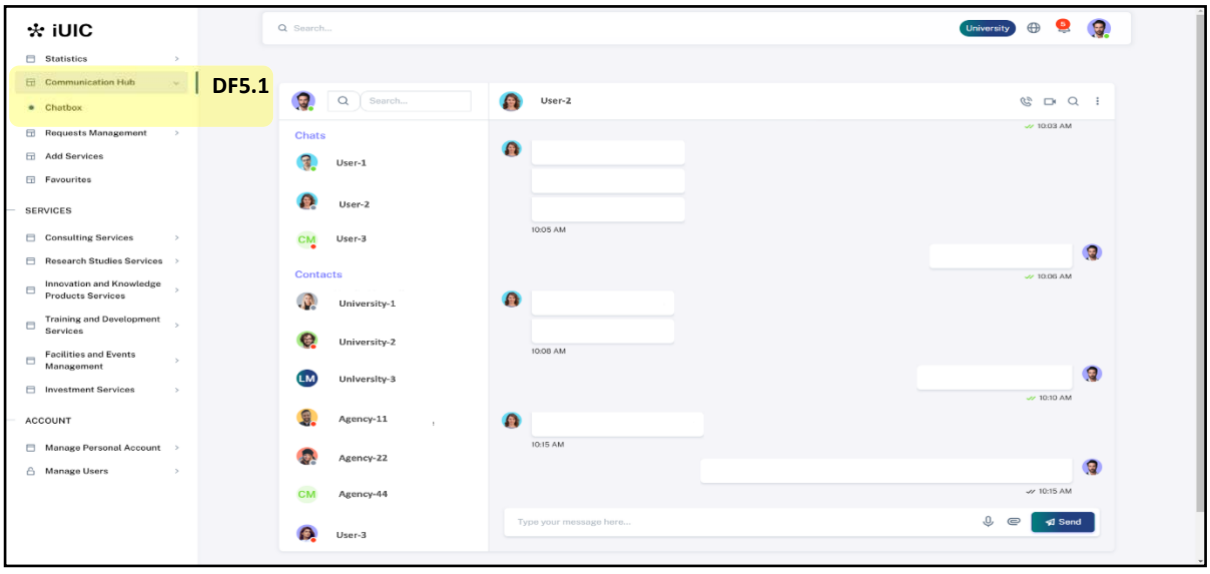



Figure 6.14: DF4- Contribution Recognition and Incentivisation

### 6.2.5 DF5- Multipurpose Communication Channels

Further, DF5 strategically provides dynamic multipurpose communication tools that facilitate seamless trust-based interaction and coordination among all stakeholders and sectors within the UIC setting. It can also maintain an active, engaged community that can efficiently share information and work together on various projects. To support this dynamic adjustment, a flexible and user-friendly infrastructure is essential to meet the criteria of DP5. The features incorporated into the UIC platform, as part of DF5, include instant messaging (DF5.1), document sharing (DF5.2), threaded discussions (DF5.3), and virtual networking spaces (DF5.4), as illustrated in Figure 6.15.

DF5.1 allows for immediate text-based communication between users to enhance collaboration by providing a platform for quick queries and rapid responses. DF5.2 allows users to upload, share, and manage documents on the platform to enable easy access to necessary resources. DF5.3 facilitates structured conversations into threads by different criteria to enable clarity, depth, and efficient tracking of multiple discussions. DF5.4 provides designated virtual areas within the platform where stakeholders can interact, share ideas, and build connections in formal and informal engaging environments beyond traditional networking (also refers to DF2.2).



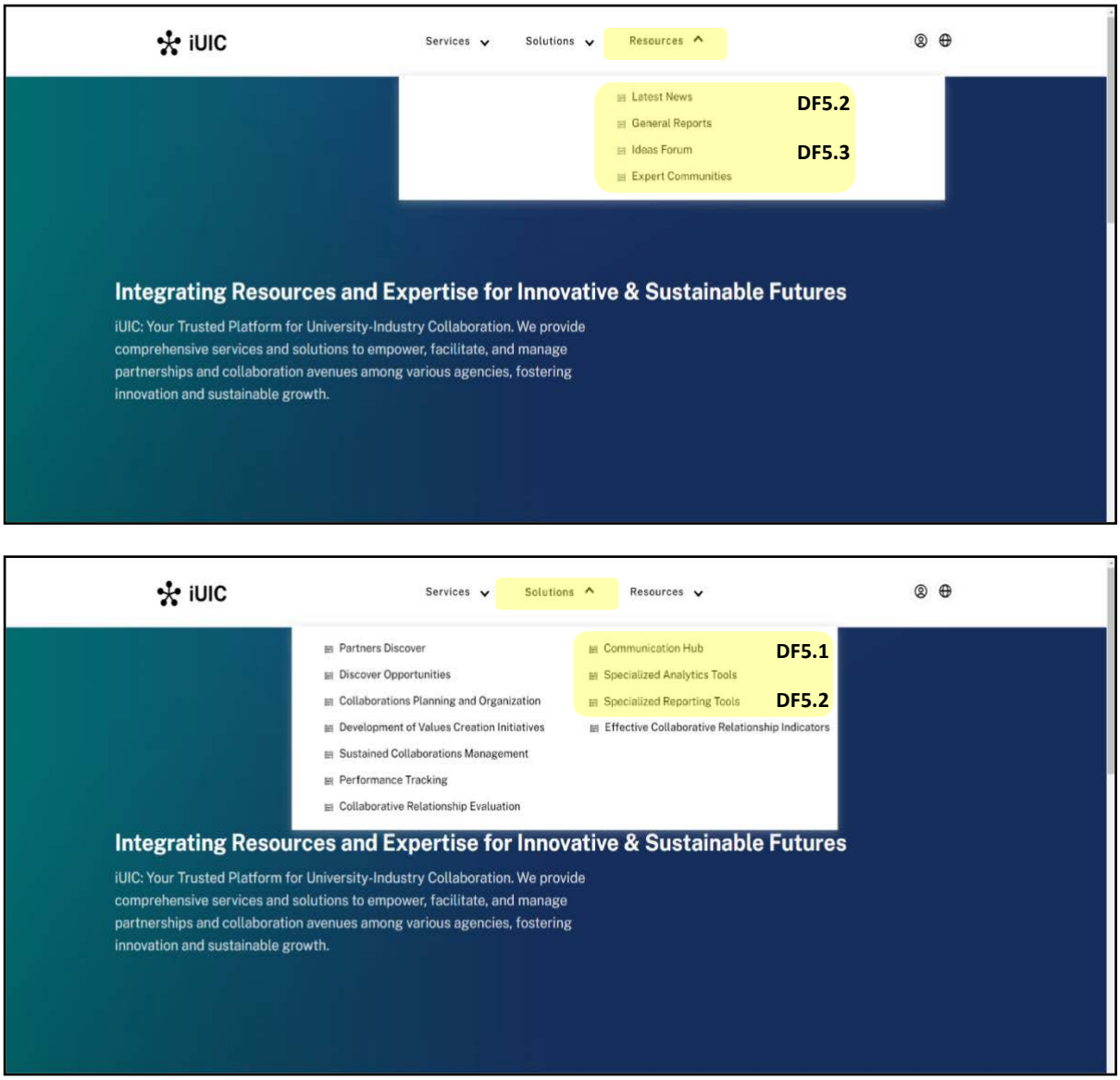



Figure 6.15: DF5- Multipurpose Communication Channels

### 6.2.6 DF6- Digital Co-creation and Open Innovation

Continuing with innovation, DF6 fosters digital co-creation and open innovation to enhance the UIC platform by promoting innovation to support collaborative problem-solving and commercialisation, to co-create innovative solutions, engage in creative thinking, and address complex challenges through diverse perspectives and shared knowledge within the UIC ecosystem. To support this dynamic adjustment, a highly interactive setting is essential to meet DP6 criteria. The features incorporated into the UIC platform, as part of DF6, include ideation boards (DF6.1), virtual brainstorming spaces (DF6.2), and open innovation events (DF6.3), as illustrated in Figure 6.16.

DF6.1 provides Digital boards to enable stakeholders to propose, discuss, and refine ideas collaboratively to develop the innovation cycle. DF6.2 integrates live interaction tools such as chat, video conferencing, and real-time editing into the platform to support synchronous brainstorming and workshops, (refers also to DF2.2 & DF5.4). DF6.3 organises structured events like workshops or competitions within the UIC community to tackle specific challenges, fostering a spirit of innovation and collaboration.

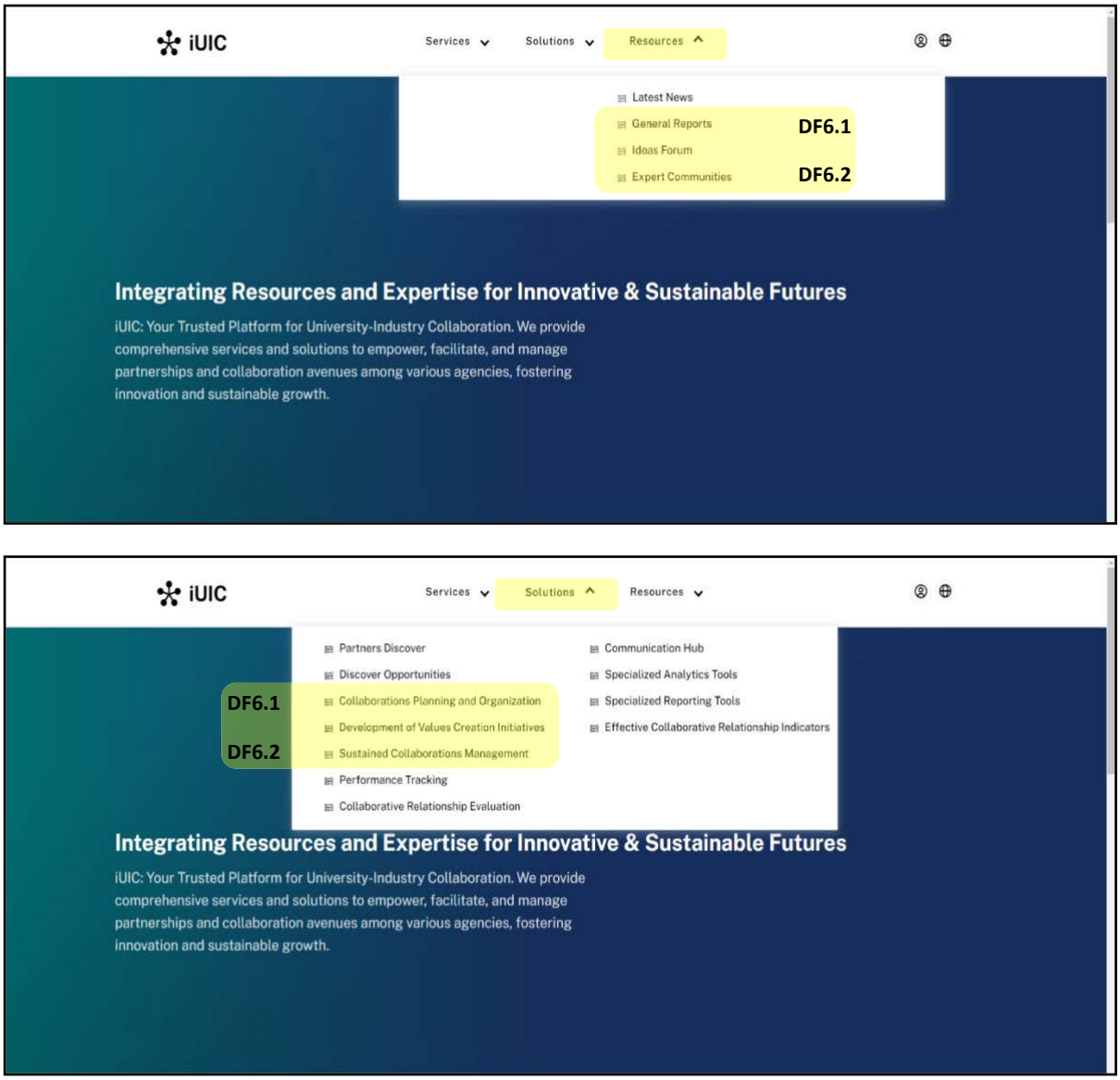


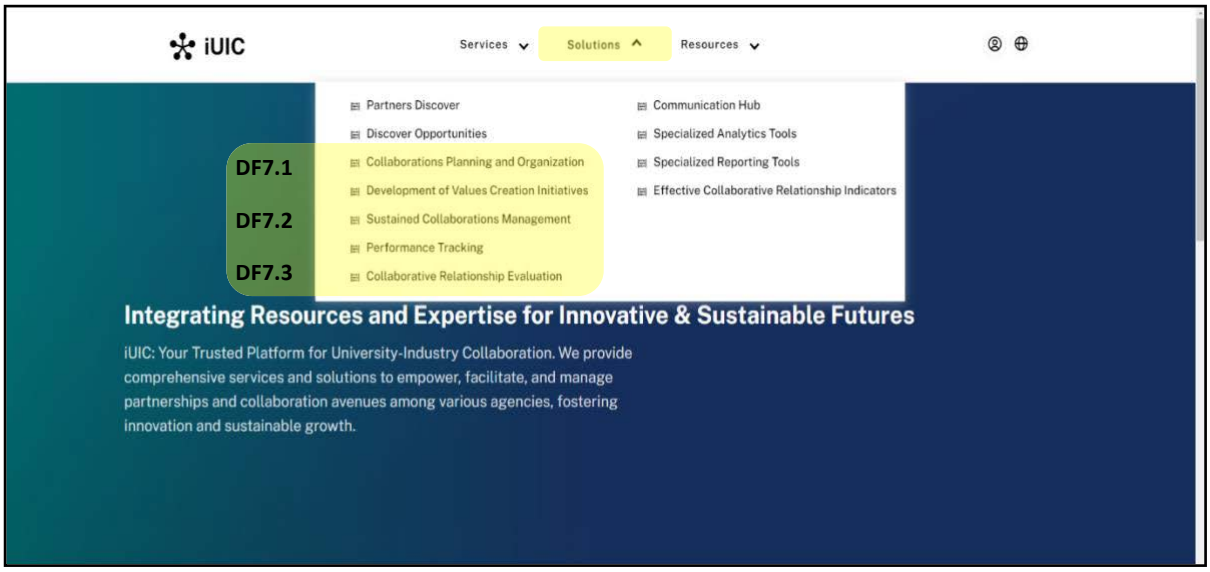

Figure 6.16: DF6- Digital Co-Creation and Open Innovation

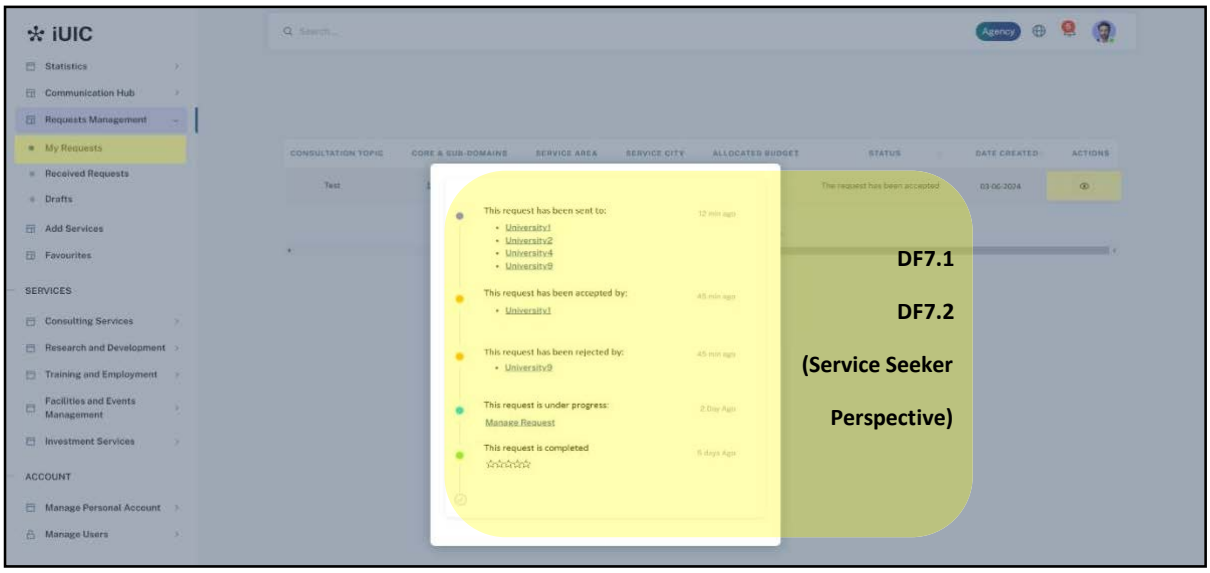
### 6.2.7 DF7- Project and Time Management Tools

Subsequently, DF7 equips users with project and time management tools within the UIC ecosystem to enable stakeholders to effectively plan, organise, and track various aspects of projects. This uplifts stakeholders' ability to efficiently manage project timelines, milestones, and resources for the complex processes involved in KT/TT-UIC activities. This leads to minimised risks and maximises performance throughout the project lifecycle. To meet DP7's criteria, comprehensive and flexible project management tools are essential. The features incorporated into the UIC platform, as part of DF7, include integrated project planning and scheduling (DF7.1), progress tracking (DF7.2), and risk and performance management (DF7.3), as illustrated in Figure 6.17.

DF7.1 provides tools for stakeholders to create and adjust detailed project plans and schedules, as well as supporting timeline visualisation and task synchronisation to align all team members with project goals. DF7.2 enables efficient monitoring of request progress and resource allocation for apparent project oversight and timely

execution to enhance coordination and goal alignment. DF7.3 features risk identification, analysis, mitigation tools, and performance management to enhance project productivity and foster continuous improvement.



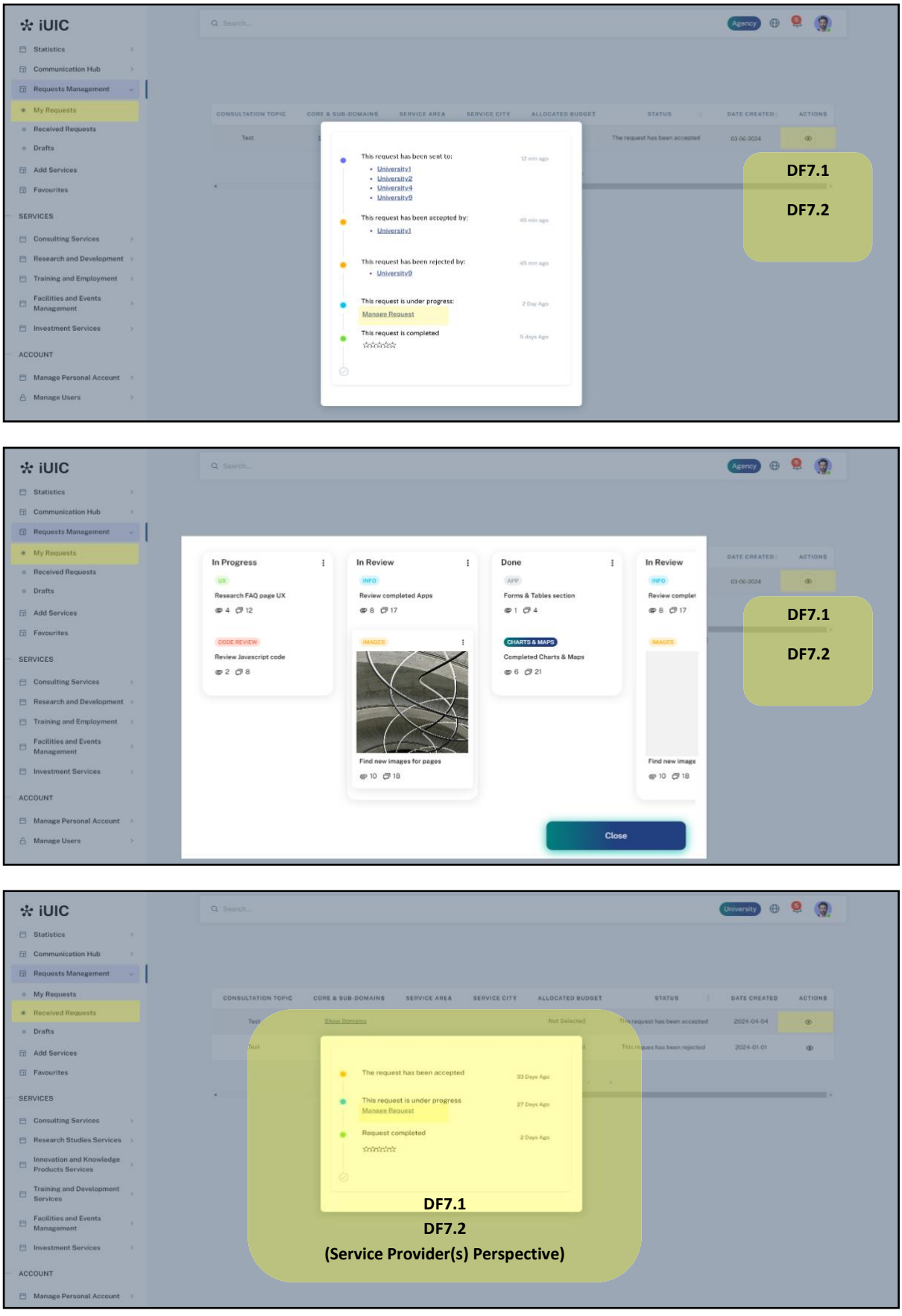



Figure 6.17: DF7- Project and Time Management Tools

### 6.2.8 DF8- Integrated Knowledge and Document Management with Advanced Analytics Capabilities

As it delves deeper, DF8 provides advanced data analysis, reporting tools, and document management systems to enhance decision-making and streamline KT/TT-UIC activities. This ensures stakeholders can access, manage, and utilise such insights effectively, driving innovation and collaboration across academic and industry boundaries. So, it helps in fostering stakeholders with dynamic data visualisation, predictive analytics, smooth data integration, and collaborative content management. Aligning with DP8 and DP9, advanced analytics capabilities are essential to fostering an informed, efficient, and connected UIC ecosystem. The features incorporated into the UIC platform, as part of DF8, include centralised collaborative knowledge management and recommendation (DF8.1), predictive analytics and integrated reporting with interoperability (DF8.2), and data management and visualisation (DF8.3), as illustrated in Figure 6.18.

DF8.1 centrally manages all documents and knowledge resources, supporting version control, access permissions, and appropriate tracking to maintain information integrity (also refers to DF5.2). It also integrates content management with advanced search and recommendation systems to enhance engagement and ensure accuracy and relevance. DF8.2 uses advanced machine learning and statistical modelling techniques to provide predictive insights and comprehensive reporting for strategic planning and risk management. It should also support data aggregation across formats for unified and accurate reporting. DF8.3 enables customisable statistics and visualisation tools like graphs and interactive maps to present insightful data and simplify complex datasets.

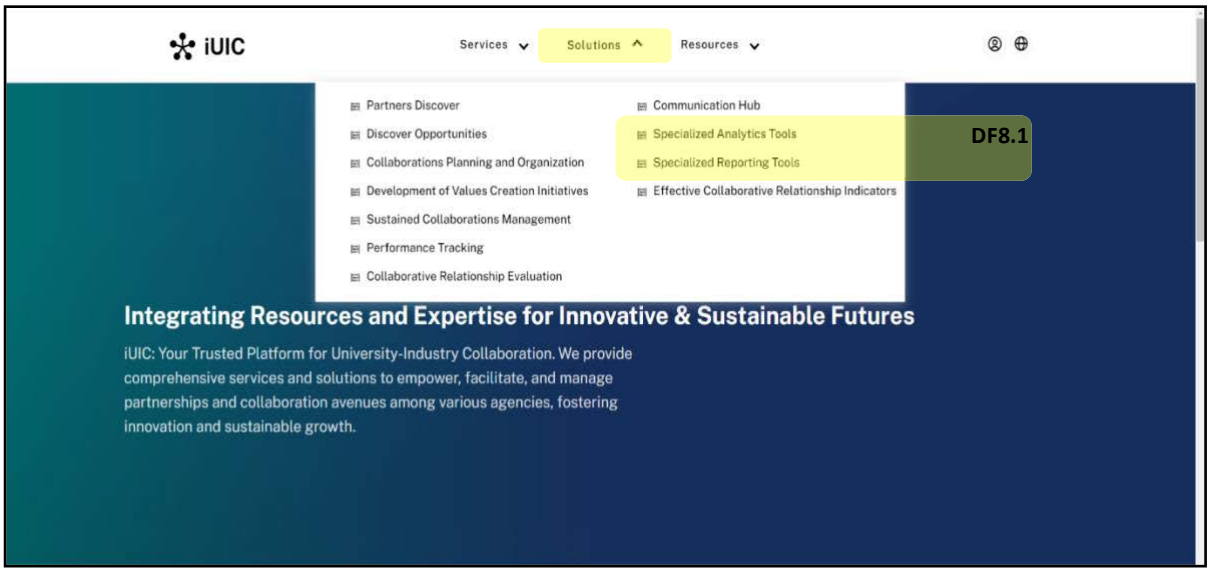
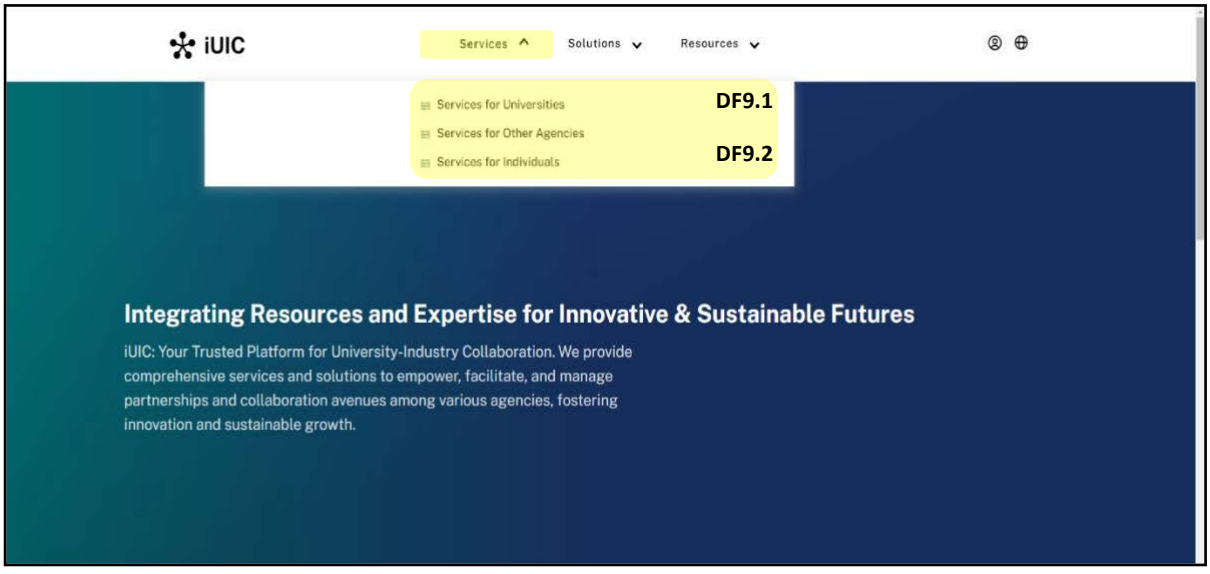



Figure 6.18: DF8- Integrated Knowledge and Document Management with Advanced Analytics Capabilities

### 6.2.9 DF9- Practical Experience Opportunities

Advancing further, DF9 integrates learning and developing opportunities, such as internships and projects, to foster a dynamic and interactive learning environment within the UIC setting. This helps bridge the gaps between theoretical knowledge and practical application, benefiting students and academics by offering real-world projects and facilitating hands-on experience. As a result, the platform progressively enhances skill development, practical knowledge acquisition, and knowledge transfer within the UIC ecosystem. To support DP10, a highly interactive and participatory environment is essential. The features incorporated into the UIC platform, as part of DF9, include learning portals with skill matching (DF9.1), competency and achievement tracking (DF9.2), and virtual mentorship (DF9.3), as illustrated in Figure 6.19. It is worth noting that while these features are fundamentally designed for the digital platform, they are not fully activated in this prototype

DF9.1 integrates a customised portal that aligns stakeholders' skills with project opportunities using an intelligent matching algorithm, which maximises the relevance and impact of such collaborations within the UIC setting. DF9.2 enables stakeholders to monitor their skills development and achievements in real time. Such tools support the documentation of competencies and experiences, simplifying the assessment of organisations' growth and the verification of accomplishments within the UIC setting (refers also to DF4.2). DF9.3 provides a virtual platform for mentoring and coaching, enabling organisations to connect their members with experts and professionals for guidance, feedback, and support while overcoming geographical barriers (also refers to DF2.1 & DF3.1).



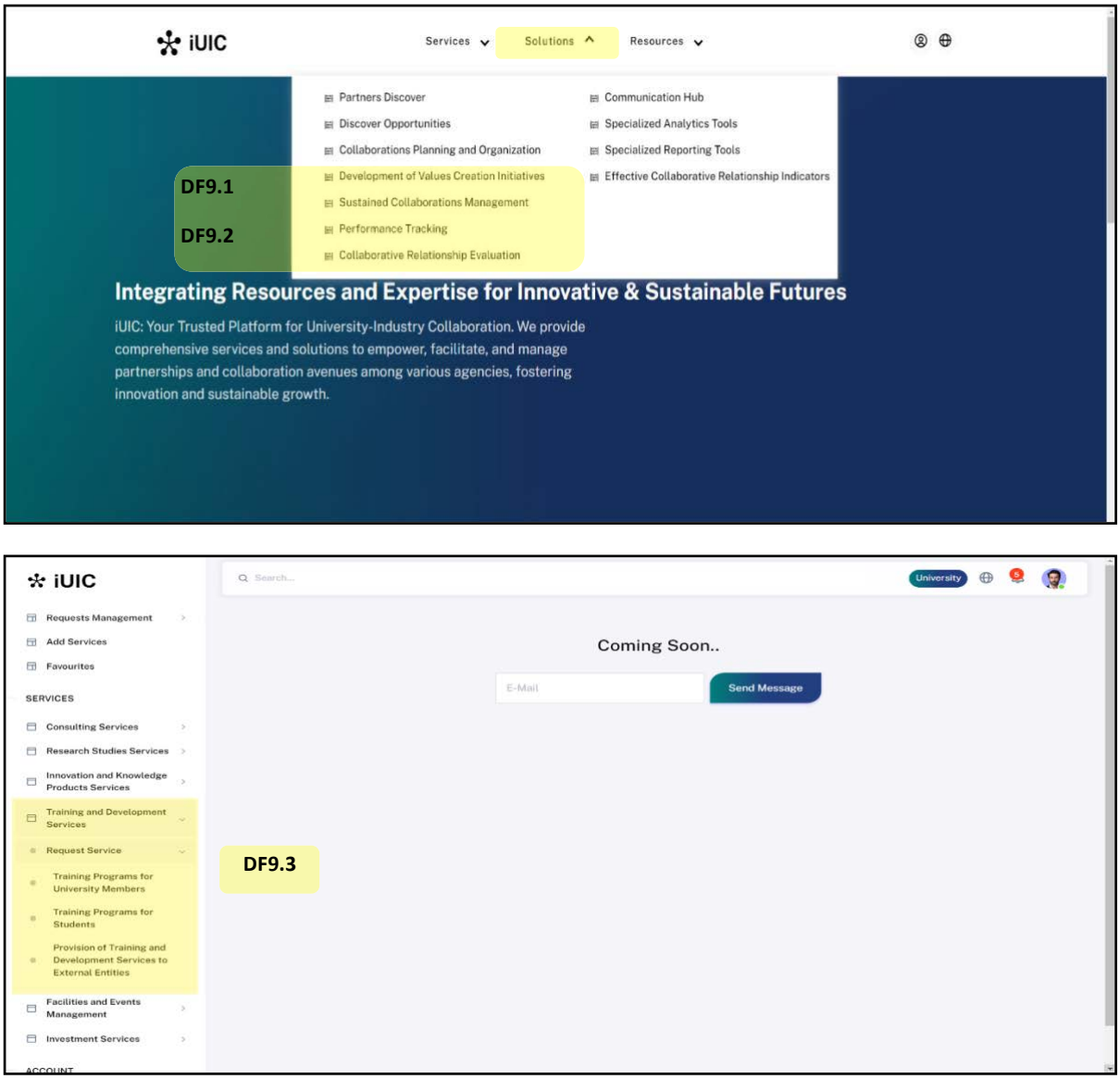



Figure 6.19: DF9- Practical Experience Opportunities

### 6.2.10 DF10- Scalability, Performance, and Compliance

Lastly, DF10 ensures the platform's scalability, performance, and compliance as the ecosystem grows and demands evolve. It integrates a framework that supports expansion and maintains high performance without compromising compliance and security, which ensures efficiency, security, and regulatory compliance. This focus on scalability, performance, and stringent security measures establishes a foundation of trust and sustainability, essential for future adaptability and regulatory adherence. To meet DP11 criteria, efficient infrastructure and a flexible architecture are necessary to enhance security measures, ensuring scalability, performance, and compliance. The features incorporated into the UIC platform, as part of DF10, include advanced security and compliance framework (DF10.1) and high-efficiency infrastructure & flexible architecture (DF10.2), as illustrated in Figure 6.20.

DF10.1 maintains high security and compliance standards, continuously adapting to regulatory changes with periodic updates and systematic audits to safeguard data privacy. DF10.2 integrates advanced load balancing to

manage server demands efficiently and caching to improve response times. The flexible architecture supports seamless updates and rapid adaptability to evolving user requirements and technological trends.

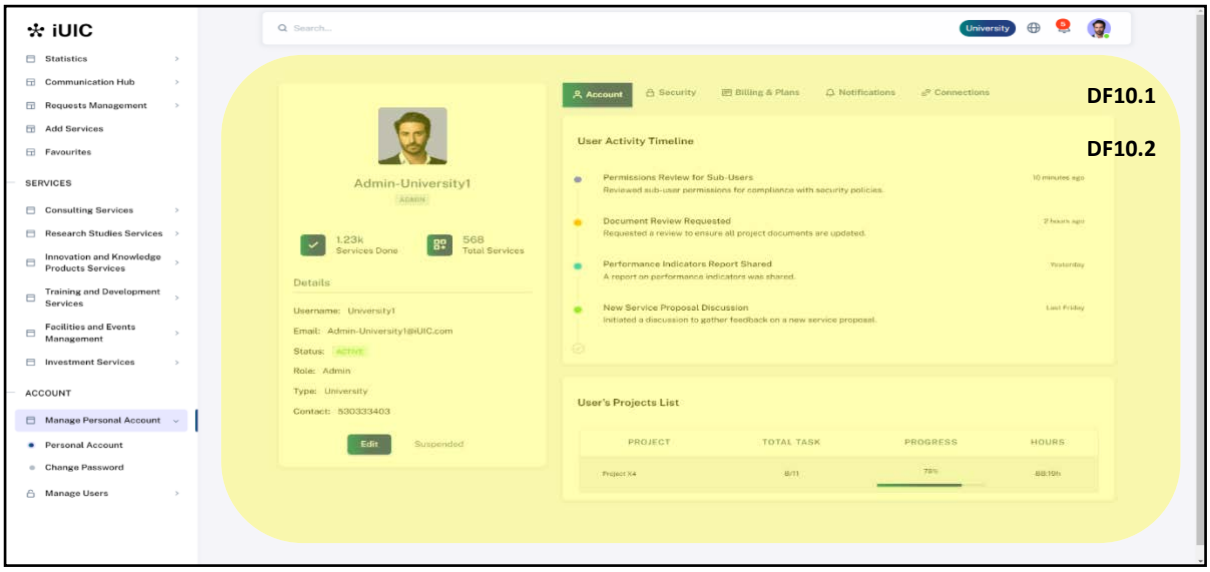


Figure 6.20: DF10- Scalability, Performance, and Compliance

## 6.3 MAPPING DESIGN PRINCIPLES TO CORRESPONDING DESIGN FEATURES

This section shows a mapping model to elucidate the connections between the DPs and the corresponding DFs. This mapping functions as a fundamental visual tool, ensuring that all DPs align with the relevant DFs to facilitate the prototype's development. It is noted that each DP is mapped with a broad DF category and its sub-features, which serve as the foundational structure of the digital platform's design, except for both DP8 and DP9, which align with DF8 to provide advanced data analysis, reporting tools, and document management systems, to enhance decision-making and streamline KT/TT-UIC activities. Figure 6.21 visually demonstrates these alignments through a detailed mapping model, clarifying the interactions and dependencies among them and their role in the overall framework.

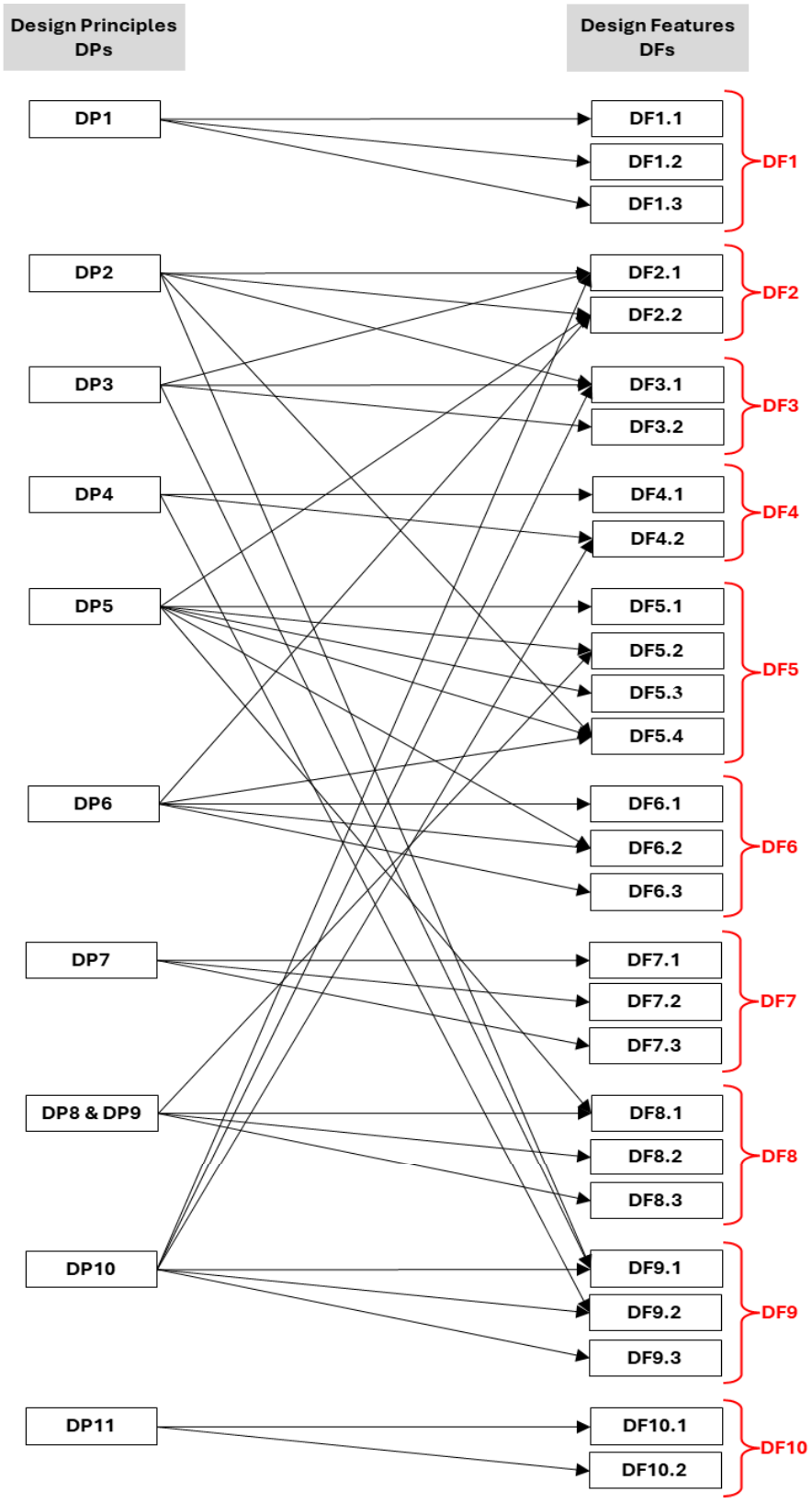



Figure 6.21: Mapping of DPs to Concrete DFs

## 6.4 CHAPTER SUMMARY

Chapter 6 upon completing the DSR development phase, has detailed the critical development and instantiation process, focusing on the practical realisation of a prototype digital platform within the UIC setting. It provides a comprehensive overview of the platform's core components, including the “iUIC” dashboard and some of its functionalities, including the “service request” process. The instantiation of key DFs has been illustrated, each addressing specific needs within the UIC ecosystem. These features range from personalised interfaces and flexible collaboration models to advanced matchmaking capabilities, integrated knowledge management, and scalable performance solutions. This chapter has demonstrated how each feature enhances the platform's functionality and user experience. The development of this prototype constitutes a significant advancement in transforming the theoretical concepts and DPs from previous chapters into practical applications. It includes adjusting to evolving UIC models, such as the ‘triple helix model’, where the number of partners may increase based on project requirements. The prototype features a detailed request process for 'consulting services,' designed to enhance KT/TT-UIC activities from both the 'service seeker' and 'service provider' perspectives within the platform. Moving forward, this chapter has set the stage for the subsequent evaluation phase, where the effectiveness and impact of the developed prototype will be assessed in real-world UIC settings.

# 7 DSR | EVALUATION

Chapter 7 delves into the fourth phase of the DSR, which focuses on evaluating the developed solutions. This phase carefully examines the effectiveness and impact of the suggested solutions through a structured evaluation framework. The chapter moves from a focus on theoretical contributions to presenting empirical evidence, clearly demonstrating how the design principles and artifacts function in real-world scenarios. The chapter begins with an introduction to the evaluation framework used to guide the systematic analysis and evaluation of the developed artifacts and DPs used (Section 7.1). This framework lays the foundation for subsequent empirical and theoretical evaluations, serving as a robust and structured approach to assessment. Following this, the interpretation of empirical insights examines the data analysis gathered during the evaluation phase (Section 7.2). Furthermore, the evaluation of instantiated DPs specifically addresses the reusability of these principles across various dimensions. This includes evaluating the DPs based on reusability criteria, such as the accessibility of the DPs, their importance within the field, and their novelty and insightfulness. Additionally, the DPs are further assessed for their actability, appropriate guidance, and overall effectiveness to provide a comprehensive view of their applicability and impact. Moreover, it evaluates the artifact's design framework to examine its structural and functional attributes aligning with the intended research outcomes.

The chapter concludes with a summary covering the key findings and contributions from evaluating the developed solution (Section 7.4). It highlights the successes and challenges identified during the evaluation phase, reinforcing the relevance and adaptability of the DPs and artifacts. This summary also sets the stage for the next chapter, outlining potential future research directions and highlighting areas for further investigation and development.

## 7.1 EVALUATION FRAMEWORK

For the evaluation phase- DSR phase (4)- as part of the ongoing research process, this study implemented the Framework for Evaluation in Design Science (FEDS), following the guidelines established by Venable, Pries-Heje, and Baskerville (2016, p. 77), which consists of four steps, including "(1) explicate the goals of the evaluation, (2) choose the evaluation strategy or strategies, (3) determine the properties to evaluate, and (4) design the individual evaluation episode(s)".

FEDS provides a framework for categorising evaluation methods along two dimensions: functional purpose and evaluation paradigm, as illustrated in Figure 7.1 and Table 7.1.

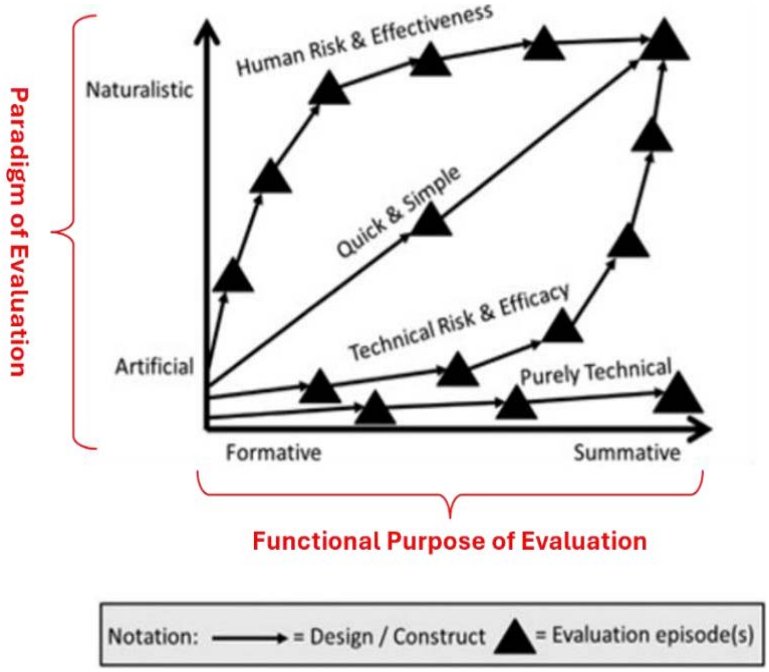



Figure 7.1: FEDS with Evaluation Strategies
Source: (Venable, Pries-Heje & Baskerville, 2016, p. 80)

The functional purpose dimension identifies the goals of the evaluation, which are either formative or summative evaluations. Formative evaluations are ongoing and iterative, essential during the development stages to refine the artifact based on continuous feedback. Summative evaluations, however, occur post-development to validate the artifact, assessing if it meets the predefined criteria of effectiveness and efficiency in real-world settings. On the other hand, the evaluation paradigm dimension addresses the evaluation context as artificial, naturalistic settings or both. Artificial settings, such as labs or controlled field trials, allow for the isolation and manipulation of variables to test specific conditions. Naturalistic settings involve evaluating the artifact in real-world conditions without external controls to assess its integration, performance, and alignment with the intended environment. This structured approach helps researchers select the most suitable evaluation strategy based on their objectives and the conditions under which this research is to be carried out.

Furthermore, Artifact evaluation can occur at different stages of product development and can be categorised as either ex-ante or ex-post (Venable, Pries-Heje & Baskerville, 2016), as illustrated in Figure 7.2. The Ex-ante evaluation happens during the formative stages of development and serves as a predictive tool to anticipate outcomes. Ex-post evaluation assesses the value of a system after it has been developed and implemented.

Table 7.1: DSR Framework of Evaluation Strategy and Evaluation Method
Source: (Venable, Pries-Heje & Baskerville, 2012, 2016)

| **DSR Framework:**<br><br>**Evaluation Strategy**<br>**&**<br>**Evaluation Method** | | **Ex-Ante** | **Ex-Post** |
|---|---|---|---|
| | | -Formative<br>-Lower build cost<br>-Faster<br>-Evaluate design, partial prototype, or full prototype<br>-Less risk to participants (during evaluation)<br>- Higher risk of false positive | -Summative<br>-Higher build cost<br>-Slower<br>-Evaluate instantiation<br>-Higher risk to participants (during evaluation)<br>-Lower risk of false positive |
| **Naturalistic** | -Many diverse stakeholders<br>-Substantial conflict<br>-Socio-technical artifacts<br>-Higher cost<br>-Longer time-slower<br>-Organisational access needed<br>-Artifact effectiveness evaluation<br>-Desired Rigor: "Proof of the Pudding"<br>-Higher risk to participants<br>Lower risk of false positive - safety critical systems | **Evaluation Strategy**<br>-Real users, real problem, and somewhat unreal system<br>-Low-medium cost<br>-Medium speed<br>-Low risk to participants<br>-Higher risk of false positive | **Evaluation Strategy**<br>-Real users, real problem, and real system<br>-Highest Cost<br>-Highest risk to participants<br>-Best evaluation of effectiveness<br>-Identification of side effects<br>-Lowest risk of false positive - safety critical systems |
| | | **Evaluation Method**<br>-Action Research<br>-Focus Group | **Evaluation Method**<br>-Action Research<br>-Case Study<br>-Focus Group<br>-Participant Observation<br>-Ethnography<br>-Phenomenology<br>-Survey (qualitative or quantitative) |
| **Artificial** | -Few similar stakeholders<br>-Little or no conflict<br>-Purely technical artifacts<br>-Lower cost<br>-Less time - faster<br>- Desired Rigor: Control of Variables<br>-Artifact efficacy evaluation<br>-Less risk during evaluation<br>-Higher risk of false positive | **Evaluation Strategy**<br>-Unreal Users, Problem, and/or System<br>-Lowest Cost<br>-Fastest<br>-Lowest risk to participants<br>-Highest risk of false positive re. effectiveness | **Evaluation Strategy**<br>-Real system, unreal problem and possibly unreal users<br>-Medium-high cost<br>-Medium speed<br>-Low-medium risk to participants |
| | | **Evaluation Method**<br>-Mathematical or Logical Proof<br>-Criteria-Based Evaluation<br>-Lab Experiment<br>-Computer Simulation | **Evaluation Method**<br>-Mathematical or Logical Proof<br>-Lab Experiment<br>-Role Playing Simulation<br>-Computer Simulation<br>-Field Experiment |

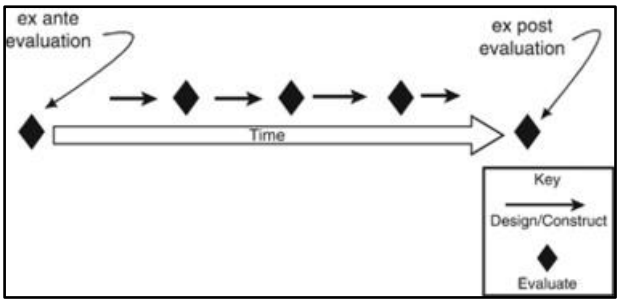



Figure 7.2: Ex-Ante and Ex-Post Evaluation Time Continuum during the DSR Cycle
Source: (Venable, Pries-Heje & Baskerville, 2016, p. 79)

An ex-ante formative evaluation is conducted during the DSR phase (2). This evaluation involved a discussion-based approach, which included conducting follow-up semi-structured interviews. The primary goal of these interviews is to revisit and refine the empirical findings (meta-users-requirements) from initial exploratory semi-structured expert interviews within the UIC setting. Additionally, these interviews aimed to gather critical feedback to derive DRs for the proposed solution. This feedback supports developing well-rounded DPs for the platform, ensuring that the DPs are both practical and shaped to meet the specific needs and challenges identified by the UIC ecosystem. Thus, this process allows for simultaneous validation of the DRs and enhances the conceptual framework to ensure it aligns with empirical insights. The SC theory lens guides the alignment and detailed analysis.

According to Hevner et al. (2004, p. 84), "Artifact instantiation demonstrates feasibility both of the design process and the designed product". Following the development of the artifact, the primary goal is to undertake a confirmatory evaluation within the Naturalistic paradigm framework, as detailed by Venable, Pries-Heje, and Baskerville (2012, 2016). This ex-post summative evaluation fulfils two primary purposes: Firstly, it aims to theoretically validate that the IT artifact addresses the specified DRs and achieves the expected DPs. This evaluation is supported by a reusability framework for assessing DPs, initially introduced by Rosemann and Vessey (2008), and further developed by Iivari, Rotvit Perlt Hansen, and Haj-Bolouri (2021). Secondly, it aims to specifically assess the design framework itself, focusing on evaluating the logic flow and coherence within the design framework of such a platform; building on this, it leads to also assessing how the tangible DFs are consistent (i.e., the extent to which translating principles into practice are effectively consistent and fit within the UIC setting). This evaluation includes examining the consistency and utility of these tangible components, as discussed in the works of Hevner et al. (2004).

## 7.2 EMPIRICAL INSIGHTS INTERPRETATION

This section interprets the empirical insights collected from the ex-post summative evaluation of the IT artifact, employing both an online confirmatory mini-focus group and individual expert interviews to gather a comprehensive spectrum of perspectives. Out of a pre-selected pool of 40 experts, all of whom had previously participated in expert interviews, 15 experts were selected based on their readiness for deeper engagement, with 6 forming the online confirmatory mini-focus group session- meanwhile, the other 9 participants, who preferred more personalised interactions, engaged in one-on-one expert interviews. However, 3 of these nine could not

participate in the Zoom sessions due to conflicting personal duties, so communication with them was conducted through an interactive online chatting platform. *As explained further in Chapter 3.*

During the discussion, the DPs being instantiated as the theoretical underpinnings was clarified . At the same time, the design framework of the artifact itself relates to the implementation of its logic flow and the design concept of its interfaces. This distinction helps participants understand how the theoretical foundations influence the practical consequences, which are explored further in the subsequent sections.

Upon analysis, it was evident that although the focus group session was more interactive and insightful, the findings, insights, and feedback consistently aligned with those from the individual expert interviews. This consistency is likely due to the participants' ongoing engagement and deeper understanding of the study's context during this research cycle.

It is worth noting that if no differences are observed among stakeholder categories- university, industry, or industry organisations- the upcoming sections will present overall perspectives holistically. However, if differences exist, they will be specifically addressed to clarify how insights vary across these categories.

The subsequent sections will integrate insights from these two data collection methods to provide a comprehensive evaluation of the instantiated design principles and the framework of the artifact. This integration will specifically address the aims and purposes of each part of the evaluation.

### 7.2.1 Evaluation of Instantiated Design Principles

This section fulfils the first purpose of the ex-post summative evaluation, which is to theoretically validate that the IT artifact addresses the specified DRs and achieves the expected DPs. The evaluation utilises a reusability evaluation framework referred to as "light reusability evaluation", initially introduced by Rosemann and Vessey (2008), and further developed by Iivari, Rotvit Perlt Hansen, and Haj-Bolouri (2021) to include five critical statements/questions, as presented in Figure 7.3. According to Iivari, Rotvit Perlt Hansen, and Haj-Bolouri (2021), DSR projects are required to include a basic reusability assessment for proposed DPs. This assessment should involve identifying the specific audience and evaluating DPs against five critical criteria aligned with feedback from this targeted audience. While this represents the minimum standard, termed 'light reusability evaluation,' more in-depth evaluations are encouraged when possible. However, comprehensive evaluations may not always be feasible or advisable. Here, the framework has been expanded to encompass two statements for each of the five criteria, totalling ten statements. This expansion aims to provide more explicit guidance for feedback across all DPsm, where overall DPs and their applicability are addressed during expert focus group sessions and interview meetings.

This section organises findings analysis according to the reusability criteria of the framework, focusing on five major areas: accessibility, importance, novelty and insightfulness, actability and appropriate guidance, and effectiveness, to enhance the understanding of how well the artifact incorporates and demonstrates such DPs.

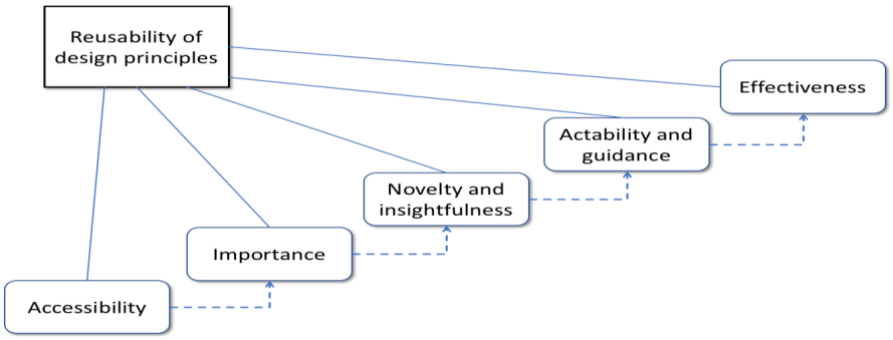



Figure 7.3: Evaluation Criteria of Reusability
Source: (Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021, p. 291)

Table 7.2 summarises the qualitative feedback questionnaire, presented in Table C.1, specifically evaluating the instantiated DPs according to their reusability criteria.

Table 7.2: Feedback Questionnaire- Evaluation of DPs based on Reusability Criteria

| **Reusability Criteria** | **Feedback Questionnaire Statements** |
|---|---|
| **Accessibility** | I believe it will be easy to regularly access the iUIC platform. |
| | The user interfaces of the iUIC platform seem easy to use. |
| **Importance** | In my view, the iUIC platform will be important for our future collaboration needs. |
| | The features and services presented in the iUIC platform are promising for fostering effective UIC. |
| **Novelty & insightfulness** | I believe the iUIC platform will bring insightful and innovative changes to current UIC practices. |
| | The iUIC platform inspires new ideas or methods for our practice. |
| **Actability & appropriate guidance** | I think that the guidance, tools, and actions offered by the iUIC platform are sufficient and can realistically be implemented in practice to help make decisions on collaboration opportunities. |
| | I find that I can customise features and services in the iUIC platform to suit such collaboration needs. |
| **Effectiveness** | Compared to our current practices, I believe that communication, productivity, and performance within the UIC ecosystem will greatly improve as a result of using the iUIC platform. |
| | I am satisfied with the potential outcomes of the iUIC platform and would recommend this platform to relevant partners based on my initial experience. |
| ***Note:*** *"iUIC platform" here refers to the DPs (theoretically), instantiated as a platform prototype within UIC settings.* | |

Figure 7.4 summarises the “light reusability evaluation" of instantiated DPs. Key findings and insights for each of the reusability criteria are highlighted in the subsequent sections. Furthermore, the term "iUIC platform" refers

to the digital platform-based intermediary developed as the suggested solution within the UIC setting. However, it is essential to note that, as mentioned in the feedback questionnaire, the "iUIC platform" explicitly denotes the instantiated and implemented DPs demonstrated as an IT artifact prototype in practical, real-world settings. These DPs are widely detailed and clarified during the evaluation and demonstration sessions of the ex-post evaluation process.

Additionally, it's essential to recognise that before these sessions, during the DSR phase, ex-ante evaluations were conducted, focused on discussing and refining the DRs that led to the development of these DPs, ensuring a thorough development and assessment cycle. Using a framework that includes ten statements - two per each of the five critical criteria, participants provided feedback on a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" after each evaluation to offer a range of flexibility for feedback. Participants filled out this feedback tool after each session. The summary of the feedback result is presented in Figure 7.4.

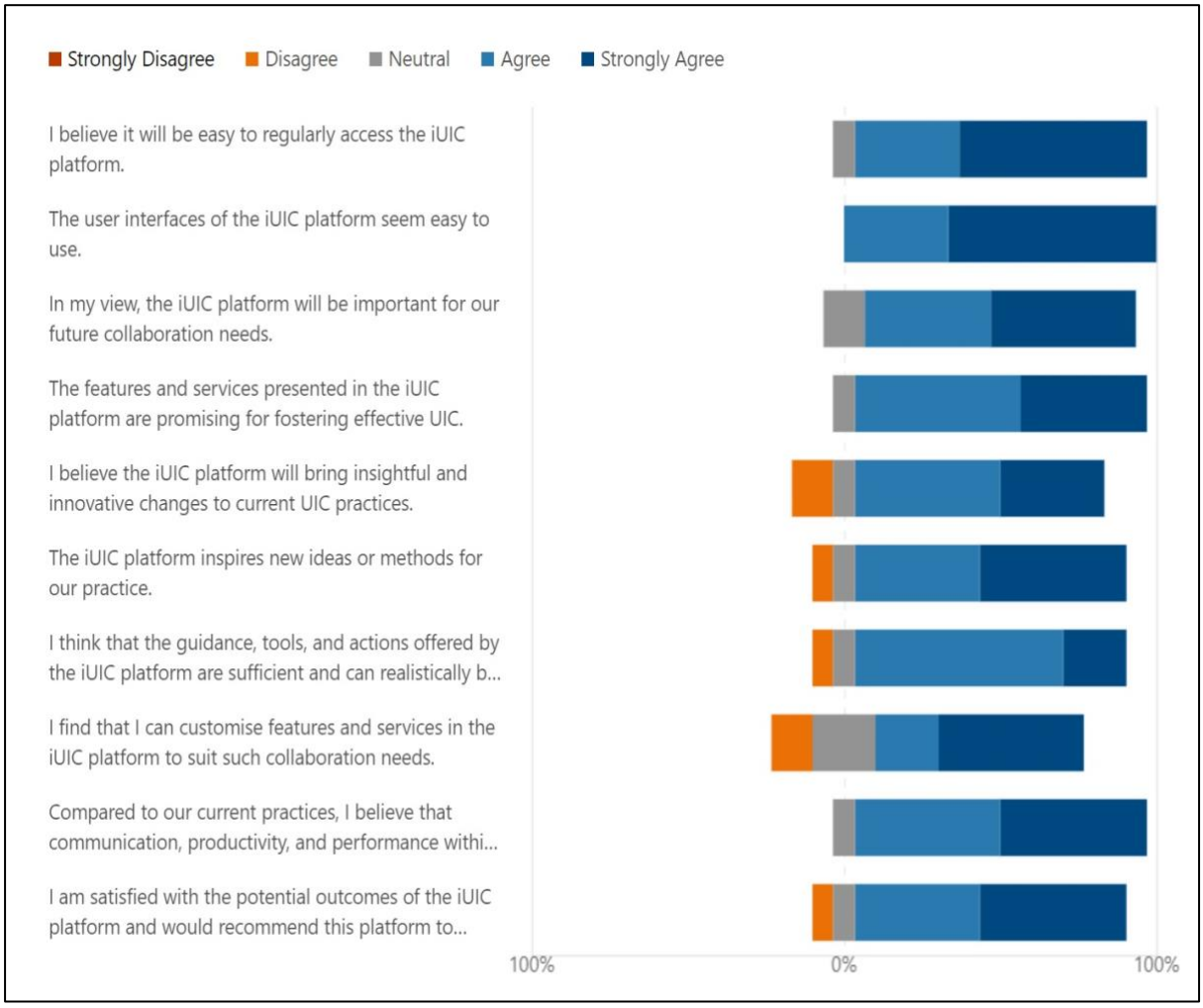



Figure 7.4: A Summary of Reusability Evaluation Results for Instantiated DPs

#### 7.2.1.1 Reusability of Design Principles - Accessibility

Accessibility of DPs is the ease with which the target community can understand the principles, both individually and collectively (i.e., at a group or organisational level) (Rosemann & Vessey, 2008). This accessibility requires that the DPs be presented in clear, straightforward language with easily understandable terminology (Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021). This clarity is essential for practitioners (i.e., the UIC ecosystem) to effectively assess the relevance, innovation, practicality, and impact of the principles. Additionally, accessibility ensures that the UIC ecosystem can fully understand the types of IT artifacts these DPs are intended to help create, making the principles theoretically sound and practically implementable.

The collective feedback on the accessibility of DPs underscores their ease of access and usability upon instantiation in user interfaces, as well as meeting user needs. The majority of participants, with 93% to 100% of participants either agreeing or strongly agreeing, reported that all DPs are easy to understand, indicating high levels of acceptance and usability.

#### 7.2.1.2 Reusability of Design Principles – Importance

The importance of DPs in a light reusability evaluation largely depends on the significance of the real-world problems such principles attempt to solve (Rosemann & Vessey, 2008). This significance is increased when DPs aid in creating contextualised IT artifacts that address critical real-world issues (i.e., heterogeneous UIC ecosystem) (Gregor, Chandra Kruse & Seidel, 2020). However, the practical relevance of these principles is not assured, even with close collaboration between researchers and practitioners. This uncertainty arises partly because historical IS failures reveal that practitioners can incorrectly identify problems, handle requirements poorly, struggle with technical implementation, or fail to ensure system adoption (Hevner et al., 2004).

In DSR, As discussed by Iivari, Rotvit Perlt Hansen, and Haj-Bolouri (2021), projects often tackle new, unresolved problems, these risks are even higher, while failures provide lessons, they mainly highlight what to avoid, offering limited guidance on what to do next. Additionally, perceptions of the importance of DPs can vary significantly among practitioners, influenced by differences in context, such as geographic location, available resources, and varying priorities. Therefore, evaluating DPs should involve a broader sample of practitioners beyond a single client organisation to capture diverse opinions and potentially reveal systematic reasons for differing views, which might prompt a reassessment and possible refinement of the target community to better align with those who find the DPs most relevant (Hevner et al., 2004; Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021; Ramakrishnan et al., 2023).

Approximately 87% to 93% of respondents agreed or strongly agreed on the effectiveness of the instantiations of DPs and their theoretical implications in addressing real-world needs and DPs' promising collaborative features within the dynamic and heterogeneous UIC ecosystem. Notably, 7% to 13% of respondents remained neutral, indicating some reservations or uncertainties about the impact of such solutions within this diverse setting.

#### 7.2.1.3 Reusability of Design Principles - Novelty and Insightfulness

It's essential to consider how practitioners view the novelty and insightfulness of design DPs (Hevner et al., 2004). Unlike academic perspectives, which often focus on scientific novelty, practitioners should find the DPs helpful and surprisingly insightful, not just confirming what they already know. This criterion highlights the significance of introducing new, valuable information that recipients are not previously aware of (Rosemann & Vessey, 2008; Venable, Pries-Heje & Baskerville, 2016; Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021). It also indicates the possible misalignment between what is considered novel in academic settings versus what is innovative in practical environments, where real-world application might outpace theoretical discoveries (Hevner et al., 2004; Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021).

This understanding leads to the conclusion that engaging diverse stakeholders within the UIC ecosystem would yield a deeper, more accurate assessment of the DPs' novelty. Such involvement ensures that such principles are innovative in theory, genuinely insightful, and helpful for practitioners in the field to bridge gaps between academic research and practical application.

Despite the limited sample, 80% of respondents affirm the novelty and insightfulness with which such DPs introduce innovative and practical changes to UIC practices, indicating strong alignment with user expectations. Notably, the practical applications of the DPs are valued more than their novelty, as evidenced by higher agreement in the 'strongly agree' category for insightfulness.

Nevertheless, two academics noted points of disagreement (one was unable to attend the initial discussion via Zoom); both raised a disagreement over a statement, while agreement was reached on another statement categorised under novelty.

Further follow-up communication with these participants provided more insight into their concerns. Initially, one academic who could not attend the ZOOM interview expressed uncertainty regarding one statement about the novelty of the DP. Upon further discussion, they acknowledged the theoretical novelty of the DPs in fostering new insights for external collaborations, as: "*I can see a lot of work has been done here and […] that helps universities to communicate with industry*". However, due to overlaps with existing internal solutions at their university, they remained unconvinced about implementing these principles as an external platform, specifically pointing out issues with DP11, which focuses on scalability, performance, compliance, and security, as highlighted: "*I believe it's really hard to convince universities to use such platform due to many reasons: policy and regulations, existing integrated systems and ERPs, financing UIC would be an issue nowadays, technical and cyber security reasons*". A second academic also discussed the uncertainty associated with DP11, providing justification that related similarly to the previously highlighted concerns: "*I recommend connecting the platform to a government agency […]*". Furthermore, concerns were expressed about DP4, noting that while the theoretical concept of contribution recognition and incentivisation is excellent, its practical implementation poses challenges. The academic articulated this: "*Providing incentives or credits to companies and universities that are frequent users of the platform could be beneficial."*

Building on this discussion, it is particularly noteworthy that this finding highlights the gap between what is perceived as novel in the academic setting and what qualifies as innovative in practical settings, where real-world

applications frequently extend beyond the scope of theoretical developments (Hevner et al., 2004; Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021).

#### 7.2.1.4 Reusability of Design Principles - Actability and Appropriate Guidance

Actability (i.e., actionability) refers to the practical utility of research outcomes, specifically that they are directly applicable and manageable in addressing urgent or common problems (Vaishnavi & Kuechler, 2015). This implies that the set of DPs should not only be actionable in practice but should also fall within the capabilities and realistic expectations of the practitioners. On the other hand, providing the proper guidance means finding a balance in which DPs should give enough direction and guidance to be helpful without being too controlling or restricting (Rosemann & Vessey, 2008; Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021).

However, it is acknowledged that the proposed DPs offer only a partial framework for designing specific types of systems, where design knowledge also includes tacit elements, suggesting that no codified set of DPs can fully capture the knowledge required for designing certain systems (Chandra, Seidel & Gregor, 2015). Practitioners, depending on their existing knowledge and expertise, might find the guidance from the DPs more or less adequate (Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021). Instead of strictly following design principles, which can be limiting, using them creatively is crucial, as emphasised by (Chandra, Seidel & Gregor, 2015; Gregor, Chandra Kruse & Seidel, 2020).

Thus, DPS must maintain balance by providing critical guidance supporting the general knowledge of IS development expected of the target stakeholders within the UIC setting without overly controlling or conflicting with their internal regulations.

Significantly, between 66% and 87% of participants affirmed the actability and practical utility of the DPs. These principles underscore the ability to customise features and services within the proposed solution to meet specific collaboration needs, demonstrating a positive alignment with the principles of balance and realism while providing appropriate guidance. This capability for customisation is essential in promoting a sense of ownership and adaptability among users to their unique contexts and challenges.

However, it is essential to note the existence of neutral opinions, which are as high as 20% (3 participants), and disagreeing opinions at 13% (2 participants), across different aspects. Additionally, one academic who could not attend the initial discussion via Zoom and had previously noted points of disagreement now showed disagreement with both statements. Another industry partner also expressed disagreement with one of the statements. Despite these variations in opinion, concerns primarily relate to the willingness and readiness to engage in activities through an external source. This applies especially regarding DP5 (Multipurpose Communication and Interaction Channels), DP6 (Digital Co-Creation and Open Innovation Practices), and DP10 (Practical Experience Module).

While not all DPs should be mandatory or strictly applied, these concerns still arise from existing barriers within the UIC setting, as emphasised by an industry partner who acknowledged the theoretical importance of these principles but expressed uncertainty about whether such theoretical principles can be actionably implemented in all scenarios within the UIC setting. This applies particularly with DP3, as "*There is an urgent need for real practical engagement before committing to such a digital platform*". An academic also suggested that for these theoretical principles and guidance to be actionable, it might be more practical to embed such features as an

additional tool within the internal systems of a university. As stated, "*It would be very nice to have iUIC as a plugin in the current systems that universities already use rather than having it as an independent platform*".

Therefore, these viewpoints emphasise that for a minority of users, the DPs may not fully meet their expectations or needs regarding actability and guidance and considering their body of knowledge and expertise. This disagreement aligns with the limitations of codified DPs, as noted by Chandra, Seidel, and Gregor (2015); the framework's limited scope often fails to capture essential details, leading experts to view the guidance as inadequate where tacit knowledge and situational specifics are crucial.

#### 7.2.1.5 Reusability of Design Principles - Effectiveness

Effectiveness in the context of DPs relates to their relative advantage and impact on the processes and outcomes within the environments where they are applied. For a research object to be effective, it must positively influence its application context; if it has no impact or a negative one, it is considered unsuitable (Rosemann & Vessey, 2008). The effectiveness of DPs essentially concerns the range of expected and unexpected effects that occur when these principles are reused within a specific setting, such as an organisation or by an individual. While these effects can manifest at various levels- from individuals to global communities- it is advisable to focus evaluations on the context where the DPs are specifically applied (Hevner et al., 2004; Rosemann & Vessey, 2008; Gregor, Chandra Kruse & Seidel, 2020).

Evaluating the effectiveness of DPs involves understanding how such principles influence the system development process within the environment and, subsequently, how DPs impact the overall performance (Gregor, Chandra Kruse & Seidel, 2020; Ramakrishnan et al., 2023). This complex process ideally requires a naturalistic approach, where a system is observed under actual conditions over an extended period to discern its effects comprehensively (Venable, Pries-Heje & Baskerville, 2016).

However, this approach also presents challenges due to numerous potential considerations affecting the system's influence. Despite these complexities, practitioners might still be able to make informed estimations about the system's potential benefits, particularly if they can observe a prototype or implemented system in action (Venable, Pries-Heje & Baskerville, 2016). If the need for a proposed system is evident, assessing the impact of DPs becomes somewhat straightforward, where the focus may shift more towards how DPs facilitate the IS development process rather than their direct effects on performance outcomes. The effectiveness of DPs can also be evaluated through specific tasks they support, employing criteria adapted to those tasks (Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021).

Hansen Ph.D. and Pries-Heje (2017) proposed a two-part method to evaluate the effectiveness of DPs. The first part assesses the value generated for the ecosystem and the practitioners' ability to utilise DPs to create similar tools. However, challenging to measure, the value relates to the effectiveness of ecosystem interactions, and the longevity of a group can indicate its ongoing value. The second part investigates the indirect effects of DPs by examining their practical application in a developed artefact and its adoption, as this does not directly evaluate how well DPs communicate design knowledge. Still, it offers insights into their practical utility and outcomes.

With 94% agreeing or strongly agreeing about enhancements in communication, productivity, and performance, the effectiveness of the DPs in improving operational aspects within the UIC ecosystem is underscored. This

aligns with the theoretical frameworks suggested by Gregor, Chandra Kruse, and Seidel (2020), which emphasise the impact of DPs on system development processes and subsequent performance outcomes.

One industry partner agreed with one statement under the effectiveness criteria but expressed dissatisfaction with other statements. This illustrates that while the DPs are generally effective, their application and impact can vary significantly across different contexts. These variations are particularly crucial when the business value of the platform relies on the types of instances created and the unique operational needs of an organisation, especially regarding DP2, DP3, DP4, DP10, and DP11.

This underscores the importance of long-term monitoring (Hansen Ph.D. & Pries-Heje, 2017), designed for the unique business contexts and operational needs of different industry partners (Venable, Pries-Heje & Baskerville, 2016; Iivari, Rotvit Perlt Hansen & Haj-Bolouri, 2021), which such observations under real-world conditions are crucial to evaluate the practical effectiveness of theoretical DPs over time within the UIC setting, offering a more thorough assessment (Hevner et al., 2004).

### 7.2.2 Evaluation of Artifact's Design Framework

This section addresses the second purpose of the ex-post summative evaluation, specifically assessing the design framework by focusing on the logic flow and coherence within the platform's framework. Additionally, it evaluates the consistency of the tangible DFs, particularly in how effectively these principles are translated into practice and integrated within the UIC setting. This evaluation includes examining the consistency and utility of these tangible components, as discussed in the works of Hevner et al. (2004). The examination is conducted by demonstrating the prototype in a real-world setting. To enhance the comprehensive demonstration and discussion, the feedback questionnaire incorporates two additional questions specifically for this purpose: 'Please share your insights on the services and features provided by the iUIC platform' and 'Please share any additional feedback or suggestions you have regarding the iUIC platform.

Thus, this section evaluates the design's consistency by exploring the consistency of various design elements and their integration within the UIC setting. Additionally, participant feedback is analysed to identify areas for improvement, ensuring the design remains sustainable and adaptable to the evolving needs of the UIC setting. Feedback helps enhance the consistency of the platform's design and integration within the UIC setting, aligning closely with the Design Principles (DPs) previously evaluated and discussed.

During the discussion of the platform design, participants provided positive and insightful feedback on the iUIC platform, highlighting its strengths and potential impact. One participant remarked on the comprehensiveness of the platform: "*My journey with the platform's details has been remarkable; I find it complete with all required details. With sufficient support [i.e., a governing body], it can be used by any entity that adopts it."* Another expert emphasised the platform's unique ability to enhance business relationships and operational efficiency: "*The platform is very unique as it bridges the gap between partners, facilitates business practices, supports integration, and stimulates the reciprocal relationship between universities and the private sector. It unifies efforts, contributes to improving the quality of work, and reduces operational costs."*

Further comments reinforced the platform's functionality. One participant noted, "*The services and features provided by the iUIC platform look promising and interesting.*" Another added, "*The iUIC platform can provide*

*a great collaboration between stakeholders.*" Additional praise came from a participant who highlighted the platform's efficiency benefits: "*It's great to see such an important platform, as it will save a lot of time and effort in building effective partnerships and creating a collaboration ecosystem between universities and other sectors.*"

The feedback also highlights endorsements, as one stated, "*This is a new platform and extraordinary effort, and it deserves appreciation. Indeed, we need such a platform for our partnerships with universities!*" Another succinctly concluded, "*It's well done.*"

Also, participants provided valuable insights into potential improvements and enhancements for the iUIC platform, concentrating on its features and user experience, mainly focusing on the user interfaces, navigation, and the implementation of advanced features to foster innovation and user engagement. This feedback helps enhance the consistency of the platform's design and integration within the UIC setting, aligning closely with the DPs previously evaluated and discussed.

Participants noted the importance of refining the user interface. One expert shared, "*The iUIC platform prototype will change how users utilise technology with its new services and features. As we examine its entire implementation, the platform has great potential to improve user experiences across domains*", highlighting its capability and the need for continuous improvement in user interaction design.

Regarding navigation and accessibility, a potential improvement was noted in integrating and simplifying the platform's feature terms and classifications: "*Some of the solutions provided by the platform can be integrated with each other, and to avoid confusion, suggest combining solutions and services into one category."* This feedback suggests a need for a more streamlined and intuitive navigation system that could enhance user satisfaction and decrease cognitive load.

The platform's visual and functional application was also a concern: "*[…] improving the platform's interface to enhance its appeal*" indicates a need for more visual upgrades to make the platform more engaging and user-friendly.

Advanced technology was suggested to enhance user interaction: "*An intelligent user interface uses advanced AI algorithms to personalise user interactions.*" This recommendation points towards leveraging AI to correspond to user experiences, making the platform more responsive and adaptive to individual user needs.

The feedback also emphasised the importance of fostering innovation and digital co-creation: *"The platform should be more open for ideas discussion*", suggesting that while the feature already exists, it needs to be more prominent to foster a collaborative and innovative ecosystem effectively.

A proposal was also suggested to boost engagement regarding performance indicators and incentives: "*Providing incentives or credits to companies and universities that frequently use the platform could be beneficial.*" Although performance and collaboration effectiveness indicators within the UIC setting platform are showcased in the design, this feedback underscores the importance of offering tangible rewards to encourage active participation and acknowledge contributions.

Lastly, security emerged as a recurrent theme in the discussions, underscoring the critical need for robust security measures to protect user data and build trust in the platform.

These insights underline the need for ongoing refinement and adaptation of the iUIC platform to meet evolving user expectations and industry standards, ensuring it remains a valuable and secure tool for collaboration and innovation.

## 7.3 PRACTICAL RECOMMENDATIONS FOR IMPLEMENTATION

While there is a high level of consensus, the presence of neutral responses or disagreements, even from just one or two participants, underscores the importance outlined in the evaluations of instantiated design principles and the artifact's design framework. This emphasises the need to consider local contexts and the specific needs of different organisations or sectors when developing and refining artifacts within a varied and heterogeneous ecosystem.

Given the insights derived from the empirical interpretation, it is crucial to strategically evaluate a theoretical set of DPs to enhance the iUIC platform. These reusability, importance, novelty, actability, and effectiveness principles should guide practical implementation steps. For instance, ensuring accessibility is not merely about compliance with standards but also about enhancing user engagement through intuitive design.

Considering the ongoing emphasis on security, implementing enhanced security measures is recommended. This includes revising DP11 and DP12 to focus distinctly on scalability, performance, compliance, and security, as follows:

- Previously, DP11 emphasised combining scalability and high performance with compliance and security; DP11: “The iUIC platform should integrate scalability and high performance with compliance and security measures to support growth and adapt to evolving requirements in a secure environment, thereby fostering trust, ensuring sustainability, and achieving regulatory compliance.”
- The updated DP11 states: "The iUIC platform should be designed for scalability, high performance, and continuous improvement to allow stakeholders to leverage a robust and future-proof platform that can accommodate growth, evolving needs, and technological advancements, thus fostering long-term sustainability and adaptability."
- Additionally, DP12 has been updated to: "The iUIC platform should implement robust compliance and security measures to allow stakeholders to operate within a secure and regulated environment, thus fostering trust, data protection, and adherence to relevant policies and regulations."

Additionally, evaluating the artifact's design framework reveals a solid foundation. However, it is essential to continually adapt the design components and frameworks based on real-world feedback to ensure functionality, ease of use, and security. Such responsiveness keeps the iUIC platform effective in the dynamic technological landscape. For instance, feedback highlighted confusion between some terms within the design; as an improvement, the design is enhanced: *“Some of the solutions provided by the platform can be integrated to reduce confusion. It is advisable to combine similar solutions and services into one category.”* Acting on this, the design has been refined to enhance clarity and user experience, as illustrated in Figure 7.5.

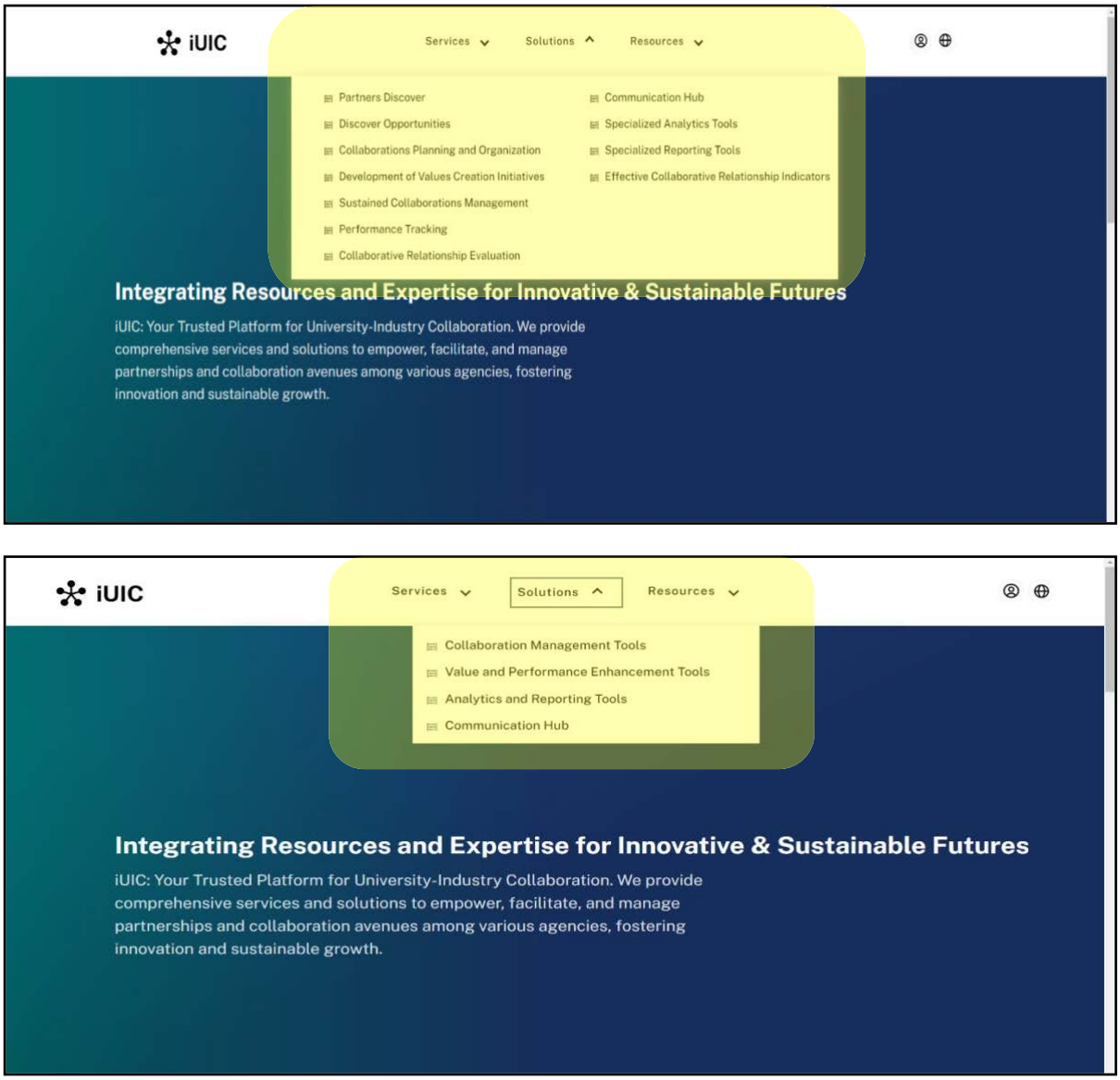


Figure 7.5: Evaluating the Artifact's Design (Example)

To ensure the platform stays relevant and effective in the future and is capable of accommodating growth and technological advancements, it is recommended that the DPs promote continuous improvement and adaptability. This involves regular updates to the platform based on emerging technologies and user feedback, ensuring that the platform can handle increased loads and more complex interactions without compromising performance within the UIC setting. This leads to incorporating a socio-technical perspective into the design and evaluation of the iUIC platform, recognising the interplay between social systems and technology. This considers how societal contexts influence and are influenced by perspective in the digital platform-based intermediary solution. Integrating these socio-technical considerations helps the platform balance technology and its ecosystem's human/social elements, leading to a more sustainable and effective solution.

Engaging stakeholders through the design and implementation phases is crucial. Their feedback should be continuously integrated into the development process to ensure the platform meets the diverse needs of its users,

DRs, which also facilitate the practical application of DPs, making them more than theoretical guidelines and turning them into actionable insights that drive the platform's evolution.

Lastly, educating the ecosystem, mainly IS practitioners and researchers, about the principles and framework guiding the platform's development is essential. Offering clear demonstrations of these principles in real-world settings helps to support and ensure that all platform features are effectively employed.

With these practical recommendations, the iUIC platform can effectively translate empirical insights into actionable improvements, fostering adaptability, security, and a user-friendly digital ecosystem.

## 7.4 CHAPTER SUMMARY

In conclusion, Chapter 7 evaluates the developed solutions within the diverse UIC ecosystem using the Framework for Evaluation in Design Science (FEDS). This chapter thoroughly assesses the effectiveness and real-world applicability of the proposed solutions, marking a transition from theoretical concepts to empirical evidence. It started by discussing the FEDS that guided the evaluation phase in interpreting empirical insights and offered a detailed examination of the data gathered during the evaluation phase. The instantiating of the theoretical DPs was evaluated based on the reusability across various dimensions, including accessibility, importance, novelty, actability, and overall effectiveness of these principles, to provide a holistic view of their applicability and impact within the UIC setting. The evaluation has also extended to the artifact's design framework, analysing its structural and logical functional attributes and their alignment with the intended research outcomes.

This critical analysis highlights the relevance and adaptability of the DPs and artifacts within real-world UIC settings, thereby addressing RQ3. Therefore, the outcomes of this chapter contribute significantly to future research directions by identifying areas for further investigation and development in enhancing KT/TT activities within the UIC setting, which advance both the theoretical understanding and practical implementation of digital intermediaries in facilitating such collaborations.

# PART IV- CONCLUSION

## Chapter 8: Final Reflections

# 8 DSR | FINAL REFLECTIONS

Chapter 8 serves as both the DSR cycle's conclusion and this thesis's final chapter. This chapter synthesises the comprehensive insights gained throughout the research journey and critically summarises the lessons learned and takeaways (Section 8.1). It articulates its significant contributions (Section 8.2), which are divided into theoretical contributions that enhance the academic understanding and frameworks within the field and practical contributions that offer tangible benefits and applications within the real-world setting. The chapter then moves towards a summary of the limitations of the research and outlines a clear path forward for future work in this area (Section 8.3). Finally, this chapter concludes with a summary highlighting the essential elements discussed, reinforcing the narrative and findings of the thesis (Section 8.4).

## 8.1 REFLECTIONS AND KEY LESSONS FROM THE DSR JOURNEY

The journey through the DSR methodology across various phases provided a comprehensive framework for investigating, identifying, and facilitating KT/TT activities within the UIC setting. This reflection captures the structured processes used to address three main research aims.

Aim 1 focused on understanding the current dynamics of KT/TT-UIC activities. The research question, *RQ1: What are the current trends and emerging practices in facilitating KT/TT activities within the UIC setting?* was formulated to address aim 1. Data collection involved primary and secondary methods during the initial problem awareness phase. Secondary data included a comprehensive literature review, and two targeted systematic reviews, one analysing 60 journal articles on UIC in the MENA region and another focusing on SC theoretical and contextual insights from 23 studies on UIC. Primary data was gathered through 40 semi-structured expert interviews conducted in Saudi Arabia with subject matter experts from university, industry, and intermediary organisations as part of the DSR process. This phase laid a foundation by identifying key trends and focusing the research on specific needs within the UIC dynamics. This phase established a foundation by pinpointing key trends and directing the research towards particular areas of need within UIC dynamics. It addressed RQ1 and prepared for addressing RQ2 in the subsequent phase.

Aim 2 centred on analysing the factors influencing KT/TT-UIC activities. Following problem awareness and proceeding to solution suggestion phases, *RQ2: How are KT/TT activities enabled and constrained within a UIC setting?* was formulated to achieve aim 2, identifying factors classified as drivers and barriers to such collaborations. Initial interview explorations provided empirical insights, which were analysed through the lens of SC theory. A mapping model and an integrated framework were then developed to address and highlight key themes essential for transforming theoretical insights into practical frameworks that manage the dynamic of KT/TT activities within the UIC setting. Building upon these empirical insights, the recommendation of a digital platform-based intermediary was prompted to bridge existing gaps. DRs were derived by aligning theoretical frameworks with these findings, complemented by conducting follow-up expert interviews for an ex-ante evaluation to gather feedback on the proposed solutions and DRs. Subsequently, a set of DPs was formulated. This comprehensive approach facilitated the derivation of DRs to meet user needs and the formulation of tentative

DPs. The model, which encompasses both DRs and DPs, establishes a solid foundation for progressing to Aim 3 and partially addresses RQ3.

Aim 3 focused on facilitating KT/TT activities within the UIC setting through a digital platform intermediation mechanism, explored through *RQ3: How would such a digital platform-based intermediary be designed to facilitate KT/TT activities?* In the development phase, DPs were instantiated directly as DFs to ensure the practical application of theoretical foundations within the prototype. This led to the creation of a framework that aligned DPs with DFs, providing a proof-of-concept prototype that highlighted functionality and potential impact, which was then demonstrated to experts in the UIC ecosystem. The evaluation phase involved an ex-post summative evaluation using follow-up expert semi-structured interviews, one confirmatory mini-focus group session, and a targeted qualitative feedback questionnaire to assess the reusability of DPs and the consistency of the prototype in a real-world setting. This evaluation aimed to validate theoretically that the IT artifact addressed the specified DRs and achieved the expected DPs while also assessing the logic flow and coherence within the design framework and the effectiveness of the tangible DFs. Findings from this phase provided valuable feedback used to refine the prototype, ensuring its effectiveness and the adaptability of the suggested solution. This effectively answered RQ3, concluding the DSR journey and summarising the lessons learned.

Building upon extensive literature reviews, this DSR project systematically addressed the critical research gaps identified early on, enhancing our understanding of UIC dynamics and effectiveness. It has enriched the holistic understanding of the UIC ecosystem by incorporating diverse expert insights, addressing Research Gap 1. The development and evaluation of a digital intermediary mechanism aimed at optimising KT/TT-UIC activities provided practical insights into the role of such an intermediation mechanism in facilitating collaboration, leading to tackling Research Gap 2. The application of SC theory allowed for a consistent analysis and measurement of interactions within the UIC setting, enhancing overall understanding and addressing Research Gap 3. A socio-technical perspective in developing the digital platform-based intermediary ensured that both social interaction dimensions and technical capabilities were considered, improving collaborations' effectiveness and addressing Research Gap 4. Finally, Research Gap 5 was addressed by investigating Saudi Arabia, which helped bridge gaps in both geographical coverage and contextual understanding, while yielding insight that may be relevant to the broader MENA region. The study systematically presented an overview of the MENA to establish the context within which Saudi Arabia is located and where data collection took place.

## 8.2 CONTRIBUTIONS OF THIS STUDY

According to Gregor and Hevner (2013, p. 342), “In the improvement quadrant, DSR projects contribute to the Λ knowledge base [Λ – Prescriptive Knowledge] in the form of artifacts at one or more levels”. They organised the contributions in DSR into three distinct levels based on the maturity and abstraction of the knowledge. Level 1 focuses on the practical implementation of artifacts, termed instantiations, which include software products or processes. Level 2 advances to nascent design theories that guide operational principles or architecture, incorporating constructs, methods, models, DPs, and technological rules. Level 3 involves comprehensive and mature design theories about embedded phenomena, typically encompassing mid-range and grand theories. This framework illustrates a progression from specific and practical instantiations to abstract and theoretical formulations within DSR.

This research provides significant contributions at Level 1 by applying instantiated DPs to a well-designed digital platform prototype further developed and evaluated during the DSR cycle. As for Level 2, the focus was on developing these DPs to meet specific DRs within the UIC setting. This section further explores the theoretical and practical contributions of this DSR project within the UIC setting.

As for the theoretical contributions, SC theory is frequently applied in IS research to analyse how information and communication technologies influence social relationships within (internally) and between organisations (externally). This provides a clear lens to examine the interplay between technologies and social relationships. This socio-technical perspective is crucial in how these interactions influence relationships' development and ongoing maintenance. The application of SC theory is further extended by demonstrating its operational efficacy in the context of UIC, offering a deeper understanding of the complex dynamics involved. This approach includes initiating with SC theory, refining it for IS practice, and pragmatically applying it to develop an IS artifact, which represents a novel contribution to the field. It provides a framework for understanding the UIC context by leveraging SC theory's dimensions- structural, relational, and cognitive- and then mapping these dimensions and sub-dimensions to empirical findings; it offers a comprehensive view that aids in developing inter-organisational relationships, fostering mutual understanding and promoting resource exchange.

The DPs formulated address specific gaps and unique needs within the UIC context. This focused approach significantly improved both the methodical and practical applications in IS research, thereby strengthening theoretical and empirical contributions to the field. This study also contributed to the DSR body of knowledge by developing both meta-user requirements and design requirements, leading to the development of DPs and instantiated later to DFs.

These DPs provide prescriptive guidance to the real-world setting, including IS developers and researchers, addressing the socio-technical aspects of systems and extending beyond purely technical solutions. The innovative development approach in formulating the DPs based on SC theory represents a significant shift from traditional development methods and aligns closely with empirical findings. Additionally, evaluating DP reusability represents a vital step towards bridging the gap between research and practice.

In addition, the "iUIC" proof-of-concept prototype for the digital platform-based intermediary shows how the theory works in practice and tests its effectiveness, further proving the research's value to both theory and practice in the field of IS.

On the other hand, the practical contributions are significant in translating research into actionable outcomes. Furthermore, the findings could serve as a valuable reference for other regions facing similar challenges within the UIC setting, which facilitates broader applicability and impact of the research outcomes beyond the initial study context, promoting a broader transformation in how academic and industry partners collaborate.

Data collection extensively included various UIC ecosystems, covering academic contributors from universities and practitioners from other industry organisations such as the private sector, not-for-profit, government, and semi-government bodies. This comprehensive involvement ensures a well-rounded understanding of the challenges and opportunities within UIC frameworks across different sectors. The diverse input gathered from these stakeholders is essential for shaping the insights that directly inform and influence policy development and strategic implementations in KT/TT-UIC activities.

By meeting these expectations of identifying key drivers and barriers effectively, the study provides valuable insights for policymakers. It suggests practical strategies such as building trust and creating supportive environments, which are essential for enhancing such collaborations. Additionally, understanding the role of digital intermediation in either facilitating or hindering these activities offers a roadmap for more integrated and efficient collaborations within the UIC setting.

By introducing iUIC as an intermediary, the effectiveness of collaborations within the UIC setting is significantly enhanced. iUIC plays a critical role in facilitating these collaborations by serving as a bridge between academic institutions and industry partners, streamlining communication, aligning objectives, and leveraging resources effectively. This structured platform supports both technological and social relational dynamics for sustainable engagements. This advances the practical applications within the field and contributes to a deeper understanding and improvement of inter-organisational relationships in various contexts.

## 8.3 LIMITATIONS AND FUTURE DIRECTIONS

Despite the success demonstrated, this study is subject to certain vital limitations that need to be considered when interpreting the findings and considering their implications, highlighting areas for future research. A significant limitation is that the empirical insights provided are broad to the UIC setting and may not delve deeply into specific industrial sectors' unique challenges and opportunities. This could make the findings less applicable to sectors with distinct characteristics and requirements not covered, considering that these collaborations are dynamic and evolve over time.

Economic and financial matters arise during investigations, yet there is often minimal integration of economic perspectives, which are crucial for explaining the financial dynamics and cost-benefit analyses within current UIC practices. This lack of comprehensive economic analysis can result in an incomplete understanding of these collaborations' financial sustainability and economic impacts.

To build on the findings and address their limitations, future research should consider further directions, including implementing longitudinal studies to track the evolution and outcomes of UIC over time, which would provide valuable insights into their sustainability and the long-term benefits they offer. Concurrently, developing and refining methodologies such as Action Design Science Research within the context of UIC could enhance the applicability and innovation of solutions, as well as consider how digital intermediaries impact these collaborations over time.

Accordingly, with ongoing digital innovation, exploring the role of new technological tools in facilitating intermediation mechanisms can uncover more efficient and effective collaboration methods. Additionally, incorporating usability testing during any further development of the system is essential to ensure the platform effectively addresses user needs, optimises functionality, and maximises collaborative outcomes. This is also aligned with examining the effects of financial sustainability and broader economic impacts, as well as specific policies on the effectiveness of UIC within different governance frameworks that can guide the development of supportive regulations and incentives.

Cultural aspects are deeply embedded within the dimensions of SC theory, with specific cultural elements aligning with each dimension. For example, *social norms* can be recognised as a sub-dimension under the relational

dimension, reflecting expectations and acceptable behaviours that guide interactions and build trust between stakeholders. Similarly, *shared culture* can be considered an integral part of the cognitive dimension, encompassing shared cultural frameworks that facilitate mutual understanding and effective communication. While these cultural aspects were acknowledged and briefly discussed in this study, they were not its central focus. As a direction for future research, socio-cultural factors within the IS field could be further explored to gain a deeper understanding of the UIC context. This is particularly critical in regions such as the MENA region, where cultural norms and social dynamics are deeply embedded in interpersonal and organisational interactions. These cultural underpinnings are pivotal in shaping collaborations among stakeholders within the UIC setting.

## 8.4 CHAPTER SUMMARY

In conclusion, Chapter 8 brings the DSR cycle and this thesis to a close, offering a comprehensive summary of the research journey. The chapter has provided a reflective overview of key lessons learned throughout the r, highlighting the critical insights gained in exploring the UIC setting and developing digital intermediary solutions. It has articulated the research's significant contributions, outlining theoretical advancements that enhance academic understanding and practical applications that offer tangible benefits in real-world UIC settings. The chapter has acknowledged its limitations and mapped a clear path for future work in this domain. By bridging theoretical frameworks with practical implementations, this final chapter has reinforced the thesis narrative, demonstrating how the developed digital platform and related criteria, including DRs, DPs, and DFs, can enhance such a facilitation mechanism to KT/TT-UIC activities. Through this final reflection, Chapter 8 has effectively provided a holistic view of the research impact and potential to drive meaningful improvements in UIC practices and outcomes.

# PART V- APPENDICES

## Appendix A: The Systematic Review Insights

## Appendix B: DSR Phase (2) Insights

## Appendix C: The Feedback Questionnaire (Qualitative Tool)

# APPENDIX A: The Systematic Review Insights

Table A.1: A Summary of Systematic Review Articles on UIC Insights in the MENA Region

| Article | Country (Study Context) | Study main Objective | Scope (Domain of Interest) | UIC Model (Ecosystem Involvement) | Type of Study - Methodology - Participants (if empirical) | Journal |
|---|---|---|---|---|---|---|
| Boutifour, Saad and Guermat (2015) | Algeria | Here are the revised sentences with verbs at the start for all of them: | General | Standard UIC | - Quantitative- Web-based Questionnaire<br>- University Staff | International Journal of Technology Management & Sustainable Development |
| Saad (2004) | Algeria | Identify potential motivators for collaboration in higher education institutions. | General | The Triple Helix | - Qualitative- Theoretical | International Journal of Technology Management & Sustainable Development |
| Saad, Datta and Razak (2017) | Algeria (& Indonesia, Malaysia and India) | Explore the main issues and challenges in implementing 'triple helix' innovation strategies. | General | The Triple Helix | - Qualitative- Case Study (multiple)<br>- Not clearly mentioned | International Journal of Technology Management & Sustainable Development |
| Saad and Zawdie (2005) | Algeria | Examine opportunities and challenges for developing countries' universities in innovation systems. | General | The Triple Helix | - Qualitative- Theoretical | Technology Analysis & Strategic Management |
| Saad, Zawdie and Malairaja (2008) | Algeria (& Malaysia) | Highlight the need for a policy shift from technology transfer to 'triple helix' for innovation in Algeria. | General | The Triple Helix | - Qualitative- Case Study<br>- Not clearly mentioned | Science and Public Policy |
| AL-Obaidy (2012) | Bahrain | Emphasise the importance of building a knowledge-based economy in Bahrain. | General | Standard UIC | - Qualitative- Review (descriptive assessment) | International Journal of Innovation and Knowledge Management in the Middle East and North Africa |
| AlAyouty (2017) | Egypt | Conduct applied research for R&D in an industry. | R&D in Pharmaceutical | Standard UIC | - Qualitative- Interview<br>- Firms | European Journal of Sustainable Development |
| Attia (2015) | Egypt | Address the literature gap on university-industry collaboration barriers and drivers. | General | Standard UIC | - Quantitative- Questionnaire<br>- Firms | International Journal of Technology Management & Sustainable Development |
| El Hadidi and Kirby (2015) | Egypt | Investigate the role, challenges and support needs of Egyptian universities in innovation. | General | The Triple Helix | - Qualitative- Interview<br>- University Staff, IT, Government, and NGOs Actors | Industry and Higher Education |
| El Hadidi and Kirby (2016) | Egypt | Explore how Egyptian universities respond to innovation challenges. | General | Standard UIC | - Qualitative- Case Study<br>- Universities | Industry and Higher Education |
| El Hadidi and Kirby (2017) | Egypt | Contextualise the research problem while contributing to existing literature on the topic. | General | Standard UIC | - quantitative- Questionnaire Survey<br>- Firms | Industry and Higher Education |
| Kirby and El Hadidi (2019) | Egypt | Examine the extent of technology transfer and effectiveness of existing measures in a country. | General | Standard UIC | - Mixed-Methods- Questionnaire Survey/Interview<br>- University Staff and business Actors | The Journal of Technology Transfer |
| Seleim, Ashour and Khalil (2005) | Egypt | Understand knowledge acquisition and transfer practices in small Egyptian software firms. | Software Technology | Standard UIC | - Mixed-Methods- Questionnaire Survey/Interview<br>Firms | International journal of knowledge management |

| Article | Country (Study Context) | Study main Objective | Scope (Domain of Interest) | UIC Model (Ecosystem Involvement) | Type of Study<br>- Methodology<br>- Participants (if empirical) | Journal |
|---|---|---|---|---|---|---|
| Sobaih and Jones (2015) | Egypt | Identify factors contributing to the university-industry research gap and barriers impacting research quality in hospitality/tourism. | Hospitality and Tourism | Quadruple helix | - Qualitative- Interview<br>- University Staff, industry, government/non-governmental organisations Actors | Tourism and Hospitality Research |
| Ansari, Armaghan and Ghasemi (2016) | Iran | Investigate barriers facing the agricultural sector and solutions for commercialising research findings. | Agriculture | Standard UIC | - Qualitative- Interview<br>- University Staff | International Journal of Technology |
| Bagherimoghadam, Hosseini and Sahafzadeh (2012) | Iran | Investigate the role of R&D management and tech organisations in promoting industry-university links in the Iranian power sector. | Power and the Energy | The Triple Helix | - Qualitative- Benchmarking Method/Theoretical | Technology in Society |
| Borghei et al. (2013) | Iran | Determine the extent of research collaboration and influencing factors at an Iranian medical university. | Medical Sciences | Standard UIC | - Quantitative- Questionnaire<br>- Researchers | Medical Journal of the Islamic Republic of Iran |
| Farzin (2017) | Iran | Assess relationships between entrepreneurs, policymakers and educators in a peripheral case. | Technology Entrepreneurship | The Triple Helix | - Qualitative- Interview<br>- Academics, Techno-Entrepreneurs, Government Policymakers) | Local Economy |
| Friedrichsen et al. (2017) | Iran | Question the appropriate strategy for commercialising academic studies in Iranian universities. | General | Standard UIC | - Quantitative- Questionnaire<br>- Experts (Not clearly classified) | AD-MINISTER |
| Majidpour (2012) | Iran | Develop an understanding of external factors affecting the cross-border technology transfer process. | General | Standard UIC | - Qualitative- Case Study<br>- Firms | World Review of Science, Technology and Sustainable Development |
| Mavi et al. (2019) | Iran | Prioritise factors influencing strategic management of university business incubators. | General | Standard UIC | - Quantitative- Questionnaire/Secondary Data<br>- University Staff | Management Decision |
| Mazdeh et al. (2015) | Iran | Identify influential factors in technology transfer from Iranian RTOs and provide an interaction model. | General | Standard UIC | - Qualitative- Delphi Method<br>- University Staff | Decision Science Letters |
| Namdarian and Naimi-Sadigh (2018) | Iran | Identify and overcome barriers to the commercialisation of humanities research findings. | Humanities | Standard UIC | - Qualitative- Delphi Method<br>- University Staff | Iranian Journal of Management Studies |
| Rafiei, Akhavan and Hayati (2016) | Iran | Identify factors affecting technology design and assimilation in knowledge-based centres and aerospace industries. | Aerospace | Standard UIC | - Quantitative- Questionnaire<br>- Experts (Project Managers, Authors, and Academics) | Aircraft Engineering and Aerospace Technology |
| Sayadi et al. (2013) | Iran | Assess and prioritise types of industry-university interactions in the Iranian manufacturing sports sector. | Manufacturing Sports Gears | Standard UIC | - Quantitative- Questionnaire<br>- Firms | Life Science Journal |
| Soleimani, Tabriz and Shavarini (2016) | Iran | Expand understanding of the technology transfer process in entrepreneurial universities. | entrepreneurial Universities | Standard UIC | - Qualitative- Interview<br>- IT Management Experts and Government Officials | Industrial Engineering and Management Systems |

| Article | Country (Study Context) | Study main Objective | Scope (Domain of Interest) | UIC Model (Ecosystem Involvement) | Type of Study<br>- Methodology<br>- Participants (if empirical) | Journal |
|---|---|---|---|---|---|---|
| Zarghami, Amrollahi and Jafari (2020) | Iran | Examine how factors influence academic/commercial outcomes and perception of PhD project success. | PhD Projects | Standard UIC | - Quantitative- Survey<br>- PhD Candidates | Higher Education Quarterly |
| Abu-Rumman (2019) | Jordan | Assess the extent to which a Jordanian university has become entrepreneurial and the importance of knowledge management factors. | Entrepreneurial Universities | Standard UIC | - Quantitative- Survey<br>- University Staff | Academy of Entrepreneurship Journal |
| Salem and Amjed (2008) | Jordan | Derive an innovative industry-university partnership model suited to the Jordanian context. | General | Standard UIC | - Qualitative- Review (Descriptive Assessment) | International Journal of Innovation and Learning |
| Ben Hassen (2018) | Lebanon | Analyse characteristics and dynamics of innovation and proximity effects in the Lebanese software industry. | software industry | Standard UIC | - Qualitative- Interview<br>- Firms | Cogent Social Sciences |
| Bizri et al. (2019) | Lebanon | Propose a model for entrepreneurial universities operating in developing countries. | entrepreneurial universities | Standard UIC | - Quantitative- Questionnaire<br>- University Staff | Journal of Management Development |
| El Achi et al. (2020) | Lebanon | Present findings of a needs assessment of Lebanon's conflict and health research capacity. | Health | Standard UIC | - Qualitative- Interview<br>- University Academics | Conflict and Health |
| Al Mabrouk and Soar (2009c) | Libya | Identify critical issues in the IT transfer process and draw consensus from experts. | Information technology | Standard UIC | - Quantitative- Delphi Method<br>- University, IT Practitioners, and Government Actors | African Journal of Business Management |
| Al Mabrouk and Soar (2009a) | MENA (Arab) | Identify, prioritise and analyse stakeholder responses on major IT transfer issues in developing countries. | Information technology | Standard UIC | - Mixed-Methods- Delphi Method<br>- University, IT Practitioners, and Government Actors | The International Arab Journal of Information Technology (IAJIT) |
| Al Mabrouk and Soar (2009b) | MENA (Arab) | Identify, analyse and discuss significant issues for successful IT transfer in Arab countries. | Information Technology | Standard UIC | - Mixed-Methods- Delphi Method<br>- University, IT Practitioners, and Government Actors | African Journal of Business Management |
| Elyoussoufi Attou (2019) | Morocco | Model current technology transfer processes at universities and propose value chain activities. | General | Standard UIC | - Qualitative- Interview/Secondary Data<br>- Industrial Clusters (Managers) | International Journal of Advanced Trends in Computer Science and Engineering |
| Khadhraoui et al. (2018) | Morocco | Identify factors encouraging universities to undertake entrepreneurial activities and critical success factors. | General | The Triple Helix | - Qualitative- Interview<br>- University Staff (Engineers) | Journal of Energy & Economic Development (JEnergyED) |
| Taouaf et al. (2021) | Morocco | Propose an efficient institutional technology transfer policy with full implementation support. | General | Standard UIC | - Qualitative- Interview/Secondary Data<br>- Experts (Managers) | Cuadernos De Gestion |
| Al-Belushi, Stead and Burgess (2015) | Oman | Provide an overview of marine bioindustry activities in Oman and survey innovation in critical companies. | Marine Biotechnology | Standard UIC | - Mixed-Methods- Interview/Secondary Data<br>- Firms | Marine Policy |

| Article | Country (Study Context) | Study main Objective | Scope (Domain of Interest) | UIC Model (Ecosystem Involvement) | Type of Study<br>- Methodology<br>- Participants (if empirical) | Journal |
|---|---|---|---|---|---|---|
| Chryssou (2020) | Oman | Examine the nature of university-industry interactions and barriers in Oman. | General | The Triple Helix | - Quantitative- Questionnaire<br>- University Staff | Industry and Higher Education |
| Halibas, Sibayan and Maata (2017) | Oman | Review how higher education can propel socio-economic growth through research, innovation and entrepreneurship. | General | Penta Helix | - Qualitative- Review/Content Analysis (Audit report) | Interdisciplinary Journal of Information, Knowledge & Management |
| Alkhaldi et al. (2020) | Palestine | Analyse perceptions to understand health research system status, gaps and policy solutions. | Health Research | Standard UIC | - Qualitative- Interview/Focus Group<br>- University, Government and local and international nongovernmental organisations (NGOs) | Eastern Mediterranean health journal |
| Morrar and Arman (2020) | Palestine | Examine the roles of universities, industry and government in influencing innovation in Palestinian firms. | General | The Triple Helix | - Quantitative- Paper-based Questionnaire<br>- Firms | Innovation: The European Journal of Social Science Research |
| Sharabati-Shahin and Thiruchelvam (2013) | Palestine | Build a framework for Palestinian university-industry ties and diaspora entrepreneurial network. | General | The Triple Helix | - Qualitative- Interview<br>- Experts (within the Diaspora) | Higher Education |
| Sultan (2020) | Palestine | Explore innovation activity between institutional spheres in the Palestinian medicinal plants sector. | Agriculture | The Triple Helix | - Qualitative- Interview<br>- University, Industry, and Government Actors (Agriculture) | British Food Journal |
| Abduljawad (2015) | Qatar | Identify challenges in cultivating academia-industry knowledge interactions in Qatar. | General | The Triple Helix | - Qualitative- Case Study<br>- University, Industry, and Government Actors | Muslim World |
| Al-Mansoori and Koc (2019) | Qatar | Discuss transformational efforts in engineering colleges in Texas and Qatar for innovative economies. | General | Standard UIC | - Mixed-Methods- Survey/Interview<br>- University/College Staff | Sustainability |
| Alshehri et al. (2016) | Saudi Arabia | Note the increasing need for strategic university-industry relationships for economic growth. | General | Standard UIC | - Qualitative- Review/Secondary Data | Education for Chemical Engineers |
| Alshumaimri, Aldridge and Audretsch (2010) | Saudi Arabia | Analyse conditions conducive and inhibitive to scientist entrepreneurship in Saudi Arabia. | Scientist Entrepreneurship | Standard UIC | - Quantitative- Questionnaire<br>- University Staff | The Journal of Technology Transfer |
| Alshumaimri, Aldridge and Audretsch (2012) | Saudi Arabia | Examine the technology transfer revolution in Saudi Arabia for a knowledge-based economy. | General | Standard UIC | - Qualitative- Review Secondary Data | The Journal of Technology Transfer |
| Khorsheed and Al-Fawzan (2014) | Saudi Arabia | Present a new program of university-affiliated research centres for industry collaboration. | General | Standard UIC | - Qualitative- Review/Secondary Data | Innovation: Management, Policy & Practice |
| Sebak et al. (2014) | Saudi Arabia | Describe a technology innovation centre established in Saudi Arabia to promote university-industry projects. | E-Society | Standard UIC | - Qualitative- Review/Secondary Data | Innovation: Management, Policy & Practice |

| Article | Country (Study Context) | Study main Objective | Scope (Domain of Interest) | UIC Model (Ecosystem Involvement) | Type of Study<br>- Methodology<br>- Participants (if empirical) | Journal |
|---|---|---|---|---|---|---|
| Ahmed (2004) | Sudan | Examine factors influencing agricultural research contribution to knowledge in Sudan. | Agriculture | Standard UIC | - Quantitative- Questionnaire<br>- University Staff | International Journal of Learning and Intellectual Capital |
| Ahmed (2005) | Sudan | Address strategic and policy challenges for technological transformation in Sudan. | Agriculture | Standard UIC | - Quantitative- Questionnaire<br>- Firms (Farmers) | International Journal of Technology, Policy and Management |
| Ahmed and Newton (2005) | Sudan | Develop a framework for identifying technology transfer opportunities to strengthen institutions' role in Sudan. | Agriculture | Standard UIC | - Qualitative- Interview<br>- University Staff | International journal of technology transfer and commercialisation |
| Khadhraoui et al. (2016) | Tunisia | Study factors inhibiting university-industry technology transfer. | General | Standard UIC | - Quantitative- Questionnaire<br>- University Staff (Engineers) | Journal of Information Technology and Economic Development |
| Khadhraoui et al. (2017) | Tunisia | Assess the impact of marketing and negotiation skills on university licensing, patenting and spin-off success. | General | Standard UIC | - Quantitative- Questionnaire<br>- University Staff (Engineers) | Journal of Marketing & Management |
| Bhayani (2015) | UAE | Present case studies identifying drivers and state of university-industry relations in UAE. | General | Standard UIC | - Qualitative- Interview<br>- University Staff | World Review of Science, Technology and Sustainable Development |
| Iqbal et al. (2018) | UAE | Investigate the current situation of a university's technology transfer office in UAE. | Entrepreneurship | Standard UIC | - Qualitative- Interview<br>- University and Industry Actors (Entrepreneurs) | International Journal of Technology Management |
| Parashar (2008) | UAE | Elucidate experience in establishing practice school programs bridging the theory-practice gap in UAE. | General | Standard UIC | - Quantitative- Evaluation<br>- University students (Practice Program) | CURIE Journal |

Table A.2: A Summary of the Systematic Review Articles (The SC-UIC Insights)

| Source | Structural Dimension | Relational Dimension | Cognitive Dimension | SC Level of Analysis | Methodology |
|---|---|---|---|---|---|
| Abdulai, Murphy, and Thomas (2020) | ✓ | ✓ | ✓ | Intra-organisation | Quantitative/ Survey |
| Chakrabarti and Santoro (2004) | Networking, and norm of reciprocity | Trust | Problem-solving and info-sharing | Inter-organisation | Review/ Theoretical |
| Dalkir, Iancu, and Oliveira (2019) | Network stability | Trust | Shared (goals and vision) | Intra-organisation | Qualitative/ Action Research Design |
| de Wit-de Vries et al. (2019) | - | Trust | Shared (goals and culture) | Inter-organisation | Review/ Theoretical |
| Filieri et al. (2014) | Network size, centrality, structural holes, and tie strength | - | - | Intra- and Inter-organisation | Qualitative/ Case Study |
| Gerbin and Drnovsek (2020) | - | Trust | - | Intra- and Inter-organisation | Quantitative/ Survey |
| Kalar and Antoncic (2016) | - | Trust | - | Individual | Quantitative/ Survey |
| Leonchuk and Gray (2019) | Networks (size and strength) | Norms and values | - | Individual | Quantitative/ Quasi-Experimental Design |
| Mäkimattila, Junell, and Rantala (2015) | ✓ | ✓ | ✓ | Inter-organisation | Qualitative/ Case Study |
| Martínez-Cañas and Ruiz-Palomino (2010) | ✓ | ✓ | ✓ | Inter-organisation | Quantitative/ Survey |
| Philbin (2008) | Familiarity | Trust, commitment, and integration | Common understanding | Inter-organisation | Qualitative/ Interview |
| Pinheiro, Pinho, and Lucas (2015) | - | trust, and commitment | Shared interest | Intra- and Inter-organisation | Qualitative/ Interview |
| Robertson, McCarthy, and Pitt (2019) | Network (ties, configuration, and stability) | Trust | Shared (goals, and culture) | Inter-organisation | Review/ Theoretical |
| Steinmo (2015) | - | Trust, personal contact, and interaction | Common goals and mutual understanding | Individual, intra- and Inter-organisation | Qualitative/ Longitudinal Case Studies |
| Steinmo and Rasmussen (2018) | - | Reciprocity | Levels of general UIC experience and academic expertise | Inter-organisation | Qualitative/ Longitudinal Case Studies |
| Thomas and Paul (2019) | Network ties | Trust | Shared goals | Inter-organisation | Review/ Theoretical |
| Thune (2007) | Access to (information and opportunities) | Trust, reputation, status, and | Common understanding, | Inter-organisation | Qualitative/ Interview |

| Source | Structural Dimension | Relational Dimension | Cognitive Dimension | SC Level of Analysis | Methodology |
|---|---|---|---|---|---|
| | | mutual obligations | | | |
| Ting, Yahya, and Tan (2019a) | Assets of (network, relational, and participation) | Trust | - | Inter-organisation | Quantitative/ Survey |
| Ting, Yahya, and Tan (2019b) | Assets of (network, relational, and participation) | Trust | - | Inter-organisation | Quantitative/ Survey |
| Tootell et al. (2020) | - | Trust and commitment | Shared values | Inter-organisation | Qualitative/ Interview |
| Wei, Hui, and Yu-ning (2017) | ✓ | ✓ | ✓ | Inter-organisation | Quantitative/ Experimental Research |
| Yang (2016) | Personal (participation, and experience) | Trust, and promise | - | Inter-organisation | Quantitative/ Survey |
| Zhang and Wang (2017) | Network ties | Ties strength | - | Intra-organisation | Quantitative/ Survey (secondary data) |

**'✓'**= SC dimension was measured as a one construct
**'-'**= SC dimension was not considered in the measurement

# APPENDIX B: DSR Phase (2) Insights

Table B.1: A Summary of the Derived DRs Aligned with the SC Theoretical Lens

| |
|---|
| **The SC Structural Dimension \| Tie Strength** |
| DR1: The iUIC platform should facilitate the development and maintenance of solid ties through frequent interactions and resource sharing among stakeholders within the UIC ecosystem, fostering strong and sustainable connections while also enabling the formation of new, diverse connections (weak ties). |
| DR1.1: The iUIC platform should facilitate geographical connectivity, proximity-based local engagement, and global collaboration while enabling seamless integration with diverse organisational structures and decision-making processes. |
| DR1.2: The iUIC platform should support flexible collaboration models, accommodating various knowledge transfer and technology transfer activities in the UIC context while enabling seamless integration with diverse organisational structures and decision-making processes. |
| **The SC Structural Dimension \| Network Configurations** |
| DR2: The iUIC platform should provide a robust and flexible network infrastructure that enables establishing, managing, and optimising diverse network configurations among stakeholders within the UIC ecosystem. |
| DR2.1: The iUIC platform should facilitate the initiation and establishment of collaborative models among stakeholders, enabling seamless networking, partner discovery, and collaboration opportunities. |
| DR2.2: The iUIC platform should enable the exploration and pursuit of funding opportunities, additional income sources, and revenue streams, supporting stakeholders in securing resources and financial sustainability. |
| DR2.3: The iUIC platform should facilitate opportunities for discovery, enabling stakeholders to explore new research areas, technologies, career progression paths, and collaborative projects. |
| DR2.4: The iUIC platform should streamline administrative processes and facilitate communication and collaboration among stakeholders to address challenges related to university bureaucracy. |
| **The SC Structural Dimension \| Network Stability** |
| DR3: The iUIC platform should foster network stability and resilience within the UIC ecosystem, ensuring sustained and consistent collaboration among the UIC ecosystem. |
| **The SC Relational Dimension \| Trust** |
| DR4: The iUIC platform should foster trust, transparency, and mutual understanding among stakeholders within the UIC ecosystem, facilitating practical KT/TT activities. |
| DR4.1: The iUIC platform should facilitate networking, communication, and collaboration among stakeholders, including providing a dedicated space for showcasing and promoting work- |

integrated learning opportunities and supporting the building and maintaining long-term collaborative relationships within the UIC ecosystem.

DR4.2: The iUIC platform should incorporate co-branding and promotional tools to enable stakeholders to leverage co-branding opportunities, enhancing their visibility and reputation within the UIC ecosystem.

DR4.3: The iUIC platform should provide a resource-sharing platform that allows stakeholders to share and access resources, such as facilities, equipment, expertise, or data, based on mutual interests and benefits.

**The SC Relational Dimension | Identification**

DR5: The iUIC platform should incorporate features and mechanisms that promote a sense of belonging and shared identity among partners within the UIC ecosystem, thereby fostering trust, commitment, and a shared understanding of goals and values.

DR5.1: The iUIC platform should provide virtual spaces or forums for partners to interact, share experiences, and engage in collaborative activities, fostering a sense of community and shared purpose within the UIC ecosystem.

**The SC Relational Dimension | Social Norm**

DR6: The iUIC platform should facilitate the recognition and promotion of social norms that encourage and support such activities, fostering an environment conducive to productive collaborations.

DR6.1: The iUIC platform should incorporate features highlighting and promoting collaborative opportunities for academics to gain practical, industry-relevant experience, such as internships, project-based collaborations, or industry-sponsored research initiatives.

DR6.2: The iUIC platform should incorporate features that recognise and celebrate successful collaborations, achievements, and partners' contributions, fostering a sense of reputational gain and promoting the social norm of engagement for potential reputational benefits.

DR6.3: The iUIC platform should provide a dedicated space or feature highlighting and promoting community-focused and socially relevant collaborative projects, enabling partners to easily identify and engage in initiatives that align with their social norms and values.

DR6.4: The iUIC platform should include features that recognise and celebrate successful collaborations, achievements, and contributions of academic partners, such as an achievement showcase, awards, or public acknowledgments, to address the perceived lack of sufficient rewards and incentives for UIC accomplishments.

DR6.5: The iUIC platform should offer virtual collaboration spaces, mentoring programs, training resources, or other interactive features designed to enhance the interpersonal and collaboration skills of academic and industry partners, enabling them to overcome potential skill gaps and engage in more effective UIC collaborations.

**The SC Relational Dimension- Mutual Obligations**

DR7: The iUIC platform should facilitate the establishment and maintenance of mutual obligations between academic and industry partners, fostering a collaborative environment built on trust, commitment, and shared responsibility.

DR7.1: The iUIC platform should provide incentives and recognition mechanisms to encourage and reward the active participation of academics in UIC activities.

DR7.2: The iUIC platform should facilitate the identification, allocation, and management of both tangible resources (e.g., funding, infrastructure, equipment, personnel) and intangible resources (e.g., IP, data repositories, knowledge bases, collaborative networks) for KT/TT-UIC activities.

DR7.3: The iUIC platform should provide a talent pool and matchmaking functionality to connect UIC projects with suitable personnel from academia and industry.

**The SC Cognitive Dimension | Shared Culture**

DR8: The iUIC platform should facilitate establishing and maintaining a shared culture that fosters mutual understanding, aligns expectations, and promotes effective communication between academic and industry partners.

DR8.1: The iUIC platform should provide dedicated spaces for researchers and universities to comprehensively showcase their research, expertise, facilities, and capabilities, tailored to align with industry interests and priorities across regions and sectors, locally and globally, fostering mutual understanding, aligning expectations, and enhancing communication between academia and industry for effective collaborations.

**The SC Cognitive Dimension | Shared Goals**

DR9: The iUIC platform should facilitate establishing and aligning shared goals between academic and industry partners, enabling effective collaboration and reducing potential misunderstandings.

DR9.1: The iUIC platform should provide tools and mechanisms for academic and industry partners to collaboratively define, align, and track their research goals, milestones, and desired outcomes, fostering a shared understanding and reducing potential misinterpretations.

DR9.2: The iUIC platform should provide tools and features that enable academic and industry partners to align their interpretations of time frames, deadlines, and milestones, addressing differing interpretations of time frames.

Table B.2: A Summary of the Formulated DPs

**DP1:** The iUIC platform should offer a highly personalised and user-friendly interface to enable stakeholders to tailor their experience, preferences, and workflows to their specific needs, thus fostering usability and engagement within the UIC ecosystem.

**DP2:** The iUIC platform should offer flexible and adaptable collaboration activities and structures to enable stakeholders to dynamically configure and modify collaboration models and project structures, thus fostering adaptability to evolving UIC ecosystem requirements.

**DP3:** The iUIC platform should incorporate matchmaking capabilities to enable stakeholders to discover and connect with suitable partners and resources based on shared interests and projects, thereby fostering effective collaboration and resource utilisation within the UIC ecosystem.

**DP4:** The iUIC platform should provide mechanisms for contribution recognition and incentivisation to enable stakeholders to showcase accomplishments and be rewarded for their contributions, thereby fostering motivation and engagement within the UIC ecosystem.

**DP5:** The iUIC platform should provide multipurpose communication and interaction channels to enable stakeholders to seamlessly communicate, collaborate, and coordinate across various modes, thereby fostering effective communication and coordination within the UIC ecosystem.

**DP6:** The iUIC platform should implement digital co-creation and open innovation practices to empower stakeholders to develop innovative solutions collaboratively, thereby fostering innovation and collaborative problem-solving in addressing challenges across UIC ecosystems.

**DP7:** The iUIC platform should provide project and time management tools to enable stakeholders to plan, organise effectively, and track project timelines, milestones, and resource allocations, thus fostering efficient management of KT/TT-UIC activities within the UIC ecosystem.

**DP8:** The iUIC platform should establish a centralised repository for relevant data, information, and knowledge resources to enable stakeholders to access, contribute to, and leverage a comprehensive knowledge base, thereby fostering efficient collaborative knowledge and resource management within the UIC ecosystem.

**DP9:** The iUIC platform should incorporate advanced analytics and reporting capabilities to enable stakeholders to gain insights, track progress, provide feedback, and make data-driven decisions, thereby fostering effective decision-making and promoting continuous collaborative growth.

**DP10:** The iUIC platform should incorporate a practical experience module to enable engagement in real-world projects and integrated learning, thereby allowing stakeholders, including students and staff, to foster cultural convergence, develop skills, gain practical knowledge, and transfer knowledge within the UIC ecosystem, as follows:

~~**DP11:** The iUIC platform should integrate scalability and high performance with compliance and security measures to support growth and adapt to evolving requirements in a secure environment, thereby fostering trust, ensuring sustainability, and achieving regulatory compliance~~**, which is later updated in Phase (4) as follows:**

**DP11:** The iUIC platform should be designed for scalability, high performance, and continuous improvement to allow stakeholders to leverage a robust and future-proof platform that can

accommodate growth, evolving needs, and technological advancements, thus fostering long-term sustainability and adaptability.

**DP12:** The iUIC platform should implement robust compliance and security measures to allow stakeholders to operate within a secure and regulated environment, thus fostering trust, data protection, and adherence to relevant policies and regulations.

# APPENDIX C: The Feedback Questionnaire (Qualitative Tool)

Figure C.1: The Feedback Questionnaire | DSR (4)

iUIC

**Feedback Survey: "iUIC" Platform Prototype Evaluation**

**Leveraging Digital Platform-based Intermediation to Facilitate Knowledge and Technology Transfer Activities through University-Industry Collaboration (UIC): A Design Science Research Approach**

* Required

1. **Based on your initial experience with the iUIC platform prototype and your expectations for its full implementation, please indicate your level of agreement with the following statement:** *

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I believe it will be easy to regularly access the iUIC platform. | ○ | ○ | ○ | ○ | ○ |
| The user interfaces of the iUIC platform seem easy to use. | ○ | ○ | ○ | ○ | ○ |
| In my view, the iUIC platform will be important for our future collaboration needs. | ○ | ○ | ○ | ○ | ○ |
| The features and services presented in the iUIC platform are promising for fostering effective UIC. | ○ | ○ | ○ | ○ | ○ |
| I believe the iUIC platform will bring insightful and innovative changes to current UIC practices. | ○ | ○ | ○ | ○ | ○ |
| The iUIC platform inspires new ideas or methods for our practice. | ○ | ○ | ○ | ○ | ○ |
| I think that the guidance, tools, and actions offered by the iUIC platform are sufficient and can realistically be implemented in practice to help make decisions on collaboration opportunities. | ○ | ○ | ○ | ○ | ○ |
| I find that I can customise features and services in the iUIC platform to suit such collaboration needs. | ○ | ○ | ○ | ○ | ○ |
| Compared to our current practices, I believe that communication, productivity, and performance within the UIC ecosystem will greatly improve as a result of using the iUIC platform. | ○ | ○ | ○ | ○ | ○ |
| I am satisfied with the potential outcomes of the iUIC platform and would recommend this platform to relevant partners based on my initial experience. | ○ | ○ | ○ | ○ | ○ |

2. **Please share your insights on the services and features provided by the iUIC platform.** *

Enter your answer

3. **Please share any additional feedback or suggestions you have regarding the iUIC platform.** *

Enter your answer

Submit

# PART VI- REFERENCES

## References List

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