

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE
ENGINEERING AND TECHNOLOGY
DELFT UNIVERSITY OF TECHNOLOGY ★ GRADUATE SCHOOL

**INTERMEDIARIES IN THE ‘DESIGN FOR SUSTAINABILITY’ FIELD:
STRATEGIES FOR DEVELOPING SUPPORT MECHANISMS IN TURKEY**

Ph.D. THESIS

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Industrial Product Design Department

Industrial Product Design Doctorate Program

SEPTEMBER 2015

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SEPTEMBER 2015

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ENSTİTÜSÜ

**‘TASARIM İÇİN SÜRDÜRÜLEBİLİRLİK’ ALANINDA ARACI KURUMLAR:
TÜRKİYE’DE İNOVASYON DESTEK MEKANİZMALARI GELİŞTİRMEK
İÇİN STRATEJİLER**

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To my family and friends,

FOREWORD

This research has been undertaken as a joint PhD collaboration between Istanbul Technical University (ITU) and Delft University of Technology (DUT) with the co-supervision of professors from both universities. The researcher worked at DUT during two semesters, Fall of 2011 and Spring of 2013. During other semesters, she attended regular meetings with her promoters.

The ITU Fund and the Scientific and Technological Research Council of Turkey financed the researcher's visits to DUT in 2011 and 2013, respectively. In addition, related to this PhD, in December of 2012, ITU hosted an "international design meeting" funded by the strategic program Dutch Design Fashion Architecture (2009-2012). As part of the event, undergraduate and graduate students attended lectures and a workshop led by academics from DUT with the aim to share knowledge and experience between DUT and ITU.

Istanbul Technical University made important contributions to the work described in this dissertation.

September 2015

Elif KÜÇÜKSAYRAÇ

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ABBREVIATIONS

BU	: Boğaziçi University
BU – SDSCPC	: Boğaziçi University, Sustainable Development and Cleaner Production Center
DUT	: Delft University of Technology
DUT-DFS	: Design for Sustainability Program at Delft University of Technology
METU	: Middle East Technical University
TÜBİTAK	: The Scientific and Technological Research Council of Turkey
TTGV	: Technology Development Foundation of Turkey
UN	: United Nations
UNEP	: United Nations Environment Program
OECD	: Organisation for Economic Co-operation and Development

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INTERMEDIARIES IN THE ‘DESIGN FOR SUSTAINABILITY’ FIELD: STRATEGIES FOR DEVELOPING INNOVATION SUPPORT MECHANISMS IN TURKEY

SUMMARY

This joint PhD study between Istanbul Technical University and Delft University of Technology explores the innovation support for companies working on design for sustainability. As design for sustainability is not yet developed in Turkey, this study investigates the innovation support needs of companies working on design for sustainability, how these needs can be fulfilled and how to enable further spreading of the design for sustainability approach throughout the industry in Turkey. By these means, the dissertation aims to contribute both to Turkey’s sustainable development and to theory in the fields of design, innovation and sustainability. More specifically, this study has a research aim to investigate innovation support for companies working on design for sustainability and a societal aim to spread the design for sustainability approach throughout the industry in Turkey by supporting the companies’ innovation processes.

The literature review is presented mainly in two sections; the conceptual background focuses on the design for sustainability concept, while the theoretical background focuses on the innovation systems theory.

Design for sustainability is defined as “industries taking environmental and social concerns along with economic concerns as key elements in their long term innovation strategy and incorporating related factors into their product-service-system development throughout the supply chain and also the life cycle of the product” (based on Crul & Diehl, 2006). This thesis reviews various approaches within design for sustainability, the specific roles of designers in sustainability, design for sustainability implications in companies, and its practice in Turkey.

The theoretical basis for the study, innovation systems, are defined as “the network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies” (Freeman, 1987). This dissertation utilizes a functional approach to innovation systems (see Hekkert et al., 2007; Bergek et al., 2008). In relation to innovation systems, design innovation processes, intermediaries, universities’ intermediary role and intermediaries in the design for sustainability field are explored.

Intermediaries are called “providers of innovation support” (EC, 2009a), and they function as brokers between the various actors of an innovation system: “companies, universities and research institutes, and political arrangements that support innovation” (Van Lente et al, 2003). Intermediaries are important for creating new possibilities and dynamism within an innovation system, along with improving its connectedness (Howells, 2006). Types and functions of intermediaries are listed in several studies and policy reports (Van Lente et al., 2003; Howells, 2006; Klerkx & Leeuwis, 2008; EC, 2009a). Moreover, some studies investigate universities as

knowledge intermediaries (e.g., EC, 2009a), or as taking on temporary intermediary roles (e.g., Cook et al., 2006). The link between design innovation and intermediaries is established via design consultancy companies, called “brokers of technology” (Hargadon, 2002). However, only a few studies investigate intermediaries working in the sustainability field (e.g., O’Rafferty & O’Connor, 2010; Keskin et al., 2013).

Following the literature review, the initial research questions are answered, the literature gaps are defined and the research questions are revised as follows:

1. What is the state of the art of companies’ design for sustainability practices in Turkey?
2. How do some companies in Turkey succeed in implementing design for sustainability despite the barriers?
3. What is the state of the art of innovation support for design for sustainability in developed countries and in Turkey?
4. What is the intermediary role of universities in diffusing design for sustainability into the industry?
5. What is the role of designers in the innovation support for design for sustainability?
6. How should companies in Turkey be supported in their innovation processes for applying design for sustainability?

To be able to answer these research questions, multiple empirical studies are designed. Five separate and interrelated empirical studies are carried out, consisting of a qualitative approach and multiple methods. The research strategy followed is to explore and explain the state of the art, learn from best examples, draw strategies based on findings and develop them further with expert opinions.

In the first empirical study, design for sustainability activities of the 26 best performing companies in Turkey are explored through a questionnaire. The second empirical study, which follows the first empirical study, relies on in-depth case studies of one large and one small company to explore how best practice companies in Turkey apply design for sustainability despite barriers. The third empirical study investigates the innovation support for design for sustainability through case studies of 14 intermediaries from the Netherlands, the United Kingdom and Turkey.

The fourth empirical study aims to complement the third one, by exploring the intermediary role of universities in diffusing design for sustainability into the industry through one case study from the Netherlands and two case studies from Turkey. The fifth empirical study builds upon the preceding empirical studies and proposes strategies for diffusing design for sustainability into the industry in Turkey. The strategies are discussed and further improved following interviews with seven experts from Turkey and Europe. As the focus, case, method, and theoretical contribution of each empirical study varies, each empirical study might be of interest to different types of readers.

Based on findings from the empirical studies, one theoretical contribution raised addresses the relationships between the innovation system’s actors as consisting not only of interactions, but also of interchanging roles. Other contributions of the thesis include a framework of intermediaries supporting all possible company needs related to design for sustainability, and explaining the different types of outreach activities

carried out by universities in the design for sustainability field. Moreover, by explaining the design for sustainability practices of best performing companies and developing strategies for diffusing design for sustainability into the industry in Turkey, the study aims to build a background for future projects both in Turkey and in other regions with similar conditions regarding design for sustainability. Finally, recommendations are drawn for various types of readers – policy makers, intermediaries, companies, academics and designers.

‘TASARIM İÇİN SÜRDÜRÜLEBİLİRLİK’ ALANINDA ARACI KURUMLAR: TÜRKİYE’DE İNOVASYON DESTEK MEKANİZMALARI GELİŞTİRMEK İÇİN STRATEJİLER

ÖZET

İstanbul Teknik Üniversitesi ve Delft Teknoloji Üniversitesi’nde yürütülen bu ortak doktora çalışması, Türkiye’de henüz gelişmemiş olan “sürdürülebilirlik için tasarım” alanında firmalar için inovasyon desteği üzerine odaklanmaktadır. Bu çalışma, Türkiye’deki firmaların tasarım ve sürdürülebilirlikle ilgili destek ihtiyaçlarını, bu ihtiyaçların nasıl giderilebileceğini ve sürdürülebilirlik için tasarım yaklaşımının Türkiye’de endüstriye nasıl yayılabileceğini araştırmaktadır. Çalışma, hem Türkiye’nin sürdürülebilir kalkınmasına, hem de tasarım, inovasyon ve sürdürülebilirlik alanlarında literatüre katkıda bulunmayı amaçlamaktadır. Daha spesifik olarak, bu çalışmanın araştırma amacı, sürdürülebilirlik için tasarım üzerine firmalar için inovasyon desteğini irdelemek ve toplumsal amacı, sürdürülebilirlik için tasarımın Türkiye’deki endüstriye firmaların inovasyon süreçlerini destekleyerek yayılmasıdır.

Literatür araştırması iki ana bölümde sunulmuştur, kavramsal zemin, sürdürülebilirlik için tasarım kavramı üzerine ve teorik zemin, inovasyon sistemleri teorisi üzerine odaklanmaktadır.

Sürdürülebilirlik için tasarım, “endüstrinin, ekonomik kaygılar kadar çevresel ve sosyal kaygıları da uzun süreli inovasyon stratejilerinin kilit esası olarak alması ve ilgili faktörleri tedarik zinciri ve ürün yaşam döngüsünü kapsayan ürün-servis-sistem geliştirmeye dahil etmeleri” olarak tanımlanmıştır (Crul & Diehl, 2006’ya dayanarak). Literatür araştırmasında, sürdürülebilirlik için tasarım üzerine çeşitli yaklaşımlar, tasarımcıların sürdürülebilirlikteki rolleri, spesifik olarak sürdürülebilirlik için tasarımın firmalardaki etkileri ve Türkiye’deki uygulamalar irdelenmiştir.

Çalışmanın teorik temeli olan inovasyon sistemleri, “aktiviteleri ve etkileşimleri yeni teknolojileri başlatan, aktaran, modifiye eden ve yayan kamu ve özel kurum ağları” olarak tanımlanmaktadır (Freeman, 1987). Bu çalışmada inovasyon sistemleri irdelenirken fonksiyonel bir yaklaşımdan faydalanılmıştır (bkz. Hekkert vd., 2007; Bergek vd., 2008). İnovasyon sistemleriyle ilgili olarak tasarım inovasyonu süreçleri, aracı kurumlar, üniversitelerin aracı rolleri ve spesifik olarak sürdürülebilirlik için tasarım alanındaki aracı kurumlar irdelenmiştir.

Aracı kurumlar literatürde “inovasyon desteği sağlayıcıları” olarak anılmaktadır (EC, 2009a) ve inovasyon sistemlerinin farklı aktörleri olan firmalar, üniversiteler ve araştırma kurumları, ve de inovasyon destekleyen politik düzenlemeler arasında simsar işlevi görmektedir (Van Lente vd., 2003). Aracı kurumların değeri, inovasyon sistemlerinin bağlantılılığını iyileştirirken sistem içinde yeni olasılıklar ve dinamiklik yaratmaktır (Howells, 2006). Aracı kurumların tipleri ve fonksiyonları çeşitli araştırma ve raporlarda sıralanmıştır (Van Lente vd., 2003; Howells, 2006; Klerkx &

Leeuwis, 2008; EC, 2009a). Ayrıca bazı çalışmalar üniversiteleri bilgi aracı kurumu olarak (EC, 2009a), bazıları ise geçici aracı kurum rolleri üstlendikleri şeklinde (Cook vd., 2006) incelemektedir. Tasarım inovasyonu ve aracı kurumlar arasındaki bağ, “teknoloji simsarı” olarak adlandırılan tasarım danışmanlık firmaları ile kurulmaktadır (Hargadon, 2002). Lakin, sürdürülebilirlik için tasarım alanında çalışan aracı kurumları irdeleyen az sayıda çalışma bulunmaktadır (örn. O’Rafferty & O’Connor, 2010; Keskin vd., 2013).

Literatür araştırmasını takiben, başlangıç araştırma soruları cevaplanmış, literatürdeki boşluklar belirlenmiş ve araştırma soruları aşağıdaki gibi revize edilmiştir:

1. Türkiye’deki firmaların sürdürülebilirlik için tasarım pratiklerinin son durumu nedir?
2. Bazı firmalar, mevcut engellere rağmen, sürdürülebilirlik için tasarım uygulamalarında nasıl başarılı olmaktadır?
3. Gelişmiş ülkelerde ve Türkiye’de sürdürülebilirlik için tasarım üzerine inovasyon desteğinin son durumu nedir?
4. Üniversitelerin sürdürülebilirlik için tasarımı endüstriye yaymada aracı kurum rolü nedir?
5. Tasarımcıların sürdürülebilirlik için tasarım üzerine inovasyon desteklerindeki rolü nedir?
6. Türkiye’deki firmaların inovasyon süreçlerinde sürdürülebilirlik için tasarımı uygulamaları için nasıl desteklenmelidir?

Bu araştırma sorularını yanıtlayabilmek için birden fazla ampirik çalışma tasarlanmıştır. Beş ayrı ve bağlantılı ampirik çalışma, nitel bir yaklaşım ve çoklu metoddan faydalanarak yürütülmüştür. Takip edilen araştırma stratejisi, son durumu keşfetme ve açıklama, iyi örneklerden öğrenme, bulgulara dayanan stratejiler önerme ve bu stratejileri uzman görüşleri ile geliştirme şeklindedir.

Birinci ampirik çalışmada, 26 örnek gösterilen firmanın sürdürülebilirlik için tasarım pratikleri bir anket yardımıyla irdelenmiştir. İkinci ampirik çalışma ilk çalışmayı takip ederek, Türkiye’de örnek gösterilen firmaların sürdürülebilirlik için tasarımı engellere rağmen nasıl uyguladıklarını, bir büyük ve bir küçük ölçekli firma üzerine yapılan vaka çalışmaları ile irdelemektedir. Üçüncü ampirik çalışma, sürdürülebilirlik için tasarım üzerine inovasyon desteğini Hollanda, Birleşik Krallık ve Türkiye’den 14 aracı kurum üzerine yapılan vaka çalışması ile irdelemektedir. Dördüncü ampirik çalışma, sürdürülebilirlik için tasarımın endüstriye yayılmasında üniversitelerin aracı kurum rollerini Hollanda’dan bir, Türkiye’den iki vaka analizi ile irdelemektedir ve üçüncü çalışma ile bütün oluşturmayı hedeflemektedir. Beşinci ampirik çalışma, sürdürülebilirlik için tasarımın Türkiye’deki endüstriye yayılması için önceki ampirik çalışmaların bulgularına dayanan stratejiler önermektedir. Stratejiler, Türkiye ve Avrupa’dan yedi uzman ile tartışılarak geliştirilmiştir. Ampirik çalışmaların odağı, örnekleme, metodu ve teorik katkısı farklı olduğu için, her ampirik çalışma farklı tip okuyucuları hedeflemektedir.

Ampirik çalışmaların bulgularına dayanarak ortaya koyulan teorik katkılardan biri, inovasyon sistemi aktörlerinin sadece etkileşimde bulunmadığı, aynı zamanda rollerini değiştirdiğidir. Çalışmanın diğer katkıları, firmaların olası tüm sürdürülebilirlik için tasarım ihtiyaçlarını karşılayacak aracı kurumlar için bir

çerçeve önermesi ve üniversitelerin sürdürülebilirlik için tasarım alanında endüstri ilişkileri aktivitelerini ve bunların çeşitlerini açıklamasıdır. Çalışma ayrıca, Türkiye’de örnek gösterilen firmaların sürdürülebilirlik için tasarım pratiklerini açıklamış ve endüstriye sürdürülebilirlik için tasarımın yaygınlaştırılması için stratejiler önermiştir. Araştırma bulgu ve sonuçları hem Türkiye’de hem de sürdürülebilirlik için tasarım açısından benzer şartlara sahip ülkelerdeki gelecek projeler için altyapı oluşturabilir. Son olarak, politikacılar, aracı kurumlar, firmalar, akademisyenler ve tasarımcılar gibi farklı tip okuyucular için öneriler sunulmuştur.

INTERMEDIAIRE ORGANISATIES OP HET GEBIED VAN 'DUURZAAM ONTWERPEN': STRATEGIEËN VOOR DE ONTWIKKELING VAN MECHANISMEN VOOR INNOVATIEONDERSTEUNING IN TURKIJE

SAMENVATTING

Dit promotieonderzoek, dat gecombineerd is uitgevoerd bij de Istanbul Technical University en de Technische Universiteit Delft, richt zich op innovatieondersteuning voor bedrijven bij duurzaam ontwerpen. Een onderwerp dat in Turkije nog niet ontwikkeld is. De studie heeft de ondersteuningsbehoeftes van bedrijven in Turkije in kaart gebracht, heeft geïnventariseerd hoe deze behoeftes vervuld kunnen worden en hoe de duurzaam ontwerpen benadering kan worden gedissemineerd in de Turkse industrie. Op deze manier streeft dit project erna om bij te dragen aan zowel de duurzame ontwikkeling van Turkije, als aan de theorie aangaande design, innovatie en duurzaamheid. Meer specifiek heeft deze studie het wetenschappelijke doel om innovatieondersteuning voor bedrijven bij duurzaam ontwerpen te onderzoeken en het maatschappelijke doel om de duurzaam ontwerp benadering te dissemineren in de Turkse industrie door bedrijven te ondersteunen bij innovatie processen.

De literatuurstudie beslaat twee delen, die focussen op de conceptuele basis – het concept duurzaam ontwerpen en de theoretische basis – de theorie van innovatiesystemen.

Duurzaam ontwerpen is gedefinieerd als “industrieën die mileukundige en sociale belangen als sleutelaspecten meenemen naast economische belangen in hun lange termijn innovatiestrategie en die gerelateerde factoren incorporeren in de ontwikkeling van hun product-diensten-systeem, over de gehele keten en ook over de hele levenscyclus van hun producten” (gebaseerd op Crul & Diehl, 2006). Het overzicht dekt de verschillende benaderingen binnen duurzaam ontwerpen, de specifieke rollen van ontwerpers binnen duurzaamheid, de implicaties van duurzaam ontwerpen binnen bedrijven, en de huidige praktijk in Turkije.

De theoretische basis van de studie – innovatiesystemen, worden gedefinieerd als “het netwerk van instituties in het publieke en private domein, wiens activiteiten en interacties de basis vormen voor het initiëren, importeren, aanpassen en verspreiden van nieuwe technologieën” (Freeman, 1987). In de studie wordt een functionele benadering van innovatiesystemen gebruikt (zie Hekkert et al., 2007; Bergek et al., 2008). In relatie tot innovatiesystemen zal worden gekeken naar designinnovatieprocessen, intermediaire organisaties, de intermediaire rol van universiteiten en de intermediaire organisaties in het veld van duurzaam ontwerpen.

Intermediaire organisaties worden ook wel “leveranciers van innovatieondersteuning” genoemd (EC, 2009a), en zij functioneren als tussenpersonen tussen de verscheidene partijen binnen een innovatiesysteem; bedrijven, universiteiten en onderzoeksinstellingen, en politieke regelingen die innovatie ondersteunen (Van Lente et al., 2003). De waarde van intermediairs ligt in het creëren van nieuwe mogelijkheden en dynamieken binnen een innovatiesysteem,

naast het verbeteren van onderlinge verbindingen (Howells, 2006). Verschillende studies en beleidsrapporten hebben onderscheid gemaakt naar typen en functies van intermediairs (Van Lente et al., 2003; Howells, 2006; Klerkx & Leeuwis, 2008; EC, 2009a). Bovendien zijn er studies die kijken naar de rol van universiteiten als kennisintermediair (e.g., EC, 2009a), en naar het tijdelijk aannemen door universiteiten van intermediairfuncties (e.g., Cook et al., 2006). De link tussen designinnovatie en intermediairs wordt gevormd door ontwerp bureaus, die ook wel “makelaars van technologie” genoemd (Hargadon, 2002). Er zijn echter maar weinig studies naar intermediairs in het duurzaamheidsveld (e.g., O’Rafferty & O’Connor, 2010; Keskin et al., 2013).

Op basis van de review worden de initiële onderzoeksvragen beantwoord, de gaten in de literatuur worden benoemd en de onderzoeksvragen worden als volgt geherformuleerd:

1. Wat is de stand van de techniek van duurzaam ontwerpen binnen bedrijven in Turkije?
2. Hoe lukt het sommige bedrijven om duurzaam ontwerpen succesvol te implementeren, ondanks de barrières?
3. Wat is de stand van de techniek in innovatieondersteuning voor duurzaam ontwerpen in ontwikkelde economiën en in Turkije?
4. Wat is de intermediaire rol van universiteiten in het verspreiden van duurzaam ontwerpen in de industrie?
5. Wat is de rol van ontwerpers in de innovatieondersteuning aangaande duurzaam ontwerpen?
6. Hoe moeten bedrijven in Turkije worden ondersteund bij het implementeren van duurzaam ontwerpen in hun innovatieprocessen?

Meerdere empirische studies zijn opgezet om deze onderzoeksvragen te kunnen beantwoorden. Vijf verschillende, maar gerelateerde, empirische studies zijn uitgevoerd met een kwalitatieve benadering en verschillende methodes. De gevolgde onderzoeksopzet was om de stand van de techniek in kaart te brengen, te leren van best practices, om vervolgens de verkregen inzichten te vertalen in strategieën en deze verder te ontwikkelen op basis van expertconsultaties.

In de eerste empirische studie zijn de activiteiten met betrekking tot duurzaam ontwerpen van 26 als beste geïdentificeerde bedrijven in Turkije geanalyseerd door middel van een vragenlijst. De tweede empirische studie volgt de eerste, door diepte case studies van een groot en een klein bedrijf die ondanks de barrières duurzaam ontwerpen. De derde empirische studie richt zich op de innovatieondersteuning voor duurzaam ontwerpen op basis van case studies onder 14 intermediaire organisaties uit Nederland, het Verenigd Koninkrijk en Turkije.

De vierde empirische studie complementeert de derde door dieper in te gaan op de intermediaire rol van universiteiten in het verspreiden van duurzaam ontwerpen in de industrie. Dit gebeurt door middel van een case studie uit Nederland en twee uit Turkije. De vijfde empirische studie is gebaseerd op de eerdere empirische studies en stelt strategieën voor het verspreiden van duurzaam ontwerpen binnen de Turkse industrie. De strategieën zijn doormiddel van expertconsultaties met zeven experts uit Turkije en Europa verder verbeterd. Aangezien de focus, de cases, de methodes

en de theoretische bijdrage van elke empirische studie afwijkt, zal elk van de studies interessant zijn voor een ander lezerspubliek.

Een theoretische bijdrage die op basis van de empirische studies kan worden gemaakt is dat de verschillende actoren in het innovatiesysteem niet alleen relaties onderhouden, maar soms ook van rol verwisselen. Een andere bijdrage van dit proefschrift is het voorgestelde framework van intermediaire organisaties dat alle mogelijke behoeften van bedrijven aangaande duurzaam ontwerp kan bieden. Een derde bijdrage ligt in het beter begrijpen van de valorisatieactiviteiten van universiteiten en de verschillende vormen daarvan op het vlak van duurzaam ontwerpen. Bovendien geeft deze studie inzicht in het stand van de techniek aangaande duurzaam ontwerpen bij enkele van de best presterende bedrijven in Turkije, en zijn strategieën ontwikkeld om duurzaam ontwerpen verder te verspreiden onder de Turkse industrie. Deze studie kan een basis vormen voor vervolgstudies in Turkije, evenals vervolgstudies in regio's die qua duurzaam ontwerpen vergelijkbaar zijn. Tot slot zijn aanbevelingen geformuleerd voor de verschillende lezersgroepen – beleidsmakers, intermediaire organisaties, academici en ontwerpers.

1. INTRODUCTION

The main focus of this study is innovation support for companies working on design for sustainability, which is not yet developed in Turkey. The study aims to investigate the innovation support needs of companies in Turkey regarding design for sustainability, how these needs can be fulfilled and, eventually, how the design for sustainability approach can be spread into the industry in Turkey. By these means, the study aims to contribute both to the sustainable development of Turkey and to theory in the fields of design, innovation and sustainability.

Sustainable development is one of the fundamental issues addressed by the United Nations (UN, 2015). Its original definition is still widely accepted; “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN, 1987). Sustainable development offers progress on global issues of peace, freedom, development, and environment (UN, 2013). It is a challenging and dynamic concept and should be developed continuously along with evolving experience and understanding (Moldan & Dahl, 2007). Moreover, it requires an interdisciplinary approach, and is of high complexity (Baumgartner, 2011).

Sustainable consumption and production and design for sustainability are among the sustainability approaches (Glavic & Lukman, 2007). The sustainable consumption and production approach embraces design for sustainability, along with many concepts including cleaner production, resource efficiency, waste management, sustainable transportation, and eco-labeling and certification (UNEP, 2010). Design has a pivotal role in sustainable consumption and production (Spangenberg et al., 2010), while having developed its own methods, tools and practices. The United Nations Environment Programme (UNEP) published several manuals on design for sustainability (e.g., Manzini & Vezzoli, 2002; Crul & Diehl, 2006).

Companies need innovation support because the implementation of the design for sustainability approach into their innovation processes is challenging. The barriers

that companies face during the implementation of design for sustainability were investigated by numerous studies in various countries (e.g., Tukker et al., 2000; Van Hemel & Cramer, 2002).

The support providers in an innovation system are intermediaries, which function as middlemen among various actors such as companies, universities and the government (Howells, 2006; EC, 2009a). Intermediaries vary in organization type and the services they provide (see Howells, 2006). They utilize various approaches, which are usually studied by relying on innovation systems theory (e.g., Van Lente et al., 2003; Howells, 2006; Klerkx & Leeuwis, 2009). Intermediaries play an important role in spreading a concept, such as design for sustainability, into the industry and society.

1.1 Design for Sustainability Implementation by the Industry in Turkey

The Republic of Turkey is one of the founding members of United Nations and began “full membership negotiations” with the European Union in 2005. Turkey’s economy is the 17th largest in the world and has been growing at a steady pace in recent years. Its population is above 75 Million and has a GDP per capita of 10,497 US\$ (UNDP-TR, 2015).

Many indicators have been developed to assess the sustainability capacity of countries. Among these, two indicators are utilized to build a dynamic map that shows the sustainable development of countries. These indicators are “the Ecological Footprint” and “the Human Development Index”. The Ecological Footprint was developed by the Global Footprint Network and measures biocapacity against humanity’s demand on nature (EF, 2007). The Human Development Index was developed by the United Nations Development Programme (UNDP) and measures “a country’s average achievements in the areas of health, knowledge, and standards of living” (HDI, 2007). The dynamic map illustrates sustainable development progress by each country between 1980 and 2007 (EF, 2007). One snapshot of the dynamic map depicting sustainable development figures for 2007 is shown in Figure 1.1. In the figure each grey circle represents a country. In addition, Turkey’s stages of sustainable development between 1980 and 2007 are connected with a line and its 2007 capacity marked with a black circle. The map visualizes the goal of sustainable development for countries in the area in the bottom right-hand corner named “Goal”.

It can be achieved by increasing the Human Development Index and decreasing the Ecological Footprint. Figure 1.1 indicates that while the Human Development Index has been increasing in Turkey as aimed, the Ecological Footprint has been increasing as well, although the aim is to decrease it.

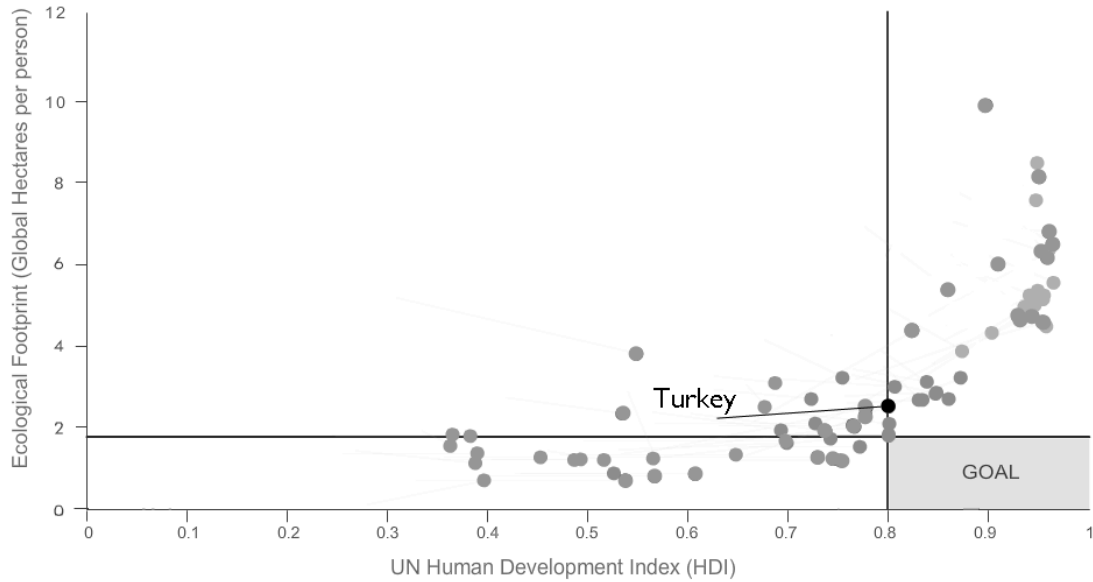


Figure 1.1 : Sustainable development of countries (EF, 2007).

Developing capacity on sustainable consumption and production has been discussed in Turkey since the late 1990s (TTGV & TÜBİTAK, 1999), but its development has been slow until recent years. In 2010, a comprehensive report (TR-MoEF & TTGV, 2010) investigated the conditions for sustainable consumption and production in Turkey, also emphasizing the importance of design for sustainability. The report indicates that sustainable consumption and production infrastructure and practices in Turkey are insufficient. Compared to the support mechanisms available in the European Union, the ones in Turkey are limited in both quantity and variety. Nevertheless, accession negotiations between Turkey and the European Union and the available related programs are important drivers for Turkey’s sustainable development practices.

1.2 Problem Definition

For companies, applying sustainable development approaches such as design for sustainability beyond the aim of fulfilling the legislation is mainly “voluntary”, as they can choose whether to engage in these strategies and can abandon them at any time (UNGC, 1999; Lozano, 2012). Regulations and market demand are cited among

the most important drivers for companies to practice design for sustainability, whereas internal drivers, such as creating opportunities for innovation and increasing product quality, are found to be stronger stimuli than the external drivers (Van Hemel & Cramer, 2002).

The findings from previous studies that investigated design for sustainability practices of companies in Turkey (Gaziulusoy, 2003; Erişmiş, 2007; Gürakar et al., 2008; Selek, 2008) are parallel to the findings of sustainable consumption and production studies (TR-MoEF & TTGV, 2010). They indicate the inadequacy of the companies' awareness and practices. However, one can observe, in Turkey, that some companies invest their resources in design for sustainability, and when they do they make an impact. However, the question of how these companies do integrate design for sustainability into their strategies remains unanswered.

Another problem is that design for sustainability is a new approach for Turkey, as indicated by both the studies that examine industrial design education (Erkaslan, 2013) and the low number of available best practice examples (CP/RAC, 2012). Therefore, even if the legislation is adequately advanced to spread implementation of design for sustainability into the industry, capacity needs to be built.

Furthermore, in order to spread sustainable development approaches into the industry, support mechanisms are needed. The actors that provide support to companies in an innovation system are intermediaries. The literature on intermediaries focuses on their various roles and approaches (e.g., Howells, 2006; EC, 2009a), however, the experiences in practice and approaches on specific issues such as design for sustainability are underexplored and intermediaries that solely focus on design for sustainability are scarce even in countries considered as advanced in the field.

1.3 Research Aim and Initial Research Questions

This study has the research aim to investigate innovation support for companies working on design for sustainability and the societal aim to spread the design for sustainability approach into the industry in Turkey by supporting the companies' innovation processes. To reach these aims, the following four initial research questions (Initial RQs) are determined for investigation:

- Initial RQ 1 What is the state of the art of companies' design for sustainability practices in Turkey?
- Initial RQ 2 What is the state of the art of innovation support for design for sustainability in developed countries and in Turkey?
- Initial RQ 3 What is the role of designers in innovation support for design for sustainability?
- Initial RQ 4 How should companies in Turkey be supported in their innovation processes for applying design for sustainability?

1.4 Research Strategy and Methods

This study examines several interdisciplinary fields, mainly design, innovation and sustainability. For reducing the complexity, and considering the university departments in which this thesis is carried out, rather than discussing the dynamic nature of sustainability approaches, design for sustainability is utilized as the focus approach on sustainable development in this study. It is a state-of-the-art approach, promoted by the United Nations through its published manuals (e.g., Crul & Diehl, 2006; Crul et al., 2009b). Nonetheless, the study also covers closely-related approaches such as sustainable consumption and production, whenever they are interwoven.

Innovation systems theory, which is foundational for the study, is widely utilized at the international policy level such as by the Organisation for Economic Co-operation and Development (OECD, 1997; Edquist, 1997; Sharif, 2006) and also in studies on intermediaries and innovation support (Van Lente et al., 2003; Howells, 2006; Klerkx & Leeuwis, 2009). Again, to reduce complexity, the study focuses on two actors within innovation systems, companies and intermediaries, which form the demand and supply side of innovation support, respectively. Nonetheless, other actors of innovation systems, such as universities, are also investigated, whenever they play a role in innovation support.

The preliminary research approach is presented in a conceptual model shown in Figure 1.2. Companies carry out an innovation process to achieve sustainable

product-service-systems outputs. A sustainable product-service-system is the combination of tangible products and intangible services in a system that satisfies the needs of users (Mont, 2002; Tukker & Tischner, 2006). Two arrows in the model represent the two processes: Innovation and innovation support for design for sustainability. Industrial designers are connected to the companies either as in-house or as external design consultants. Also, according to company needs during the innovation process, intermediaries supply them with innovation support for design for sustainability. The first two research questions investigate the demand side and the next two investigate the supply side of innovation support. The conceptual model will be revised following the literature review and the findings from the empirical studies.

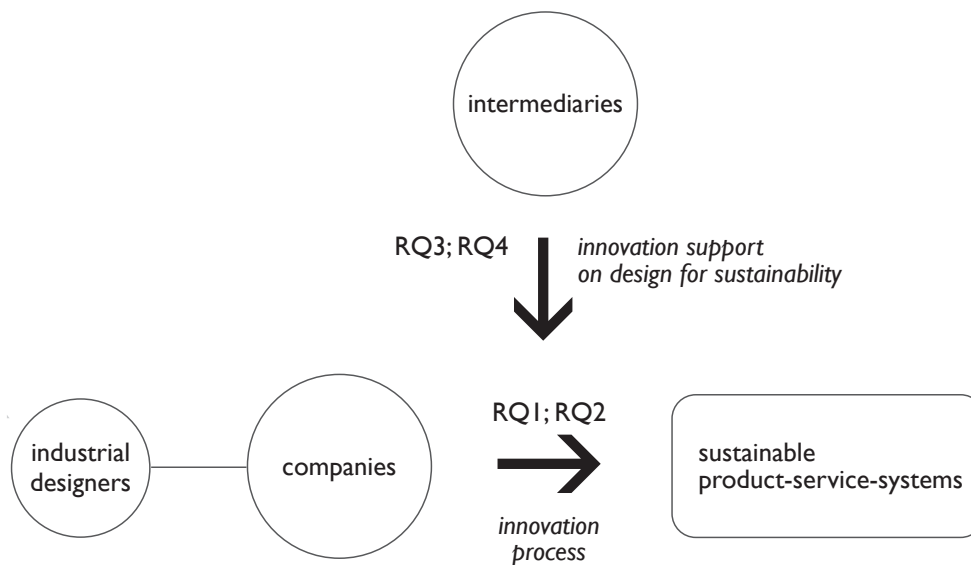


Figure 1.2 : The preliminary conceptual model and research questions that will be developed further via literature review and empirical studies.

The research strategy followed in this study consists of exploring and explaining the state of the art, learning from best examples, drawing strategies based on findings and developing them further with expert opinions. More specifically, firstly the current situation of companies' sustainability practices in Turkey are explored and explained. Next, national and international best practices and experts, including companies, intermediaries, and academics are investigated with the aim to learn from them. Based on the findings, strategies for spreading design for sustainability into the industry in Turkey are proposed. And lastly, strategies are developed further and validated by national and international experts.

Following the literature review and revision of the research questions, the research stages are investigated in five separate and interrelated empirical studies, for which multiple methods are utilized according to the research questions and the data available. While the first four empirical studies are exploratory and explanatory, the final empirical study synthesizes the findings in previous empirical studies. This final empirical study is used to propose strategies. The research strategy is elaborated further in the corresponding chapter and the methods of each empirical study are elaborated in the chapter reporting it.

While the cases in the first two empirical studies are from Turkey, the cases and experts referenced in the other empirical studies are from various European countries, mostly from the Netherlands. European countries were selected because of several related studies carried out in the design for sustainability field (e.g., Van Hemel & Cramer, 2002), as the literature describes some European-based intermediaries as advanced (Van der Meulen & Rip, 1998; Howells, 2006), and as the accession negotiations between Turkey and European Union are an important driver for Turkey in its sustainable development practices (TR-MoEF & TTGV, 2010). Besides, instead of carrying out a sustainability assessment of processes, cases that had already been assessed by eminent national and international organizations and cited as good examples of sustainability practice were selected.

1.5 Thesis Outline and Reader's Guide

The outline of the thesis, and the relationship between the empirical studies and the countries they investigated are presented in Figure 1.3. The first three chapters ENCOMPASS the introduction, conceptual and theoretical background and the research strategy. The following five chapters describe the empirical studies. The empirical studies were carried out in three groups. The first two empirical studies (Chapter 4-5) explore the demand side of innovation support – the companies. Chapter 4 discusses the survey for investigating 26 companies in Turkey and Chapter 5 investigates the product development processes of two of these companies in depth through case studies. The next two empirical studies (Chapter 6-7) explored the supply side of innovation support – the intermediaries. Chapter 6 and 7 complement each other for understanding innovation support, by investigating intermediaries as the usual actors that provide it and universities as temporary providers. And the last

empirical study (Chapter 8) synthesizes the findings of previous empirical studies (Chapter 4-7), builds strategies for achieving the aim of the study, develops the strategies further and validates them via expert opinions. Finally, in the Conclusions (Chapter 9), the research contributions to the practice and theory are discussed, and recommendations are drawn for various types of readers – policy makers, intermediaries, companies, academics and designers.

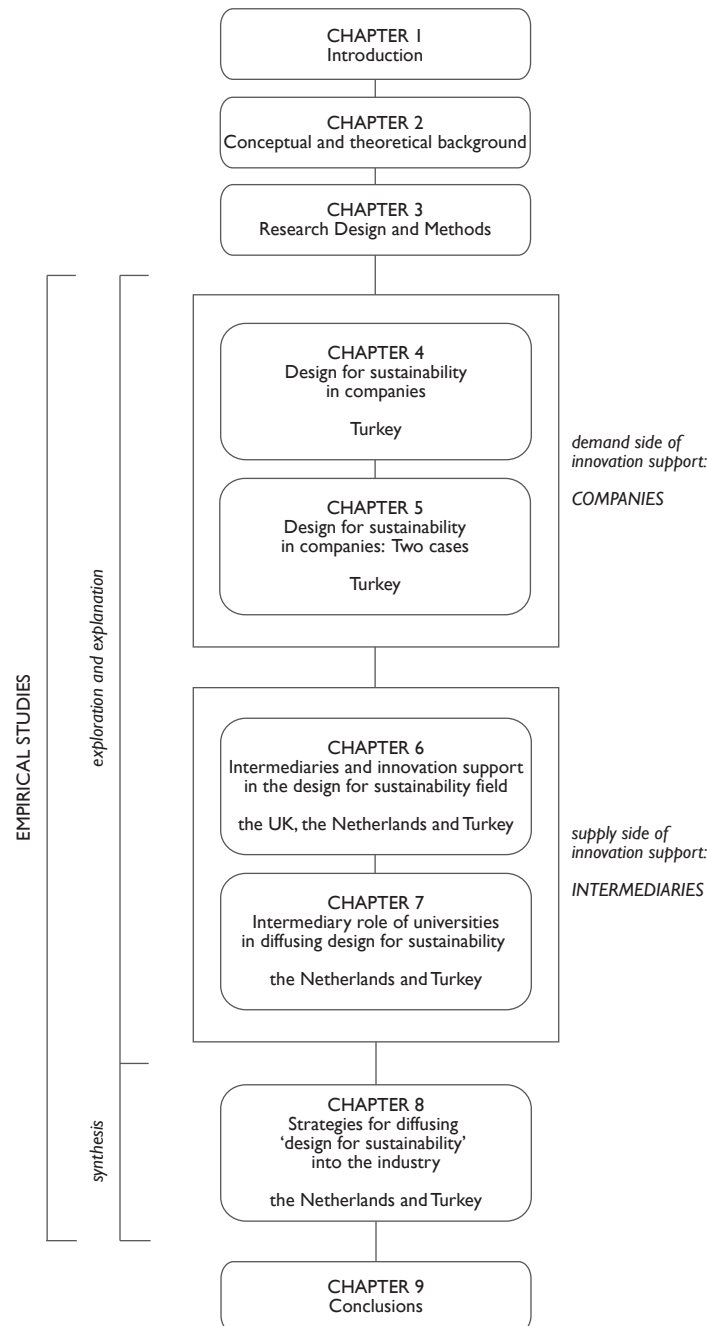


Figure 1.3 : Outline of the chapters.

As the focused field, case, method, and theoretical contribution of each empirical study vary; each empirical study might be of interest to different types of readers. The empirical study on the sustainability practices of companies in Turkey (Chapter 4) could inform policy makers, intermediaries, and academics about the state of the art of the sustainability practices of companies in Turkey and provide a basis for developing projects and programs on sustainable consumption and production and design for sustainability. Companies and designers could learn how to start and develop sustainability practices and overcome barriers from the case studies on two best-practice companies in Turkey (Chapter 5). The empirical study on intermediaries (Chapter 6) includes theoretical contributions in the field and reports the intermediaries' experiences with sustainability in detail and would be beneficial for all stakeholders working on projects for spreading sustainability into the industry. The empirical study on the intermediary roles of universities (Chapter 7) could especially be of interest to academics working on outreach activities in addition to education and research. The final empirical study, on the strategies for spreading design for sustainability into the industry (Chapter 8), could inform all potential stakeholders planning future projects on sustainability.

2. BACKGROUND

This chapter presents the literature review in two sections; the conceptual background focuses on the design for sustainability concept (Section 2.1) and the theoretical background focuses on innovation systems theory (Section 2.2). Additional concepts and theories related to the research questions are discussed as well. In the last sub-section of the chapter (Section 2.3), conclusions are drawn from the literature review and the answers for the initial research questions are discussed. Following the literature review, the preliminary conceptual model that was proposed in Chapter 1 is revised in Chapter 3.

As shown in the initial conceptual model (Figure 1.2), the goal of the innovation processes of companies reviewed in this study is developing sustainable product-service-systems, which can also be called sustainable innovation. Sustainable innovation is defined as “the renewal or improvement of products, services, and processes that not only delivers an improved economical performance, but also an enhanced environmental and social performance, in both the short and long term” (Bos-Brouwers, 2010) or simply as “innovation that improves sustainability performance” (Boons et al., 2012). It should be emphasized that not every innovation is sustainable (Bos-Brouwers, 2010).

The innovation processes of companies for developing sustainable product-service systems are approached with design perspective. Design is defined as “a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles” and “the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange” (ICSID, 2014). The widely referred basic design cycle is shown in Figure 2.1. The professional design discipline includes product, industrial, service, graphic, fashion and interior design. In this thesis the main foci are industrial and product design except for where otherwise noted. Moreover, design for sustainability, the state-of-the-art approach to designing sustainable product-service-systems, is

reviewed in sub-section 2.1, following a discussion of the broader concept of sustainable development.

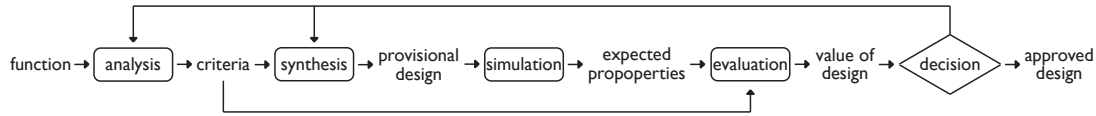


Figure 2.1 : The basic design cycle (Roozenburg & Eekels 1995).

Innovation processes in the design field are studied within the scope of product-development processes. Although the development processes of products and services differ (Hallengabrink & Brezet, 2005), in this thesis they are described as one model since the main foci are industrial and product design. The literature on product development and design innovation processes, and types of design innovation are reviewed in the beginning of Section 2.2 to provide a basis for investigating and evaluating companies' innovation processes and outputs. For investigating innovation support mechanisms for companies, this study relies on innovation systems theory, which is justified by discussing other theories that could be utilized as well. The theoretical background focusing on innovation systems theory, and the innovation support providers in innovation systems – intermediaries – is discussed in sub-section 2.2 following the review of specific design-innovation processes.

2.1 Conceptual Background

The concept “sustainable development” was formulated for the first time in 1987 by the report *Our Common Future* by Gro Harlem Brundtland as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN, 1987). Three requirements for achieving sustainable development are: (1) poverty eradication, (2) sustainable consumption and production, and (3) protecting and managing the natural resources in order to foster economic and social development (UN, 2002). Sustainable development goals will be redefined in 2015, following agreement by the United Nations' member states at the *Rio+20 Conference* in 2012 (UN-SD, 2015).

Scholars have suggested several terms for explaining and expanding the term sustainability. “The triple bottom line” is a widely used framework coined for more easily communicating sustainability easier, by naming its three dimensions –

economic, social and environmental (Elkington, 1998). The framework is also referred to as the “three pillars of sustainability” and “triple P: people, profit, planet” (Figure 2.1-I) (Diehl, 2010). In different contexts, the emphasis on the three pillars of sustainability might change. While in a developing rural context, the emphasis might be on the “people” (Figure 2.1-II), in an urban industrial context, the emphasis might be on the “planet” (Figure 2.1-III). The latest is more relevant to this study, as the design for sustainability approach is aimed at being diffused into the industry in Turkey.

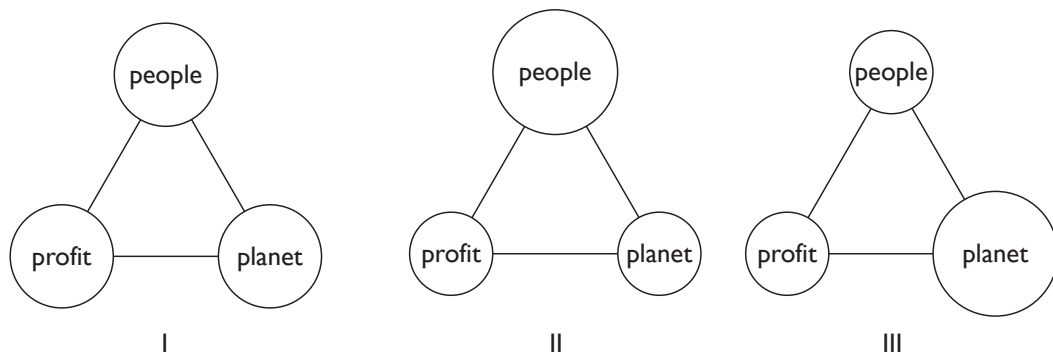


Figure 2.2 : “Triple P”, three pillars of Sustainability (Elkington, 1998; Diehl, 2010) and two examples for the changing emphasis.

Another approach, “resilience” was first developed in ecology and its characteristics are listed as diversity, efficiency, adaptability and cohesion (Fiksel, 2003; Korhonen & Sieger, 2008). The United Nations utilizes the approach mostly in the context of urban risk prevention (UN-Habitat, 2011).

One of the sustainable development approaches, sustainable consumption and production were defined as “the use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of future generations” (UN, 1994). While having developed its own methods, tools and practices, design for sustainability is a crucial part of sustainable consumption and production (Spangenberg et al., 2010). In this thesis, as design for sustainability is a new concept and in some cases not diffused yet, sustainable consumption and production are explored as well except for where otherwise noted.

2.1.1 Design for sustainability

Design for sustainability is defined as “industries taking environmental and social concerns along with economic concerns as key elements in their long-term innovation strategy and incorporating related factors into their product-service-system development throughout the supply chain and also the life cycle of the product” (based on Crul & Diehl, 2006). The United Nations Environment Programme promotes design for sustainability as one of the tools to “reformulate how consumer needs are met with less environmental and social impacts” (Clark, 2007).

Design started to be cited as a source of sustainable development in the 1970s (e.g., Papanek, 1971). In the 1990s, initiatives in the industry on eco-efficient products started (e.g., Cramer & Stevels, 1995; Stevels, 2007). Meanwhile, ecodesign was developed as a strategy for diminishing the environmental impact of companies (Brezet & Van Hemel, 1997; Sherwin & Bhamra, 2000; Crul et al., 2009). Design for the environment has also been used interchangeably with ecodesign (Ryan, 1998). In the 2000s, ecodesign evolved into design for sustainability by also embracing social and economic concerns in addition to environmental concerns (Crul et al., 2009b; Fuad-Luke, 2009).

Design for sustainability was the focus of several European Union-funded projects such as *Emude*, which aimed at mapping the user demands related to sustainability and at generating scenarios to illustrate how these can evolve into product and service design (Manzini & Meroni, 2007); *LeNS*, which aimed at “developing and diffusing system design for sustainability into design schools with a transcultural perspective” (Vezzoli & Cheschin, 2011); and *Ecomind*, which aimed at “supporting sustainable business growth, facilitate the development and market penetration of the new sustainable products and services” (Ecomind, 2009). In addition, design for sustainability strategies and practical applications were the focus of several joint-publications by the United Nations Environment Programme, such as those on eco-design (Brezet & Van Hemel, 1997), design for sustainability (Crul et al., 2009b) and design for sustainability in developing economies (Crul & Diehl, 2006).

The main design for sustainability approaches are cited as: (1) redesign, (2) benchmarking, (3) new product design and (4) product-service-systems design (Crul & Diehl, 2006). While new product design leads to function innovation, product-

service-systems design leads to system innovation (Brezet, et al., 2001a). Recently, design models and methods were developed for combining design and innovation models that aim at achieving sustainable societal change (Gaziulusoy et al., 2013; Joore & Brezet, 2015).

Moreover, a large number of tools have been developed for evaluating environmental requirements for products. They vary in complexity and the time required to implement them while criteria have been developed for selecting the most fitting one depending on the project at hand (Bovea & Perez-Belis, 2012). There is not a one-size-fits-all solution but customization of design for sustainability tools and techniques tailor-made for the company's needs is recommended (Boks, 2006; Knight & Jenkins, 2009).

Among the various tools and methods, checklists are simplest (Ryan, 1999) and are usually utilized in early stages of design processes (Bakker, 1995). UNEP's Manual *Design for Sustainability: A Step-by-Step Approach* presents such a checklist with 33 design-for-sustainability strategies that are grouped under 12 foci (Table 2.1) (Ryan, 2009). Many designers also consider these strategies "principles of good design" (Ryan, 1999). The strategies embrace both an incremental approach, such as in the focus of "selection of low impact materials" and a radical approach such as in the focus of "exploiting new technological opportunities". This checklist is utilized for investigating the state of the art of companies' design for sustainability practices in Turkey.

Table 2.1 : 33 design for sustainability strategies (Van Hemel, 1998; Ryan, 2009).

Focus	Strategy
Selection of low impact materials	• Eliminating materials with sensitive origin • Selecting materials which are low in embodied energy and water • Eliminating toxic materials • Using recycled materials • Using recycled and recyclable materials • Using biodegradable materials
Material usage	• Optimising total weight • Reducing the number of different materials being used • Snapping different materials mechanically or geometrically instead of bonding
Packaging	• Reducing and reconsidering the packaging materials used according to environmental considerations

Table 2.1 (continued) : 33 design for sustainability strategies (Van Hemel, 1998; Ryan, 2009).

Focus	Strategy
Producing and manufacturing	• Reducing the material, energy and water used in manufacturing • Recovering and reusing the resources or using renewable energy resources
Distribution and transportation	• Reducing the outputs of pollution and waste • Reducing the transportation distances by reorganising logistics • Using less polluting transportation modes (e.g. from truck to rail) • Improving transportation load efficiencies • Reducing the weight of product and packaging
Improving the social and economic benefits of manufacturing	Choosing best social and ethical conditions in production and distribution to add to social and economic development
Extending initial product life-time	• Making more durable and reliable products • Reducing the products' 'fashionable' aspect to avoid obsolescence • Making products, which get more valuable as they get older • Conceptualising products as a combination of 'long-life' and 'short life' components (e.g. removable head for shaving razors)
End of life systems	• Making easily disassembled products • Making easily reusable products • Making easily remanufactured products • Making modular products • Making products which are easily collected for reuse or recycling
Meeting user needs with a different product or service	• Designing products and services, which together fulfil the need of the user
Developing a hybrid product	• Combining functions of separate products into one product
Exploiting new technological opportunities	• Exploiting new technologies for complete product innovation

The "life-cycle-assessment" is cited as one of the most successful and widely used tools to assess environmental quality of product design processes. Although it is considered more adequate for assessing a final product, it might be restricting for product innovation (Bakker, 1995; Millet et al., 2007). Some scholars suggest that design for sustainability tools such as life-cycle-assessment should be the responsibility of a specific expert within the company for strategic evaluations of new concepts and translating the results to the design team (Millet et al., 2007).

Moreover, communicating life-cycle-assessment results to non-specialists is challenging, as its data is complex. Recently, an “eco-cost / value model” was developed based on the life-cycle-assessment for overcoming the communication challenges and for eco-efficient value creation (Vogtländer et al., 2002; 2013).

Another influential approach that focuses on the environmental quality of product design processes is “cradle-to-cradle”. It requires designing the products in a continuous flow to be up-cycled after having been used as nutrients to either nature or to industry. In the former case, the product is considered a biological nutrient, whereas in the latter case a technical nutrient. This approach also requires establishing product-service-systems, where products are leased, up-cycled, or upgraded by manufacturers in time (McDonough & Braungart, 2002). In addition, products that are completely recyclable, reusable and re-manufacturable, also called “zero to landfill”, are produced (Ehrenfeld, 2008).

The aim of the product-service-system approach is to meet user needs with a combination of intangible services and tangible products, for reducing environmental impact. The approach shifts the focus of business models from products to system of products by providing complementary services (Manzini & Vezzoli, 2002; Mont, 2002; Tukker & Tischner, 2006). Although the knowledge and experience on the approach has been developed and the approach promises radical innovation, its implementation in the industry is still limited. The reasons for that are cited as cultural, corporate and regulative barriers (Vezzoli et al., 2012; Ceschin, 2013). The product-service-system design also aims at dematerialization (Ryan, 2000; Mont, 2002), which can only be achieved by focusing on needs instead of utilitarian factors and on creating a material culture instead of designing products (Ehrenfeld, 2008).

The approaches “design activism” (see Chapman & Gant, 2007; Fuad-Luke, 2009; Middlemiss & Parrish, 2010), “design for the base of the pyramid” (see Smith, 2007; Kandachar & Halme, 2008) and “design for sustainable behavior” (see Morelli, 2007; Marchand & Walker, 2008; Bhamra et al., 2011) are linked more to the social level of design for sustainability. Design activism is studied in two categories, targeting under-consumers and targeting over-consumers (Fuad-Luke, 2009). The first category overlaps with design for the base of the pyramid, which aims to offer solutions for poverty (Kandachar & Halme, 2008). Design for sustainable behavior overlaps with the second category and aims to lead and enable users for sustainable

behavior and lifestyles. With this approach, designers' interventions with products are classified as "informative", "persuasive" and "coercive" (Lilley, 2009).

As cited above, there are many different approaches to how to link design and sustainability, which is confusing for companies hence increasing their need for support. These approaches are searched, when investigating the state of the art of companies' design for sustainability practices.

2.1.1.1 Designers' role in sustainability

Along with the role of design for sustainability, many scholars have envisioned the specific role of designers in sustainability (e.g., Papanek, 1971; Cross, 1981; Ryan et al., 1992; Birkeland, 2002; Ehrenfeld, 2008) and have investigated the issue empirically (e.g., Bakker, 1995; Boks, 2006; Lofthouse, 2004; Deutz et al., 2013). Four levels of possible intervention of industrial designers into sustainability are suggested as: (1) environmental redesign of existing systems, (2) designing new and sustainable products and services, (3) designing new production-consumption systems with sustainable satisfaction of need and desires and (4) creating new scenarios for sustainable life styles (Vezzoli & Manzini, 2008).

The role of designers in ecodesign is described as either operational or strategic. Operational roles aim at incremental improvements in products, whereas strategic roles exploit designers' abilities for new product systems that aim at more sustainable lifestyles (Bakker, 1995). Strategic roles of designers in design for sustainability are akin to the design thinking approach, which is elaborated in Section 2.2.1. The role of designers in ecodesign is parallel to their role in general design projects but with additional consideration for environmental issues (Lofthouse, 2004). Design for sustainability activities are different from general design activities with regard to: (1) environmental assessment, (2) solution-finding, and (3) strategy definition. Moreover, designers' expertise on design for sustainability influences the initial environmental assessment and strategy definition more than the design for sustainability tools (Vallet et al., 2013).

When investigating the state of the art of companies' design for sustainability practices in this study, the above-mentioned roles of designers are explored.

2.1.1.2 Design for sustainability in companies

Although the design for sustainability debate is mostly dominated by research and academics, the same is not true of the practice and designers (Chapman and Gant, 2007). Sustainability requires a systematic change, which can occur through a wide social learning process. Design research has to enable the learning process with visions, proposals, and tools (Manzini, 2008). Within the consumption and production system, companies play a central role as they have the knowledge and organizational capacity. Therefore, companies need to become more competitive through sustainable processes, which need to be viewed as opportunities for innovation (Vezzoli & Manzini, 2008).

The extent to which companies incorporate environmental issues into product design depends on several interrelated organizational issues (Petala et al., 2010), which include: (1) the designers' understanding of environmental issues, (2) the extent of the design space, (3) the legal requirements, (4) economic constraints and (5) supply chain constraints (Deutz et al., 2013).

Sustainability practices of companies are studied mostly in two main groups – large enterprises, and small/medium enterprises. On the one hand, small/medium enterprises are cited as lacking the human and financial resources to tackle environmental concerns and legislation. They are also referred to as ignorant of environmental concerns, cynical of the benefits of sustainability strategies, and difficult to reach, mobilize, or engage in relevant initiatives (Hillary, 2000). On the other hand, small/medium enterprises are cited as having advantages when implementing sustainability strategies, as they are less bureaucratic than large enterprises, are able to respond to change quickly and are better able to establish efficient internal communication (Meredith, 2000).

Nonetheless, the definitions of small/medium enterprises vary in different countries and, even within the same country, according to different organizations (Hillary, 2000). This means that those fitting the definition of large enterprises in one country might be classified as small/medium in another country, which might also reflect the companies' characteristics. This difference exists between the definitions in Turkey (KOBİ, 2015) and European Union (EC, 2015). Therefore, this study focuses on both small/medium enterprises and large enterprises to exemplify related design for

sustainability practices and innovation processes, but avoids comparing them. In addition, details of the differences are reported, whenever the data allows it.

Studies on the ecodesign practices of companies have been carried out in specific regions such as the Netherlands (Van Hemel, 1998; Van Hemel & Cramer, 2002), the European Union (Tukker et al., 2000), Baltic States (Belmane et al., 2003), Central America (Crul, 2003), and Northeast Brazil (Costa & Gouvinhas, 2004). The first two of these are reviewed with regard to the current situation of the sustainability practices of companies in Turkey. These two studies were selected because of the level of elaboration of the content, the medium in which they are published, such as an academic journal or European Commission documents, and the context of the study. Comparing the situation in Turkey with European countries is preferred, as European Union adaptation is one of the key drivers of sustainable development in Turkey (TR-MoEF & TTGV, 2010).

The first study (Van Hemel, 1998; Van Hemel & Cramer, 2002) investigates the design for sustainability process of the companies that participated in the *Ecodesign Project*, which was financed by the Dutch Ministries of the Environment and of Economic Affairs, as well as coordinated and implemented by non-profit innovation centers in the Netherlands along with “backup” teams such as the Industrial Design Engineering Faculty at Delft University of Technology. The aim of the project was to achieve solutions, which could provide both environmental benefits and commercial gains for the sample companies. The project was a follow-up of a demonstration project called *PROMISE* (*Dutch acronym for Product Development with the Environment as Innovation Strategy*) undertaken with medium and large-sized companies (Brezet et al., 1994; Brezet & Van Hemel, 1997; Van Hemel, 1998). The second survey (Tukker et al., 2000) was undertaken within the scope of the report *Eco-design: European State-of-the-art* prepared for the European Commission’s Joint Research Center Institute for Prospective Technological Studies. The key points of the two studies are summarized in Table 2.2.

Table 2.2 : Surveys on small and medium enterprises' design for sustainability practices in the literature.

	SURVEY I	SURVEY II
Context	The Netherlands	The European Union
Project	EcoDesign Project	Not following an implementation project
Survey	Questionnaire with 77 small and medium enterprise participants	Maturity assessment with experts
Reference(s)	Böttcher & Hartman, 1997; Van Hemel, 1998; Van Hemel & Cramer, 2002	Tukker et al., 2000
Design for sustainability / ecodesign practices	• Recycling of materials • High reliability / durability • Recycled materials	From a country perspective, Germany, the Netherlands, Austria and Sweden were reported as frontrunners. In Belgium, Spain, France, Ireland, Portugal, Finland and the United Kingdom, only some large companies were practising ecodesign. In other countries, companies did not yet practise the concept of ecodesign, except the transnationals.
Drivers	External stimuli: • Customer demands • Government regulations • Industrial sector initiatives Internal stimuli: • Innovation opportunities • Increase of product quality • New market opportunities	• Regulations • Customer demand • Marketing opportunities
Barriers	Initial barriers: • Conflict with functional requirements • Commercial disadvantage No-go barriers: • No clear environmental benefit • Not perceived as responsibility • No alternative solution available	For applying methods of ecodesign: • Language barriers • Cultural barriers For broader dissemination of ecodesign: • Lack of expertise • Lack of funding possibilities

Table 2.2 (continued) : Surveys on small and medium enterprises' design for sustainability practices in the literature.

	SURVEY I	SURVEY II
Benefits	• 2/3 of companies proceeded with concrete changes in products • 1/3 of the options located during the project were put into practice immediately • More than 1/3 of companies stated that they will be able to apply environmental product development independently (2/3 of companies were eager to apply them to their other products) • Results included remarkable product innovations • Almost every company gained some environmental profit	Benefits are not investigated but cited hypothetically: • Benefits related to customer demands • Benefits related to costs

Although these studies were carried out in the early 2000s, they were carried out during the early diffusion of design for sustainability into the industry and are therefore expected to be comparable to the current situation of sustainability in Turkey. For comparison sake, the scope of these two studies from Europe is utilized to a certain extent in forming the sub-questions for assessing the sustainability practices of companies in Turkey.

2.1.1.3 Design for sustainability in Turkey

In 2010, a comprehensive report (TR-MoEF & TTGV, 2010) investigated the sustainable consumption and production capacity in Turkey. Some of its results are as follows:

- Although the concepts of sustainable consumption and production are frequently cited in the existing legislation and emphasized as a need, Turkey does not have legislation and/or an action plan that directly addresses the issue.
- Within the European Union adaptation process, most of the regulations that crosscut sustainable consumption and production have already been adapted or included an adaptation plan.
- Although universities and public institutions carry out projects on sustainable consumption and production, the existing capacity is far from sufficient for the

needs of the country and the projects have not been carried out within a systematic national plan framework.

- The incentive mechanisms available for sustainable consumption and production are limited and not even comparable to those in the European Union, in terms of both variety and amounts.

In 2011, the National Productivity Center of Turkey was assigned to carry out cleaner production activities, although the Scientific and Technological Research Council of Turkey and the Technology Development Foundation of Turkey had already called attention to this need in 1999 (MPM, 2011). The task was recently assigned to the Scientific and Technological Research Council of Turkey's Marmara Research Center (TÜBİTAK-MAM, 2013).

Regarding the sustainability practices of companies, a study showed that large enterprises in Turkey consider implementation of sustainability practices a cost driver. They emphasize the implementation of environmental issues mostly in process design, then in product design and lastly in the design of logistics activities. The main problem they came across during implementation, they indicated, was a lack of environmental consciousness within the companies and even society as a whole (Yüksel, 2008). Nevertheless, the number of companies holding an ISO14001 certification in Turkey rose 65% between the end of 2005 and that of 2006, which indicates that companies are advancing their sustainability practices rapidly (Türk, 2009).

Previous studies on the specific focus of design for sustainability in Turkey investigated either a single or limited number of prominent companies (Gaziulusoy, 2003; Gürakar et al., 2008) or a wide group of small/medium enterprises (Selek, 2008). These studies show that the understanding of sustainable solutions lacks an integrative approach and is limited to recycling and using recycled materials. Moreover, companies take design for sustainability strategies into account only if they suggest the most economical solutions and consumers do not yet have the awareness and influence to create demand for sustainable products and services. Small/medium enterprises, unlike large enterprises, implement environmental regulations only if they are exporting to European countries and if they perceive governmental legislation as guidance rather than a coercive factor. Also in industrial design education, the current specialization on sustainability is inadequate (Erkaslan,

2013). Some positive initiatives on design for sustainability in Turkey are that the Turkish Design Advisory Board, which was established in 2009, supports innovation and creativity by emphasizing sustainability (Hasdoğan, 2009); and Turkey's Branch of the Regional Environmental Center published a manual on ecodesign in the Turkish language (REC-TR, 2011).

The report (TR-MoEF & TTGV, 2010) cites design for sustainability with regard to two activity proposals for Turkey: (1) an action plan is needed on sustainable consumption and production including eco-labeling, ecodesign, life-cycle-assessment, etc. and tools must be prepared, and (2) funds should be created for R&D, commercialization and investment projects of the industry, in the areas of environmentally friendly products, ecodesign etc., which will provide an advantage in exporting industrial products. The report also lists relevant institutions that could participate in these actions, ranging from Ministries to public organizations and NGOs.

The literature review on the companies' design for sustainability practices in Turkey only partially answers the first research question. This is discussed further in subsection 2.3.

2.2 Theoretical Background

The scope of this study extends to the interdisciplinary fields of, mainly design, innovation and sustainability. Several theoretical frameworks were examined in search for the most fitting to the research questions and strategy. As the study focuses on the demand and supply sides of innovation support separately, but not on the processes of innovation support, frameworks on organizational learning and knowledge transfer are excluded. Moreover, a framework that would enable defining the roles of various innovation support suppliers was needed. For that, diffusion, transition and entrepreneurship studies were explored, but they did not provide the required framework. Nevertheless, they are covered shortly in the following paragraphs.

Diffusion studies (Rogers, 2003) include many disciplines, such as sociology, communication and marketing. "Diffusion of innovations" is defined as a kind of "social change" and as "the process in which an innovation is communicated through

certain channels over time among the members of a social system”. The four main elements in the diffusion of innovations are: (1) the innovation, (2) communication channels (3) time, and (4) the social system. Diffusion takes place in diffusion networks through social learning, where opinion leaders play an important role. Intermediaries are called “change agents” in diffusion literature and the sequence of their roles is defined as: (1) to develop a need for change, (2) to establish an information exchange relationship, (3) to diagnose problems, (4) to create an intent to change in the client, (5) to translate an intent into action, (6) to stabilize adoption and prevent discontinuance, and (7) to achieve a terminal relationship (Rogers, 2003). However, most diffusion studies focus on a particular function of intermediaries and on a non-theoretical level (Howells, 2006). In addition, most diffusion studies aim to spread a specific technological innovation (Rogers, 2003). Therefore, the theoretical framework on diffusion of innovations is less applicable in this study, which focuses on the broad concept of design for sustainability.

Transition studies explore governance and management approaches for achieving sustainability (Geels, 2004; Kemp & Rotmans, 2004; Loorbach & Wijsman, 2012). The “multi-level perspective on socio-technical transitions” framework aims to further develop sectorial innovation systems theory for analyzing long-term, dynamic changes in technology and society. It focuses on “socio-technical systems” as the unit of analysis instead of sectorial systems and on changes in systems rather than functioning of systems. The transition processes are explained in three levels: (1) technological niches, (2) socio-technical regimes, and (3) socio-technical landscape (Geels, 2004). However, the theory is criticized for several reasons: (1) a lack of navigation support for the actors (i.e., designers, intermediaries); (2) failure to acknowledge that actors can be simultaneously engaged at several levels of the transition processes; and (3) a lack of transparency within the co-development role of the academic approaches involved (Jorgensen, 2012; Joore & Brezet, 2015). For overcoming these limitations, an “arenas of development” perspective was proposed (Jorgensen, 2012). However, this study focuses on the innovation process within companies, which does not require a societal level analysis.

Although entrepreneurship studies also investigate sustainable innovation (e.g., Berchicci, 2005; Boons et al., 2012; Keskin et al., 2013), they are mostly concerned with radical innovation. These studies focus on developing new product-service-

systems, new ventures and new business models for sustainability, which can also be adapted to existing organizations through intrapreneurial activities. Entrepreneurship studies focus mainly on one type of innovation support provider – incubators (e.g., Clarysse et al., 2005). Recent studies started investigating innovation support for new ventures working on sustainability (e.g., Keskin et al., 2013). However, incremental innovation is also important, if the aim is to diffuse the sustainability approach throughout most of the industry and society. Furthermore, this study aims to investigate a wide range of companies and intermediaries, for which entrepreneurship theories are not suitable. Therefore, entrepreneurship studies are suggested as further research with a more specific focus in radical innovation.

The main theoretical framework of this study – innovation systems, are defined as “the network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies” (Freeman, 1987). Innovation systems theory focuses on the flow of knowledge and therefore, on people and technologies embodying knowledge (OECD, 1997; Lundvall, 2010). “Innovation systems theory” was selected as the main theoretical framework in this study for several reasons. First, it allows analyzing “roles” of specific actors – organizations and people, with a functional approach (Bergek et al., 2008). Second, it is widely utilized at the policy level such as by the Organisation for Economic Co-operation and Development, the European Commission and the United Nations Industrial Development Organisation (Edquist, 1997; Sharif, 2006). Third, intermediaries are usually studied with an innovation systems approach (Van Lente et al., 2003; Howells, 2006; Klerkx & Leeuwis, 2009). Innovation systems theory is utilized for discussing innovation support and intermediaries and in proposing strategies for spreading design for sustainability into the industry.

Before elaborating on innovation systems theory and innovation support, innovation and design innovation processes are examined in the next sub-section for acquiring a company-level focus.

2.2.1 Design innovation processes

Innovation is acknowledged as principal for growth of output and productivity (OECD, 2005). Especially in the 1980s and 1990s, various models and frameworks were developed for studying innovation. *The Oslo Manual*, which was published in

1992, 1997 and most recently in 2005 by the Organisation for Economic Co-operation and Development, is one of the main manuals on innovation.

There are several classifications regarding innovation processes. One classification, distinguishes innovation levels as “radical innovation” encompassing major disruptive changes and as “incremental innovation” encompassing continuous changes (Schumpeter, 1934). Accordingly, five innovation categories are suggested as: (1) introduction of new products, (2) introduction of new methods of production, (3) opening of new markets, (4) development of new supply sources for raw materials or other inputs and (5) creation of new market structures within the industry. *The 2005 Oslo Manual* proposes another set of innovation categories: (1) product, (2) process, (3) marketing, and (4) organizational innovations (OECD, 2005).

In the last decade, design innovation gained importance, with many scholars working on elaborating and demonstrating its qualities (e.g., Utterback et al., 2006; Heskett, 2008; Kyffin & Gardien, 2009; Verganti, 2009; Hobday et al., 2011; Rampino, 2011). Design innovation is defined as “radical innovation in meaning” and as an exploratory research project of the evolution of society, culture and technology (Verganti, 2009).

The role of designers in companies is described as “gatekeepers”, who integrate marketing, design and production in new product development processes (Walsh, 1985). Designers have traditionally been employed in-house within the industry, and in the 1970s, design consultancies emerged, enabling companies to outsource design (Bruce & Docherty, 1993), and usually matching the needs of small companies to make the relationship fast and flexible (Berends et al., 2011). Design consultants are considered brokers, who transfer knowledge and technology to disconnected industries and in this way, facilitate innovation (Hargadon & Sutton, 1997; Hargadon, 2002).

Following the shift from an industrial to a knowledge economy, the expansion of the scope of innovation, and innovation outputs moving from tangible products to processes and services, “design thinking” started to gain importance (Brown, 2008). Design thinking is defined as “a human-centered innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis, which ultimately influences

innovation and business strategy” (Lockwood, 2009) and is indicated as an effective approach towards sustainability (Brown, 2008).

Design had attracted little attention from policy-makers up until the last decade, a fact that was criticized by economists (e.g., Freeman, 1987). This is however changing, and in many countries policies have begun to aim at improving design’s contribution to innovation (Hobday et al., 2012). The 3rd and last edition of *the Oslo Manual* (OECD, 2005) and the reports of the European Commission (EC, 2003, 2009b, 2010) include design as a source of innovation. More recently, *The European Design Innovation Initiative* was launched in 2011 with the aim “to provide recommendations on how to enhance the role of design in innovation policy in Europe at the national, regional or local level and to develop a joint vision, priorities and actions to enable design to become an integral part of innovation policy at the European level, in line with the Innovation Union” (EDII, 2012).

The definition of innovation provided by the first edition of *the Oslo Manual* (OECD, 2005) focuses on technological products and processes in manufacturing sectors and was extended to address non-technological innovation in later editions, mainly to include service sectors as well. *The 2005 Oslo Manual* defines innovation as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations” with the minimum requirement of being “new to the firm”. Product innovation is defined as “the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics” (OECD, 2005).

Several models were suggested for describing product and design innovation processes. A widely acknowledged product innovation model is shown in Figure 2.3 (Roozenburg & Eekels 1995). More recently, instead of linear models, cyclic models of design innovation process in business practice were explored (Buijs, 2003).

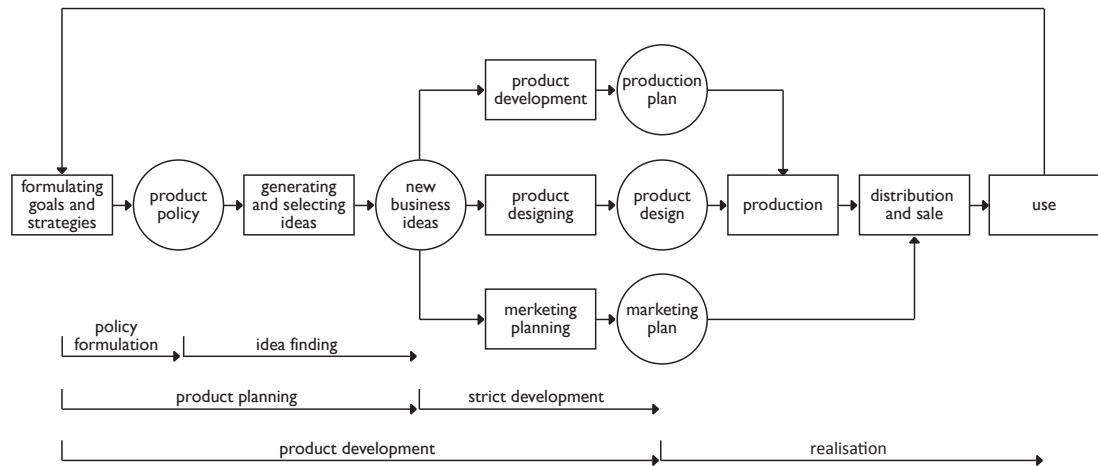


Figure 2.3 : The phases of the product innovation process (Roozenburg & Eekels, 1995).

Nevertheless, defining the role and effectiveness of industrial design is not easy and not always quantifiable, but it encompasses greater qualitative value than commercial success alone (Heskett, 2008; Rampino, 2011). Moreover, not only industrial designers (or departments) but also R&D and marketing departments, usually manage product innovation, which makes the contribution of industrial design difficult to demonstrate (Rampino, 2011). Another innovation process model (Hobday et al., 2011) aims to emphasize the bridging function of design, linking R&D to marketing (Figure 2.4).

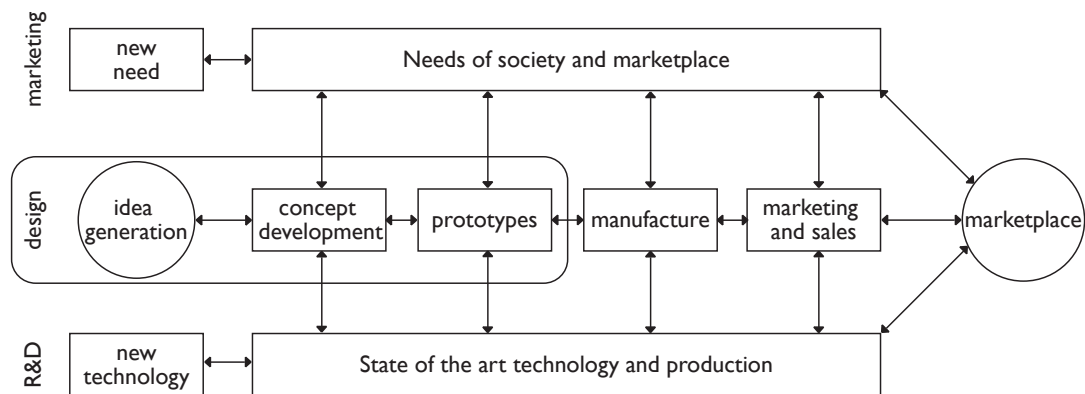


Figure 2.4 : Innovation process model with design as a bridging function (Hobday et al., 2011).

Recently, the “Multilevel Design Model” was developed for explaining the design innovation process not only at the company level, but also at the societal level from a change and transition perspective. It examines design innovation in four hierarchical levels: (1) product-technology system, (2) product-service system, (3) socio-technical system, and (4) societal system (Joore & Brezet, 2015).

Another model aims to classify the types of innovations at the product level (Rampino, 2011). The innovation pyramid shown in Figure 2.5 categorizes four different types of design innovation as: (1) aesthetic, (2) usage, (3) meaning and (4) typological innovation. The first two of these are classified as incremental innovation and the last two as radical innovation.

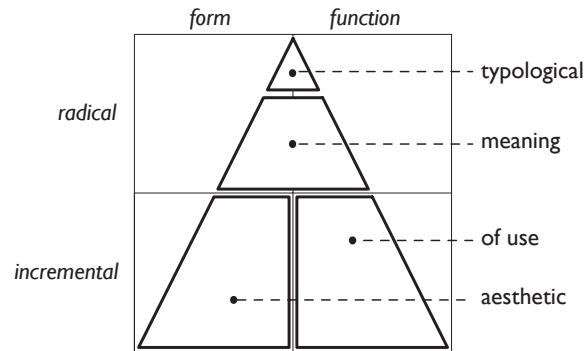


Figure 2.5 : The Innovation Pyramid and the categories of design innovation (Rampino, 2011).

In this thesis, when investigating the state of the art of companies' design for sustainability practices in Turkey, the above mentioned design innovation processes informs the explanation of innovation processes. Furthermore, the design innovation pyramid model (Rampino, 2011) is utilized for evaluating the product-service-system outputs of companies' innovation processes.

2.2.2 Innovation systems

The theory of innovation systems first started to develop as “national innovation systems” in the late 1980s (e.g., Freeman, 1987; Lundvall, 1988, 1992). The national innovation systems approach defines the key of the innovation process as “the flows of technology and information among people, enterprises, and institutions”, and emphasizes the need to understand and enhance the complex relationships among these actors as crucial for competitiveness (OECD, 1997). Three factors increased the influence of the national innovation systems approach: (1) the recognition of the economic importance of knowledge, (2) the increasing use of systems approaches; and (3) the growing number of institutions involved in knowledge generation (OECD, 1997).

Many country-specific factors influence national innovation system's actors, such as the financial system and corporate governance, legal and regulatory frameworks, and the level of education and skills (Figure 2.6) (OECD, 1999).

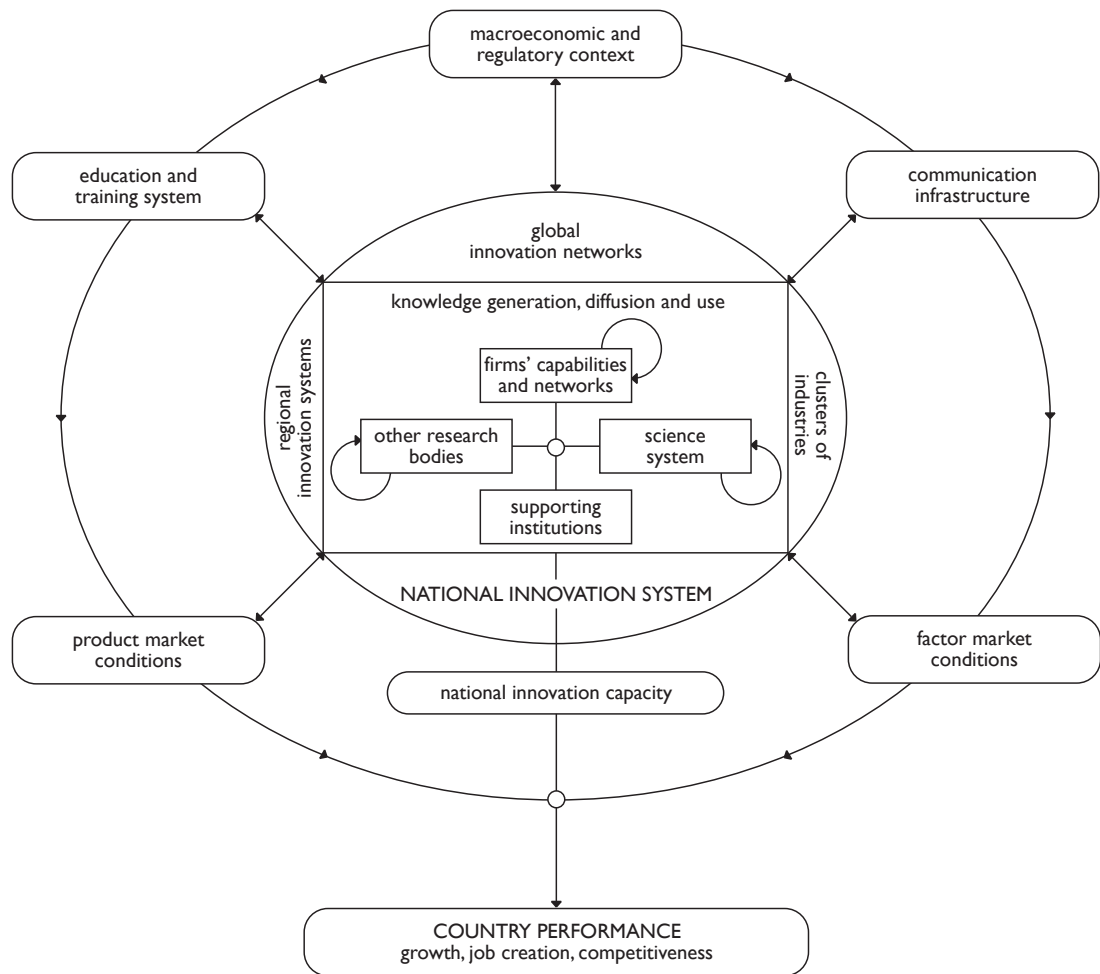


Figure 2.6 : Actors and linkages in the innovation system (OECD, 1999).

National innovation systems can be studied from either a broad or narrow perspective. While the broad perspective covers all institutions in the system that affect the introduction and diffusion of innovations, the narrow perspective focuses on only a set of institutions that are directly involved in the activities (Freeman, 2010). Determining which institutions will be included and excluded from the system in the analysis depends on historical analysis and theoretical considerations (Lundvall, 2010).

The national innovation system approach was later adapted to other levels as well, such as sectorial (Bresci & Malerba, 1997), regional (e.g., Braczyk et al., 1996), and technological (Carlsson & Stankiewicz, 1991) innovation systems. It is also noted that an innovation system is an “analytical construct”, does not have to exist in reality, and the interactions between its components may be unplanned (Bergek et al., 2008).

Several approaches have been examined for studying innovation systems. One of them is the system failure approach. Based on previous studies, this approach categorizes the innovation systems failures in four main categories shown in Table 2.3. The approach suggests analyzing the failure categories for each actor of innovation systems, which are listed as demand, companies, knowledge institutes and third parties (Klein Woolthuis et al., 2005). However, the evaluation of the failures is noted as difficult as they are related to structural components of innovation systems (Bergek et al., 2008).

Table 2.3 : Innovation systems failures (adapted from Klein Woolthuis et al., 2005).

Innovation system failures	Sub-categories	Explanation
Infrastructural failures		Communication, energy and science–technology infrastructure
Institutional failures	Hard institutional failures	Technical standards, laws, regulations
	Soft institutional failures	Social norms and values, culture
Interaction failure	Strong network failure	Too much interaction
	Weak network failure	Too little or no interaction
Capabilities' failure		Competences, resources

Another approach for studying innovation systems is the functional approach (Hekkert et al., 2007; Bergek et al., 2008). The main function of innovation systems is to develop, diffuse and utilize new knowledge (technologies, products, services and processes) (cf. Freeman, 1987; Carlsson and Stankiewicz, 1991; OECD, 1997; Bergek et al., 2008). The functional approach was suggested for better enabling policy makers to identify practical guidelines and set policy goals. Based on previous studies, the innovation systems functions are listed as: (1) entrepreneurial activities, (2) knowledge development (learning), (3) knowledge diffusion through networks, (4) guidance of the search, (5) market formation, (6) resource mobilization, and (7) creation of legitimacy / counteract resistance to change (Hekkert et al., 2007).

In this study, the innovation systems theory and related functional approach are utilized both when investigating innovation support for companies' design for sustainability practices and when building strategies for supporting companies' innovation processes for applying design for sustainability.

2.2.3 Intermediaries

Studies on intermediaries emerged in the 1980s in various fields such as technology and knowledge transfer and diffusion, innovation management, and systems and networks (Howells, 2006). Intermediaries are called “providers of innovation support” (EC, 2009a), and they function as brokers between the various parties of an innovation system, “companies, universities and research institutes, and political arrangements that support innovation” (Figure 2.7) (Van Lente et al, 2003). The value of intermediaries in policy terms is creating new possibilities and dynamism within an innovation system, along with improving its connectedness (Howells, 2006).

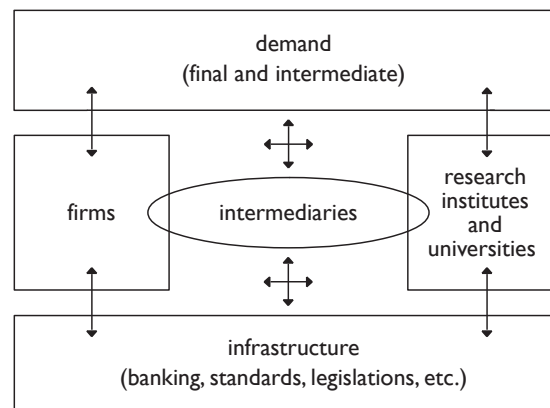


Figure 2.7 : Building blocks of innovation systems (Van Lente et al., 2003).

Several “gaps” were identified within innovation systems: technology, productivity (Nelson, 1967; Freeman, 1987), management, awareness, capabilities, resources (Bessant & Rush, 1996), and knowledge translation (Major & Corde-Hayes, 2000). To fill or bridge these gaps or “weak areas” is the role of intermediaries. Intermediaries consist of different structures for overcoming these gaps (for a typology see Howells, 2006).

Types and functions of intermediaries were listed in several studies and policy reports (Van Lente et al., 2003; Howells, 2006; EC, 2009a) and are shown in Table 2.4. Intermediary functions are also called support instruments (EC, 2009a). The lists that are cited in The European Commission Document, *Making Public Support for Innovation in the EU More Effective* (EC, 2009a) are utilized in this study for easier application of the study findings in future projects and programs.

Table 2.4 : Types and functions of intermediaries.

Types of intermediaries	Source: Van Lente et al., 2003	Source: EC, 2009b
	1. Knowledge Intensive Business Services 2. Research and Technology Organizations 3. (Semi-)public organizations or industry associations a. Industry Associations b. Chambers of Commerce c. Innovation Centers d. University-liaison Offices	1. Innovation and business development agency 2. University and research centre 3. Chamber of commerce and business association, 4. Incubator and science park, 5. Cluster organization 6. Private consultants
Functions of intermediaries / Support instruments of intermediaries	Source: Howells, 2006	Source: EC, 2009b
	1. Foresight and diagnostics, 2. Scanning and information processing 3. Knowledge processing and combination / recombination 4. Gatekeeping and brokering, 5. Testing and validation 6. Accreditation 7. Validation and regulation 8. Protecting the results 9. Commercialization 10. Evaluation of outcomes	1. Networking and cooperation between actors 2. Financing innovation projects (including R&D) 3. Innovation management including IP management, design management and organizational innovation 4. Creation of specific skills 5. Identify innovation potential (information on market needs, market conditions, new regulations, new technology, etc.) 6. Technology / knowledge transfer 7. Internationalization of innovative small and medium enterprises 8. Develop new forms of innovation support measures that could be implemented nationally or at European level 9. Awareness raising and information on support possibilities

Several classifications also organize the approaches of intermediaries (Table 2.5). One of them (Van Lente et al., 2003) classifies intermediaries as “hard, soft, and systematic”, based on the source of innovation they support. According to this classification, hard intermediaries are traditional intermediaries and focus on

engineering and R&D related services. Soft intermediaries focus on management or organizational services. And systemic intermediaries are cited as a new type of intermediary, whose emergence is triggered by complex long-term changes such as sustainable development. Systematic intermediaries function at a system or network level, instead of focusing on building bilateral relations for knowledge transfer or management support for companies as traditional intermediaries do. Another classification differentiates intermediaries based on the innovation type they support. Intermediaries that follow a top-down approach promote innovation to potential adapters, whereas intermediaries that follow a bottom-up approach facilitate projects and opportunities for problem solving (Winch & Courtney, 2007). The funding source also differentiates intermediaries and their functions (Klerkx & Leeuwis, 2008). This classification suggests that the intermediary functions that are of public interest should be funded publicly to ensure the neutrality of the intermediaries. Moreover, the functions that are in the interest of companies should be funded privately, rather than publicly, in order not to overpopulate the intermediary level.

Table 2.5 : Approaches of intermediaries.

Source	Van Lente et al., 2003	Winch & Courtney, 2007	Klerkx & Leeuwis, 2008
Approaches of intermediaries	Hard Soft Systematic	Top-down Bottom-up	Publicly funded Privately funded

Intermediaries face many challenges; innovation activities continuously undergo change, the use of external resources and networks grow (Smits, 2002), and new paradigms emergence, such as “open innovation” (Chesbrough, 2003) and “design innovation”. An increasing number of actors and the complexity of innovation systems create a bigger need for intermediaries to transfer and translate knowledge to companies (Van Lente et al., 2003, Kirkels & Duysters, 2010) and to enable convergence among stakeholders’ goals and perspectives (Massa & Tessa, 2008). Sustainability goals add to this complexity, as they require an interdisciplinary approach (Baumgartner, 2011). Thus, understanding sustainable innovation that operates across different scales is necessary in order to generate theoretical and practical enrichment in policy (Doloreux, 2004).

Because of the indirect effect of intermediaries on the value chains of businesses, it is difficult to appraise the impact of intermediaries and it might be difficult for their

target group to understand the value of their services (Klerkx & Leeuwis, 2009). Moreover, for studying intermediaries, it is crucial to understand the context in which they function and the actors with whom they interact. The European Commission-funded project *Changing Behaviour* that aimed at supporting intermediaries in the sustainability field offered two recommendations to address the challenges that the intermediaries face: (1) to pay more attention to the context, stakeholders, monitoring, evaluation and learning, and (2) to build longer-term implementation plans and funding schemes for intermediaries (Backhaus, 2010).

The link between design innovation and intermediaries is established via design consultancy companies, also called the “brokers of technology” (Hargadon, 2002). The design and innovation consulting companies IDEO and Design Continuum were studied as examples through case studies (Hargadon and Sutton, 1997; Hargadon, 2002). Their source of innovation is defined as “ties to multiple disconnected industries”, and they are described as not only linking ideas and knowledge, but as also transforming them.

This sub-section forms the theoretical basis for investigating both the state of the art of innovation support on design for sustainability and the related role of designers. Former studies on intermediaries specific to the design for sustainability field are reviewed in the following sub-sections.

According to some intermediary classifications in the literature (e.g., EC, 2009a), universities are considered intermediaries, although they are usually listed as a separate innovation system’s actor (Van Lente et al., 2003; Figure 2.7). Some studies investigate universities as knowledge intermediaries (e.g., EC, 2009a), and as taking on temporary intermediary roles (e.g., Cook et al., 2006). Also in the design for sustainability field, universities are observed as undertaking intermediary roles such as carrying out projects with companies with the aim to diffuse their design for sustainability into the industry (Van Hemel, 1998; Crul, 2006; Diehl, 2010), and publishing manuals on design for sustainability (e.g., Brezet & Van Hemel, 1997; Crul & Diehl, 2006; Crul et al., 2009b; Vezzoli et al., 2014). Therefore, universities are investigated within the scope of this study in the next sub-section.

2.2.3.1 Intermediary role of universities

The roles of universities in innovation processes have been evolving (Etzkowitz & Leydesdorff, 2000; Nowotny et al., 2003; Mowery & Sampat, 2006). Along with education and research, they are expected to “outreach” to, or “engage” in, the development of society and industry, which are also called “third mode activities” or “third mission” (Etzkowitz & Leydesdorff, 2000; OECD, 2007; Lehmann et al., 2009). The third mode of universities stems from “Mode 2” science, and is defined as “a new paradigm of knowledge production, which is socially distributed, application-oriented, trans-disciplinary, and subject to multiple accountabilities”. And the old paradigm “Mode 1” is “characterized by the hegemony of theoretical or, at any rate, experimental science”. (Gibbons, 1994; Nowotny et al., 2003).

Outreach is considered a relatively new task for universities compared to the education and research tasks. Through outreach they utilize knowledge in solving complex societal problems such as achieving sustainable development (Wright, 2002; Lehmann et al., 2009). The outreach activities of universities have been studied from several perspectives. Universities are cited as “development hubs” (Hansen & Lehmann, 2006), “knowledge hubs” (Youtie & Shapira, 2008) and “knowledge intermediaries” (EC, 2009a). Among the various metaphors used to refer to the outreach activities of universities are: “engine”, “dynamo”, “accelerator”, “lever” and “catalyst” (Arbo & Benneworth, 2007).

Even in developed countries, the push for technology and pull from the market are not always adequate drivers for the industry; yet, the new concepts have to be transferred to them by, for instance, the universities. The transfer of knowledge from universities to industry needs to be completed by intermediaries, and for that universities should develop the methodology and frameworks, through research projects, that should be applied. In such projects, researchers act as intermediaries (Cook et al., 2006). However, it has also been argued that the intermediary roles of universities might be putting too much responsibility on universities and the policy-level effects should be considered carefully (Howells et al., 2012). Besides, only few universities have or can develop the required skills and expertise (Lockett & Wright, 2005).

The types of intermediaries that link universities to other actors are: (1) internal, (2) external, (3) hybrid intermediaries, and (4) individual scientists (Youtie & Shapira,

2008). Most common types of internal intermediaries are technology transfer offices, which aim to commercialize research results, manage and protect intellectual property (Siegel et al., 2004; Wright et al., 2008). The external intermediaries include surrogate entrepreneurs, venture capitalists and business angels, regional development agencies and collective research centers (Wright et al., 2008). Hybrid organizations emerge in the interfaces of the overlapping university, industry, and governmental domains (Etzkowitz and Leydesdorff, 2000). Individual scientists also undertake intermediary roles (Wright et al., 2008), mostly through consultancies.

Since the 1990s, several initiatives have urged universities to incorporate sustainability into their activities and proactively engage in it (Wright, 2002; Zilahy & Huisinigh, 2009). They include the *Talloires Declaration* (ULSF, 1990) and the *Halifax Declaration* (IISD, 1991). More recently, the United Nations launched *the Decade of Education for Sustainable Development* that lasting from 2005 to 2014, and aiming “to mobilize the educational resources of the world to help create a more sustainable future” (UNESCO, 2002).

The specific roles of universities in regional sustainable development are cited as: (1) acting as facilitators or first movers, (2) contributing with highly qualified staff and their accumulated knowledge in all of the complex issues, and (3) providing policy advice and corporate consulting in technical, economic and social issues alike (Zilahy & Huisinigh, 2009). The extent to which universities are able to undertake these roles depends on the characteristics of the institution, their region and the policy frameworks (Arbo & Benneworth, 2007). Some of the barriers that universities face while engaging in regional communities and outreach activities are mainly organizational issues, such as inadequate incentives, financial resources and time (Zilahy et al., 2009).

Several studies explore design for sustainability in the context of higher education. The aims of the studies include utilizing an online source for linking design to sustainability knowledge in higher education (Fletcher & Dewberry, 2002), integrating sustainability into industrial design engineering courses (Boks & Diehl, 2006), exploring methods for improving the students’ understandings of sustainability in design education (Gulwalidi, 2008), exploring user-centered design research for achieving innovation in sustainable lifestyles and products (Liedtke et

al., 2012), and advancing the contribution of design education to sustainable development (O’Rafferty et al., 2014).

The outreach activities of universities in the design for sustainability field were explored in several studies that were mentioned earlier in this chapter (Van Hemel, 1998; Crul, 2003; Diehl, 2010). They are dissertations undertaken in the Design for Sustainability Program at Delft University of Technology, which is one of the cases described in Chapter 7.

2.2.3.2 Intermediaries in the design for sustainability field

Few studies investigate intermediaries working in the sustainability field (O’Rafferty & O’Connor, 2010; Keskin et al., 2013). One study investigates the regional dimension of design for sustainability support for small/medium enterprises (O’Rafferty & O’Connor, 2010), for which a model was developed from four cases studying the intervention process of a single intermediary, the Ecodesign Center (Table 2.6). The processes of the cases were cross-analyzed according to capacity, endogenous change and adaptation, performance and interaction. The study recommends developing flexible and evolving intervention models that are not too prescriptive. However, because the model is driven from four case studies of a single intermediary’s support processes, it does not reflect on various intermediary types and approaches.

Table 2.6 : Intervention model (O’Rafferty & O’Connor, 2010).

Strategy	Governance	Framework management Alignment with EDC strategy Strategic alignment with national policy
	Agenda setting	Establishing business case Project planning Project scoping
	Management	Oversight of process Allocation of resources Project management Administration
	Monitoring	Performance monitoring
Inputs	Finance	Financial support
	Research	Compliance research Material research Market research Packaging research
		Capital equipment purchasing
	Manufacturing capacity	

Table 2.6 (continued) : Intervention model (O’Rafferty & O’Connor, 2010).

Process	Mentoring / Coaching	Regular project meetings
		Design workshops (e.g. brand workshops)
	Training	LCA training
	Alignment with national delivery	Meetings with other support organizations
	Networks	Commercial Support Partner workshop
		Collaborative meetings

Another study (Keskin et al., 2013) investigates innovation support organizations involved with the *Ecomind* project mentioned in Section 2.1.1, by focusing on how the innovation processes and sustainability goals of eight new ventures influence this process.

As only a few studies on intermediaries pertain to the design for sustainability field and they do not study a variety of intermediaries, an explorative study is needed to determine the state of the art of innovation support on design for sustainability. The literature cites intermediaries from the Netherlands and the United Kingdom as good examples (Van der Meulen & Rip, 1998; Howells, 2006). Therefore, the study focuses on these two cases. Furthermore, the intermediary role of universities specific to the design for sustainability field is investigated.

2.3 Answers to the Initial Research Questions

In this sub-section, the answers to the initial research questions are summarized and the extent to which they answer the corresponding questions is discussed. Gaps in the literature are listed in Chapter 3, and the research questions are revised accordingly.

Initial RQ 1 What is the state of the art of companies’ design for sustainability practices in Turkey?

Former studies, which investigate companies’ design for sustainability practices in Turkey (Gaziulusoy, 2003; Erişmiş, 2007; Gürakar et al., 2008; Selek, 2008) and that are reviewed in Section 2.1.1.3, conclude that the practices of companies are insufficient and lack an integrative approach on sustainability. Moreover, the most recent report on sustainable consumption and production (TR-MoEF & TTGV, 2010) reveals that the related legislation and market demand, which are important drivers for companies, are inadequate in Turkey. Besides, companies perceive the

few existing environmental regulations as guidance rather than as a coercive factor (Gaziulusoy, 2003; Gürakar et al., 2008; Selek, 2008; TR-MoEF & TTGV, 2010).

Initial RQ 2 What is the state of the art of innovation support on design for sustainability in developed countries and in Turkey?

The literature on intermediaries focuses on their types, approaches, services, and support instruments (Van Lente et al., 2003; Howells, 2006; Winch & Courtney, 2007; Klerkx & Leeuwis, 2008; EC, 2009a). Intermediaries are usually studied according to innovation systems theory (e.g., Van Lente et al., 2003; Howells, 2006; Klerkx & Leeuwis, 2009). They are defined as “providers of innovation support” (EC, 2009a), and they function as brokers between the various parties of an innovation system: “companies, universities and research institutes, and political arrangements that support innovation” (Van Lente et al., 2003). In addition, universities are considered knowledge intermediaries (EC, 2009a), or as taking temporary intermediary roles (Cook et al., 2006). In the design for sustainability field, despite the availability of a number of support programs, the implementation is low. Former studies mostly focus on the organizational and methodological barriers causing a low level of implementation. A model was developed for the regional dimension of design for sustainability support for SMEs (O’Rafferty & O’Connor, 2010).

Initial RQ 3 What is the role of designers in the innovation support for design for sustainability?

The literature cites design consultancy companies as intermediaries. They are described as brokers, who transfer knowledge and technology to disconnected industries and in this way, facilitate innovation (Hargadon & Sutton, 1997; Hargadon, 2002). In addition, many studies investigated the role of designers in sustainability (e.g., Bakker, 1995; Lofthouse, 2004; Deutz et al., 2013). They are reviewed in Section 2.1.1.1.

Initial RQ 4 How should companies in Turkey be supported in their innovation processes for applying design for sustainability?

A model was developed for “ecodesign intervention” targeting SMEs at a regional level. The model was informed by four case studies on the intervention process of a single intermediary, the Ecodesign Center (O’Rafferty & O’Connor, 2010). In the case of Turkey, the most recent report on sustainable consumption and production (TR-MoEF & TTGV, 2010) includes design for sustainability for the scope of “ecodesign” and suggests the following actions:

- An action plan on sustainable consumption and production, including environmental management tools such as eco-labeling, eco-design and life cycle assessment, must be developed
- Financial models that are utilized for achieving sustainable consumption and production suitable to Turkey’s conditions must be investigated and developed. Next, funds should be created for R&D and industry’s commercialization and investment projects in the export-intensive fields, such as environmentally friendly products and eco-design.

3. RESEARCH STRATEGY AND METHODS

The research strategy and methods of the study were introduced shortly, and initial research questions listed, in Chapter 1. The literature review in Chapter 2 aimed to answer the initial research questions and in Section 2.3 the preliminary answers were discussed. In this chapter, first the preliminary conceptual model is developed further according to the findings from the literature review. Next, the gaps in the literature are identified and the initial research questions are revised accordingly. The empirical studies designed to answer the research questions and the respective methods that are utilized are introduced in this chapter but the details are presented in each corresponding chapter (Chapter 4-8). This chapter concludes with discussing research reliability and validity of the research.

3.1 Revised Conceptual Understanding

Following the answers obtained from the review, the preliminary conceptual model is revised as in Figure 3.1. The model uses arrows to show the two main processes in question, innovation processes of companies and innovation support processes for design for sustainability. This study focuses on the actors and on the demand and supply side of innovation support – companies and intermediaries. Nonetheless, universities, which carry out outreach activities along with educational and research activities, are also considered knowledge intermediaries in the literature. Therefore, universities are included in the conceptual model as well and are investigated in the empirical studies. As the literature cites external design consultants as intermediaries, they are linked to intermediaries in the model while internal designers are linked to companies. In addition, the factors discussed in the literature review related to the research questions, which shape the empirical studies, are noted in the model and linked to the actors, processes and outputs.

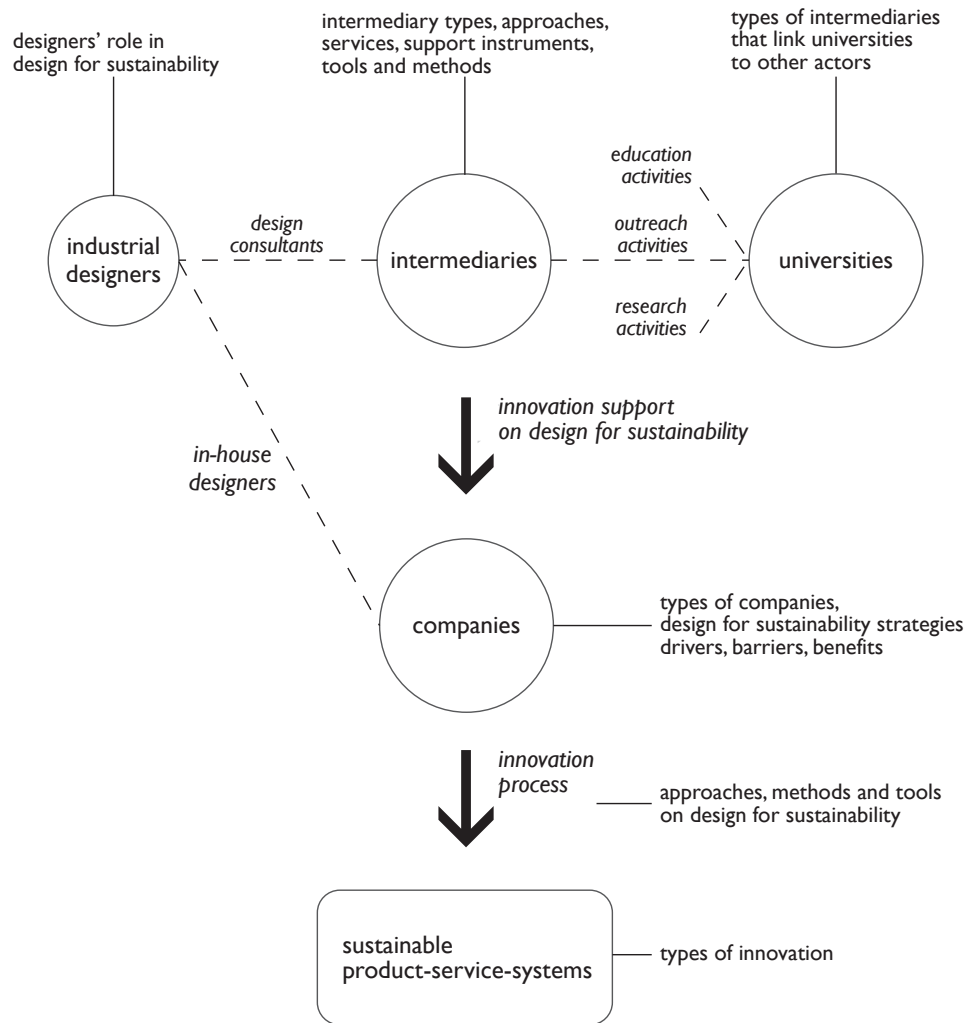


Figure 3.1 : The conceptual model revised following the literature review.

The following gaps are identified in the literature (Chapter 2) regarding the research questions:

Literature Gap 1 Previous studies, which investigated companies' design for sustainability practices in Turkey, focused on either a single or limited number of companies (Gaziulusoy, 2003; Erişmiş, 2007; Gürakar et al., 2008) or a wide group of SMEs (Selek, 2008). They report the inadequacy of legislation, market demand and companies' practices. Nonetheless, one can observe good examples of design for sustainability in Turkey. The question, how do some companies achieve practicing design for sustainability in Turkey despite the barriers, remains unanswered.

- Literature Gap 2 The literature on intermediaries, their types, approaches, services, and support instruments is vast (Van Lente et al., 2003; Howells, 2006; Winch & Courtney, 2007; Klerkx & Leeuwis, 2008; EC, 2009a), but the question, how do intermediaries function in the specific field of design for sustainability remains unanswered. Similarly, the literature cites universities as knowledge intermediaries or as taking intermediary roles but the question, how do universities function as knowledge intermediaries in the design for sustainability field, remains unanswered.
- Literature Gap 3 Many studies explain the role of designers in design for sustainability (e.g., Papanek, 1971; Cross, 1981; Ryan et al., 1992; Bakker, 1995; Boks, 2006; Lofthouse, 2004; Deutz et al., 2013), but few studies focus on their role as intermediaries in the innovation support process. The number of studies that focus on the design for sustainability field is even lower.
- Literature Gap 4 A report on sustainable consumption and production addresses suggestions for diffusing design for sustainability into the industry in Turkey (TR-MoEF & TTGV, 2010). The issue needs to be studied further for suggesting specific aims, strategies and actions.

3.2 Revised Research Questions

Following the literature review and the identified gaps, initial research questions are revised (RQs) as follows:

- RQ 1 What is the state of the art of companies' design for sustainability practices in Turkey? (Addressing Gap 1)
- RQ 2 How do some companies in Turkey succeed in implementing design for sustainability despite the barriers? (Addressing Gap 1)
- RQ 3 What is the state of the art of innovation support on design for sustainability in developed countries and in Turkey? (Addressing Gap 2)

- RQ 4 What is the intermediary role of universities in diffusing design for sustainability into the industry? (Addressing Gap 2)
- RQ 5 What is the role of designers in the innovation support for design for sustainability? (Addressing Gap 3)
- RQ 6 How should companies in Turkey be supported in their innovation processes for applying design for sustainability? (Addressing Gap 4)

3.3 Research Design and Methods

The main focus of this study is the innovation support for companies working on design for sustainability. In a developed country context, this focus can be investigated through case studies of innovation support processes, supplied by various types of intermediaries and received by different types of companies. Because the innovation support for companies working on design for sustainability is not yet developed in Turkey, the research strategy followed in this study is to explore and explain the state of the art of design for sustainability practices of companies and innovation support processes of intermediaries, learn from best examples, draw strategies based on findings and develop them further with expert opinions. Following the research questions, five empirical studies are designed. The contributions from the literature review and each empirical study to the research stages are listed in Table 3.1. The levels of contribution are grouped as main and secondary contributions and represented with a small and a bigger circle respectively.

Table 3.1 : Contribution of each study to the research stages.

Study	Research stages			
	Assessing the state of the art	Learning from best examples	Drawing strategies	Developing the strategies further
Literature review	●	●	●	
Empirical study 1	●	●	●	
Empirical study 2		●	●	
Empirical study 3	●	●	●	
Empirical study 4		●	●	
Empirical study 5			●	●

The aim, research type, method, sample and location of each empirical study are shown in Table 3.2. In the empirical studies, a qualitative approach is utilized, except for the first study, where mixed methods are used, combining quantitative and qualitative approaches (see Creswell, 2009). A qualitative approach is selected with the aim of exploration and explanation. The study utilizes multiple methods. Case studies and experts' interviews comprise a considerable extent of the study's methods. Experts who are interviewed for the study are from Turkey and Europe – though mostly from the Netherlands, also from the United Kingdom and Denmark.

Table 3.2 : Summary of the empirical studies 1-5.

	Aim	Type	Method	Sample	Location
1	Design for sustainability in best performing companies	Mixed methods	Questionnaire	26 companies	Turkey
2	Design for sustainability in best performing companies	Qualitative	Case study	2 companies	Turkey
3	Intermediaries in the design for sustainability field	Qualitative	Case study	5 intermediaries 5 intermediaries 4 intermediaries	Netherlands Turkey United Kingdom
4	Universities' intermediary role in the design for sustainability field	Qualitative	Case study	1 university 2 universities	Netherlands Turkey
5	Strategy building for design for sustainability diffusion	Qualitative	Experts' interviews	4 experts 2 experts 1 expert	Netherlands Turkey Denmark

In the first empirical study, best practices of design for sustainability activities by companies in Turkey are explored through a questionnaire. The sample group consists of manufacturing companies, which were awarded for their practices in sustainable consumption and production practices by regional chambers of industry

or the EU and which received non-mandatory international certificates such as EU Eco-label and Energy Star partnership. 26 companies participated in this study.

Following the first empirical study, the second empirical study explores the research question, how do best practice companies in Turkey apply design for sustainability despite barriers, through in-depth case studies. Case selection is of the “best practice” type (see Langrish, 1993) and the two cases, of one large and one small company, are selected through the first empirical study according to several criteria.

The third empirical study focuses on intermediaries that operate in the design for sustainability field. The study is designed in two parts, the first part in the form of a questionnaire and the second part composed of open-ended questions. The sample group of 14 intermediaries was formed by starting with the partner institutions through the EU-funded project *EcoMind: Environmental Market & Innovation Development* (Ecomind, 2009) from the Netherlands and United Kingdom, and extended by following their advice. The intermediaries in Turkey were selected starting with a leading intermediary and discussing the options of the sample list with them. In the study, a framework of a set of intermediaries that provide a full spectrum of services in design for sustainability to companies is developed.

The fourth empirical study aims to complement the third one, by exploring the intermediary role of universities in diffusing design for sustainability into industry. In the study, one case from the Netherlands and two cases from Turkey are examined through case studies.

The fifth empirical study is built on all of the former empirical studies, for answering the research question, how can companies in Turkey be supported in their design for sustainability practices. The framework that was developed in the third empirical study was taken as a starting point and strategies for applying the framework in Turkey are suggested. The framework and strategies are discussed and improved through interviews with seven experts from Turkey and Europe in two rounds.

The scope of each empirical study, the corresponding research question(s) and chapters covering the empirical studies are shown in Figure 3.2.

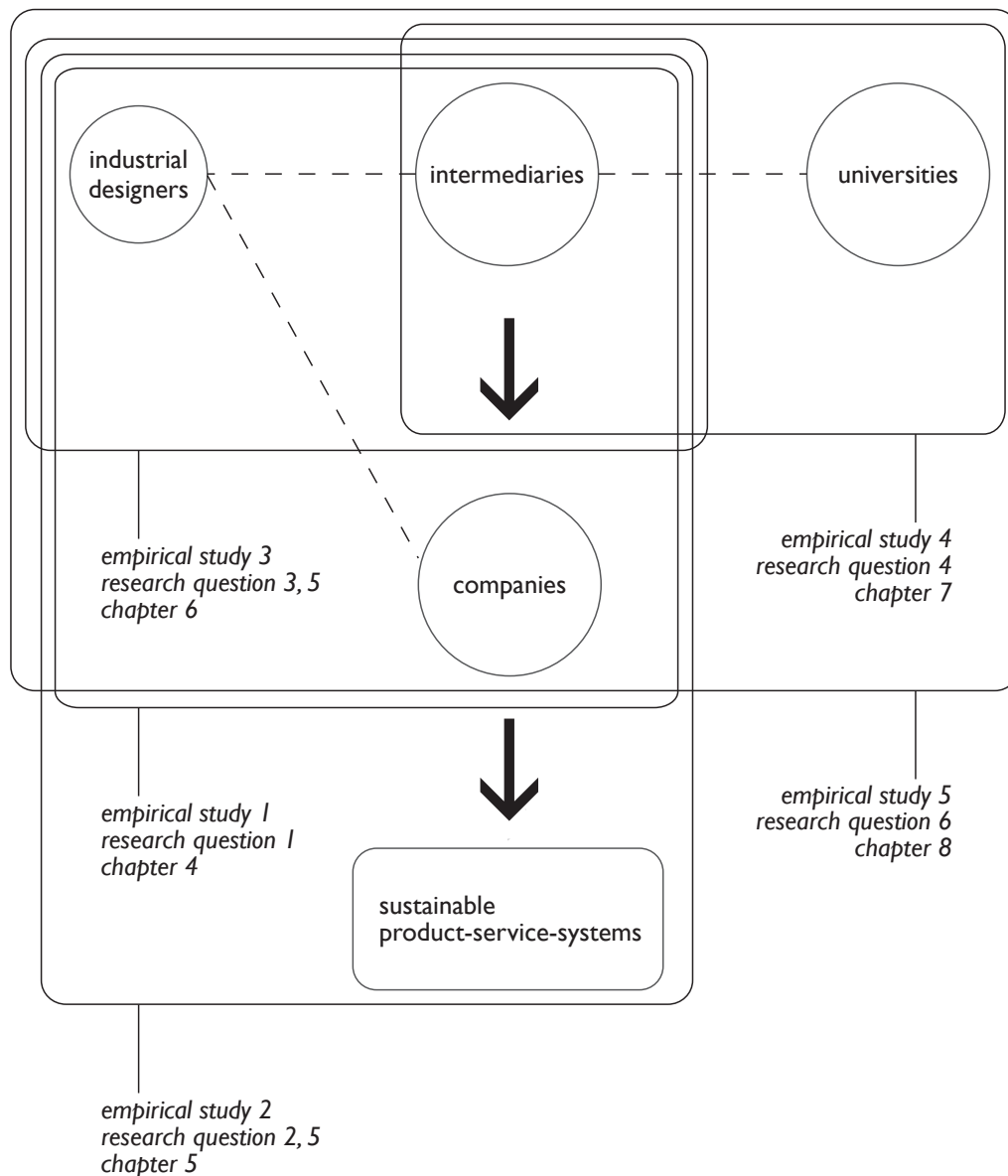


Figure 3.2 : Scope of empirical studies and corresponding research sub-questions.

3.4 Reliability and Validity

The reliability of research is related to the consistency of data collection and analysis. One way to ensure reliability is triangulation, which refers to utilizing more than one data source and method (Bryman & Bell, 2003; Saunders et al., 2009). In this thesis, as seen in Table 3.2 and Figure 3.2, the scopes of some empirical studies overlap with each other. Empirical study 1 and 2 (Chapter 4 and 5) investigate design for sustainability practices of companies in Turkey, the former with a questionnaire and a sample of 26 companies, while the latter with case studies of outstanding two among these 26 companies. While the focus of the studies differ, the former aiming at exploration of the state of the art and the latter aiming at explanation of processes,

their findings reinforce each other. Similarly, data on the intermediaries is collected in all of the empirical studies, and data on the role of designers in the innovation support on design for sustainability is collected in empirical studies 1, 2 and 3 (Chapter 4-6), providing triangulation.

Moreover, multiple sources of data are utilized in the studies, whenever possible. Along with the data gathered through the method of each empirical study, such as interviews and surveys, websites, reports and articles on sample companies and intermediaries are investigated for data triangulation. In the case studies in empirical study 2 (Chapter 5), more than one interview is carried out with more than one employee from different departments. In all of the empirical studies, information about the interviewees and from the interviews is reported in the corresponding chapter. Furthermore, the interviews were carried out in two rounds whenever possible. The second rounds of interviews were carried out by sharing the preliminary draft of corresponding chapters, structured as research papers, with the interviewees. While some interviewees only checked the facts that relate to them, some interviewees also shared overall comments on the study in general. In addition, for purposes of transparency of data collection the questions of each survey and interview are listed in the appendices. Transparency of the data analysis is ensured through detailed explanations of the method(s) of each empirical study in the corresponding chapters (Chapter 4-8).

Research validity refers to the relationship between the findings and theory building and to the generalizability of the findings (Bryman & Bell, 2003; Saunders et al., 2009). In this study, validity is reached mainly by discussing the research findings with experts. This is carried out with academics from both universities where the research was carried out and the experts that participated in the last empirical study (Chapter 8).

The generalizability of the research findings refers to external validity of research and “the extent to which the research findings are applicable to other research settings” (Bryman & Bell, 2003; Saunders et al., 2009). Generalizability of the findings is discussed in the corresponding chapters discussing each empirical study. In the first empirical study (Chapter 4), it is noted that the findings must be used cautiously as the number of the sample companies is low, although the response rate to the study is high. The findings and conclusions drawn from investigating best

practices of companies, intermediaries and universities in empirical studies 2, 3 and 4 (Chapter 5-7) are applicable to other research settings. In these studies, conclusions are drawn from the findings separately for Turkey and for other research settings. How to apply the strategies developed in the empirical study 5 (Chapter 8) in other research settings is explained in the conclusions (Section 8.5).

4. DESIGN FOR SUSTAINABILITY IN COMPANIES: STRATEGIES, DRIVERS AND NEEDS OF TURKEY'S BEST PERFORMING BUSINESSES¹

The literature on design for sustainability in Turkey highlights the inadequacy of legislation, market demand and companies' practices. Nonetheless, one can observe good examples of design for sustainability in Turkey. Therefore, this study (Küçüksayraç, 2015) investigates 26 best performing companies in the sustainability field in Turkey through a questionnaire that addresses the scope of their practices, the drivers for these practices, the barriers they face during the process, the benefits they achieve and their further needs on design for sustainability. The conceptual understanding following the literature review and the scope of the study are shown in Figure 4.1.

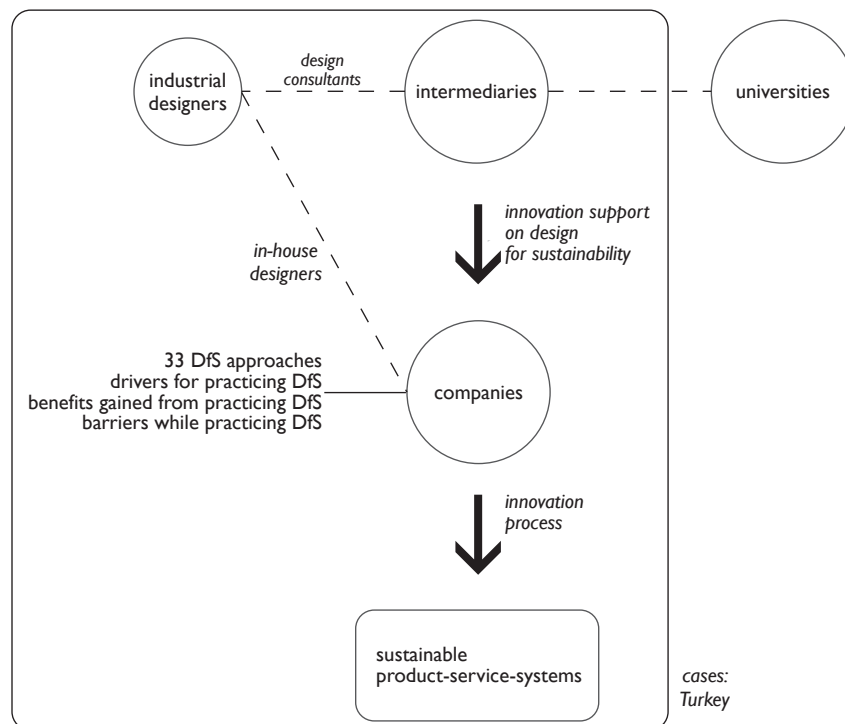


Figure 4.1 : Conceptual understanding and scope of the study.

¹ This Chapter is based on Küçüksayraç, E. (2015). Design for Sustainability in Companies: Strategies, Drivers and Needs of Turkey's Best Performing Businesses. Journal of Cleaner Production, 106, 455-465.

This study aims to answer the first research question: What is the state of the art of companies' design for sustainability practices in Turkey? Five sub-questions are: (1) What is the scope of design for sustainability practices implemented by companies? (2) What are the drivers? (3) What are the barriers the companies face? (4) What are their needs and (5) with which organizations did they collaborate on sustainability or plan to collaborate in the future? A survey was designed to answer these five sub-questions (available in the Appendix A).

4.1 Research Methods

This study utilizes exploratory mixed-methods research. The surveyed companies were first asked to list their projects, awards and certificates in the sustainability field and their collaborators for each project. Second, they were asked to evaluate the 33 design-for-sustainability approaches (Ryan, 2009) and indicate which they are realizing. Third, they were asked to evaluate the drivers needed to start sustainability practices; the list was derived from the inventory of internal drivers with a profit aspect suggested by Crul et al. (2009a). Later they were asked to evaluate the same list, this time regarding the benefits they reaped from their sustainability practices. Fourth, the companies were asked to select and evaluate the barriers they faced from the list suggested by Van Hemel & Cramer (2002) and to select and evaluate their needs from the list suggested by Kletzan-Slamanig et al. (2009). And last, the companies were asked to list the support organizations with which they collaborated in their sustainability practices and with which they would like to further collaborate to realize future projects.

For some of the questions (see Appendix A, Questions 18-21), a five-point Likert scale (from least to most) was used for the evaluation. In this study, the Likert scale is assumed as interval and the ratings generated are summarized through means and standard deviations as accepted in the literature (Carifio & Perla, 2007, 2008; Norman, 2010) (Tables 4.2, 4.3 and 4.4). The results were analysed using SPSS software. In addition, as one of the companies did not complete this step, the number of companies in the corresponding analysis (N) is 25.

The sample companies for this study were selected among the best performing companies in Turkey, more specifically companies that were awarded for their practices in sustainable consumption and production by regional Chambers of

Industry and the European Union and that received non-mandatory international certificates such as the European Union Eco-label and the Energy Star partnership. Of 12 Chambers of Industry present in Turkey, three of them award their member companies for their sustainability practices. They are the Istanbul Chamber of Industry, the Kocaeli Chamber of Industry and the Aegean Region Chamber of Industry. The Kocaeli Chamber of Industry has been granting environmental awards since 1995. The award process was restructured twice in 1997 and 2003, hence only companies winning awards beginning in 2003 were considered for the sample companies. The awards are usually grouped separately for small/medium enterprises versus large enterprises and include categories such as product design, process design and corporate social responsibility.

Out of 102 businesses, 39 companies, whose production involves industrial or engineering design, were invited to participate in the survey by phone, 26 among them agreed (Table 4.1). The companies that participated in the study are, Adell Armature, Akın Tekstil, Arçelik, Asas, Autoliv, BTM, Delta Furniture, Deniz Tekstil, Ege Profil, Ezinç, Federal Mogul, Friterm, Ford, Izeltas, Kale Oto Radyatör, Kaleseramik, Litpa, Norm, Papyrus, Sanko, Siemens, Steppen, Safak Makina, Uniteks, VitrA and Yapi Merkezi Prefabrication. The companies that declined to answer the questionnaire mostly indicated “lack of time” as the reason.

Table 4.1 : The awards, certificates and the number of participating companies.

	Award winning companies	Companies invited to participate in the study	Sample companies
Istanbul Chamber of Industry – Environment Awards Winners (2007-2009; 2011)	30	14	12
Kocaeli Chamber of Industry – “Sahabettin Bilgisu” Environment Awards Winners (2003-2011)	20	4	4
Aegean Region Chamber of Industry – Environment Awards Winners (2001-2010)	38	15	4
Energy Star Partners	1	1	1
European Union Eco-label holders	4	3	3
European Union Business Awards For The Environment (2006-2010, biannual)	13	6	6
TOTAL	102	39	26

Although the sample size is low, the response rate of 67% is high. It should be noted that although the sample companies were selected among the “best performing companies” in Turkey, they may not be defined as “best performing” in the design for sustainability field worldwide. Six of the surveys were carried out face-to-face in Istanbul and Kayseri, while 20 of the companies completed an online version of the survey. The sectors and cities in which the companies operate are shown in Figure 4.2.

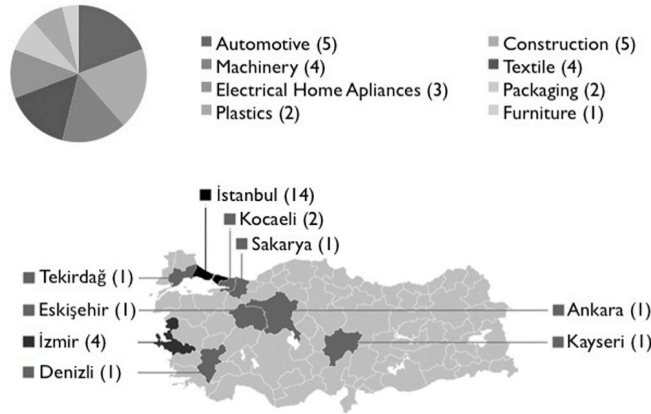


Figure 4.2 : The sectors in which the companies operate and the cities in which they reside (N=26).

4.2 Results and Discussion

The data were analysed and the results were compared to those from other studies in Turkey and those from the European countries that were cited in Section 2.2 and 2.3. The data were also analysed by comparing large enterprises to small/medium ones, and by comparing companies that employ designers to those that do not. The results were checked and reported whenever they differed. The number of companies in each group is shown in Figure 4.3. The answers to each research sub-question are reported in the following subsections.

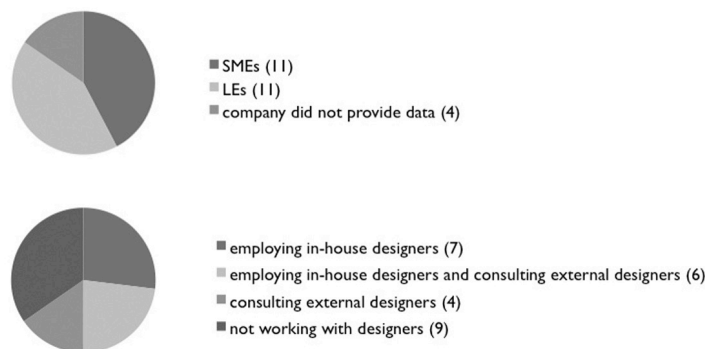


Figure 4.3 : Groups of sample companies (N=26).

4.2.1 The departments that completed the survey

Specific departments, within each company, which completed the survey, are noted (shown in Table 4.2) as an important indication of how the responsibility to communicate sustainability practices is assigned. “Quality Management” and “Production” departments were predominantly tasked with filling out the survey, as emphasized in the table. In four cases, two or more different departments completed it together. Three companies delegated the “Environment, Health & Safety” department. It is noteworthy that one of the participating companies has established a department called “Innovation and Sustainable Development”.

Table 4.2 : The departments that completed the survey (N=26).

Department(s)	n	Department(s)	n
Quality Management	5	Innovation and Sustainable Development	1
Production	4	Multiple Departments	1
Human Resources	2	Product Development	1
Management	2	Research & Development	1
Chemistry	1	Research & Development; Quality Management	1
Central Maintenance	1	Quality Management; Environment, Health & Safety	1
Corporate Communications	1	Systems	1
Environment, Health & Safety	1	Technical Department	1
Human Resources;			
Environment, Health & Safety	1		

4.2.2 The design for sustainability strategies of companies

In the survey, the companies were first asked to list the projects they carried out and the certificates they received on sustainability by stating the title, duration/date of the projects/certificates and the third parties with which they collaborated. A separate question asked them to list the corporate social responsibility projects carried out and certificates received.

Second, the companies evaluated their design for sustainability strategies via a checklist of 33 strategies grouped under 12 foci (Ryan, 2009). The results are shown in Figure 4.4 indicating the percentages of the strategies that the companies realized for each focus. It should be noted that each strategy focus is composed of a different number of strategies, varying from 1 to 6. According to the chart, the companies mostly used strategies regarding “producing and manufacturing”, then “packaging” and finally “extending initial product life-time” the least. The strategic focus

“producing and manufacturing” includes “reducing the material, energy and water use in manufacturing”, “recovering and reusing the resources or using renewable energy resources” and “reducing the outputs of pollution and waste”, which are closer to sustainable consumption and production strategies.

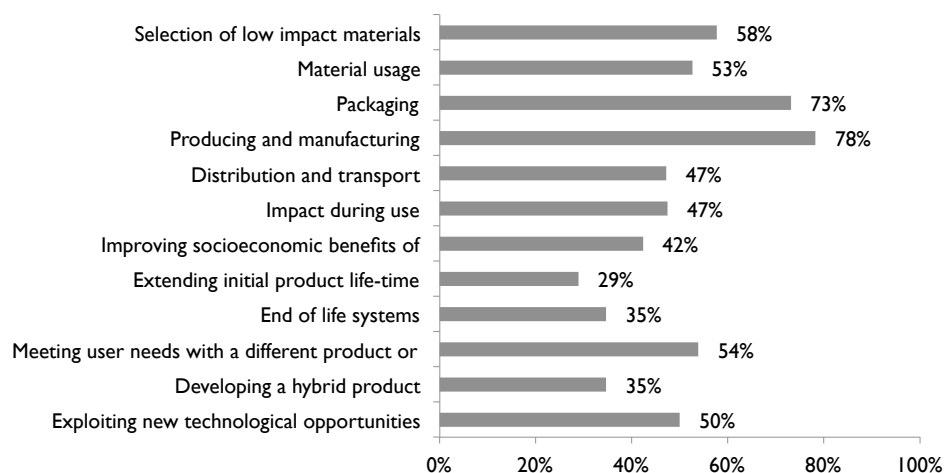


Figure 4.4 : The average rates of design for sustainability strategies (Ryan, 2009) carried out by the companies (N=26).

Among the sample companies, when comparing “large enterprises” to “small/medium enterprises” and those “with designers” to those “without designers” the results differ, as shown in Figure 4.5. Companies that employ design selected, “packaging” the most for their strategy focus. On the other hand, small/medium enterprises selected “meeting user needs with a different product or service” and “producing and manufacturing” as their two foci in the highest percentages.

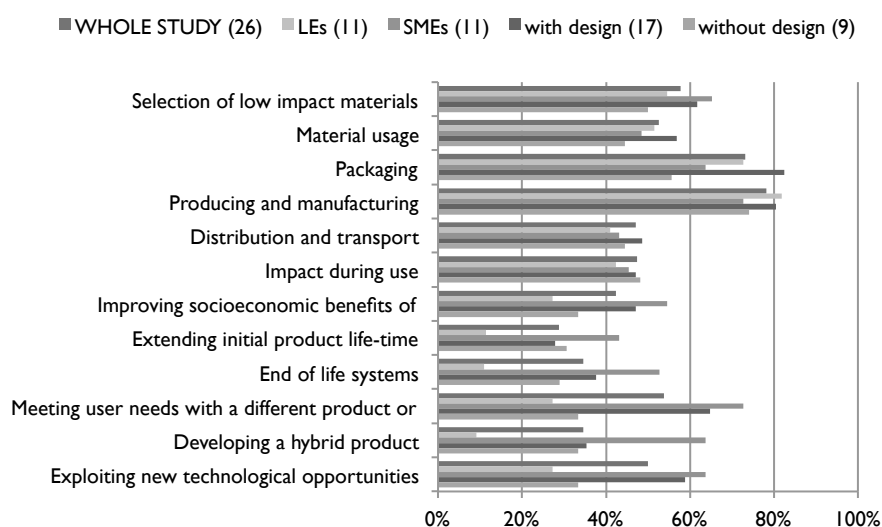


Figure 4.5 : Average rates of design for sustainability strategy foci (N=26).

The companies were also asked if they carry out a life-cycle assessment. The number of companies that perform it internally is 7; those that outsource it are 4 while the remaining 15 do not carry out a life-cycle assessment at all.

4.2.3 Drivers for sustainability and its benefits

Third, the companies rated a list of drivers for acting on sustainability and later they rated the same list according to the benefits they achieved. The results are shown in Table 4.3.

Table 4.3 : Comparison of driver and benefit ratings (N=25).

Driver/Benefit (adapted from Crul et al., 2009a)	Expected		Realised		Difference	P value
	Mean	SD	Mean	SD		
Reach new customers	3.44	1.29	3.16	1.31	-1.35	0.18
Export improvement	3.04	1.31	2.84	1.34	-1.12	0.27
Product quality improvement	3.76	1.33	3.40	1.35	-2.32	0.02
Saving costs	3.80	1.35	3.52	1.26	-1.29	0.20
Boost brand value and reputation	4.04	1.14	3.80	1.29	-1.40	0.16
Product innovation	3.44	1.45	3.24	1.51	-1.21	0.23
Brand differentiation	3.72	1.31	3.72	1.28	-0.11	0.91
New opportunities for value creation	3.72	1.43	3.24	1.51	-2.40	0.02

“Boosting brand value and reputation” was rated the highest, both as a driver and as a benefit. This result differs from the studies mentioned in the literature review, as the most emphasized drivers common to all of the other surveys were “legislation”, “customer demand” and “market opportunities”. It indicates that, in Turkey, the legislation on sustainable consumption and production is weak, customer demand is low, and the best performing companies are mainly driven to differentiate their brands with the aim of being pioneers.

Moreover, the Wilcoxon test was used in the analysis of pair-wise comparison to identify whether a driver was realised as a benefit for the company. The Wilcoxon test is a nonparametric statistical test for comparing two related samples (Ho, 2013). The results indicate that the drivers for companies mostly resulted in benefits ($P > 0.05$), except for “product quality improvement” and “new opportunities for value creation” ($P < 0.05$).

Contrary to the results from previous studies in Turkey, “increase exports” was rated the lowest, both as a driver and as a benefit. This result does not change according to company size of, or design employed by, the participant groups although the highest-rated driver and benefit factors do change slightly. One possible explanation for this could be that the companies mostly export to non-European Union countries. The companies were asked to list the five countries where they export the most. Result list 70% of the countries in the European Union. The percentages of exported production vary between 10 and 100%, with an average of 45%. This result can be interpreted as the companies’ sustainability practices not being dependent on a specific market’s demand, which further strengthens the conclusion that they are mainly driven to differentiate their brands with the aim of being pioneers. The results differ from the previous studies on design for sustainability in Turkey, probably because those studies mostly evaluated a broad group of companies, whereas this study focuses specifically on the best performing ones.

4.2.4 Barriers to design for sustainability

Fourth, the companies rated the primary barriers they face while carrying out sustainability practices; the results are shown in Table 4.4.

Table 4.4 : Ratings of barriers that the companies face when implementing sustainability (N=25).

Barriers (Van Hemel & Cramer, 2002)	1		2		3		4		5		Mean	SD
	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)		
Doubts about the environmental benefit of the option suggested	18	72	2	8	5	20	0	0	0	0	1.48	0.82
The company does not feel responsible for realising the option	18	72	2	8	5	20	0	0	0	0	1.48	0.82
Only becomes relevant if supported by environmental legislation	8	32	2	8	5	20	9	36	1	4	2.72	1.37

Table 4.4 (continued) : Ratings of barriers that the companies face when implementing sustainability (N=25).

Barriers (Van Hemel & Cramer, 2002)	1		2		3		4		5		Mean	SD
	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)	<i>n</i>	<i>f</i> (%)		
Only becomes relevant if supported by market demands	3	12	2	8	7	28	8	32	5	20	3.40	1.26
Creates a commercial disadvantage for our company	14	56	6	24	5	20	0	0	0	0	1.64	0.81
Creates a conflict with actual functional product requirements	18	72	5	20	2	8	0	0	0	0	1.36	0.64
Not a challenging technological innovation opportunity	17	68	3	12	5	20	0	0	0	0	1.52	0.82
At the moment there is no proper alternative	18	72	3	12	4	16	0	0	0	0	1.44	0.77
New investments in redesigning the product in question as fruitless	16	64	6	24	2	8	1	4	0	0	1.52	0.82
Lack of sufficient time to realise the option	14	56	3	12	6	24	2	8	0	0	1.84	1.07
Lack of sufficient knowledge to realise the option	16	64	5	20	4	16	0	0	0	0	1.52	0.77

“The need to be supported by market demands” was rated as by far the biggest barrier with “the need to be supported by environmental legislation” as the next one. Other barriers receiving lower ratings are close to one another. These results are not

consistent with the surveys from the European Union, reflecting setbacks, inadequate legislation and differing market demand in Turkey.

4.2.5 Needs of companies regarding design for sustainability

Fifth, the companies rated their needs from a list of support instruments; the results are shown in Table 4.5. “Research & development” is rated the highest with all entries in the list rated high and close to one another. These results indicate the urgent need to develop effective support systems for sustainability in Turkey.

Table 4.5 : Ratings of support instruments that the companies indicated as being necessary for sustainability practices (N=25).

Support instruments (Kletzan-Slamanig et al., 2009)	1		2		3		4		5		Mean	SD
	n	f (%)	n	f (%)	n	f (%)	n	f (%)	n	f (%)		
Equity support	4	16	2	8	7	28	6	24	6	24	3.32	1.38
Research and development	1	4	1	4	4	16	12	48	7	28	3.92	1.00
Demonstration and commercialisation	5	20	0	0	4	16	10	40	6	24	3.48	1.42
Education and training	2	8	0	0	7	28	11	44	5	20	3.68	1.07
Networks and partnerships	3	12	0	0	7	28	9	36	6	24	3.60	1.23
Information services	4	16	2	8	10	40	5	20	4	16	3.12	1.27
Provision of infrastructure	4	16	2	8	4	16	11	44	4	16	3.36	1.32
Regulations and standards	2	8	2	8	10	40	3	12	8	32	3.52	1.26
Public procurement and demand support	7	28	1	4	3	12	8	32	6	24	3.20	1.58
Technology transfer	4	16	0	0	9	36	6	24	6	24	3.40	1.32

4.2.6 Collaborations on design for sustainability

Lastly, the companies were asked to list the support organizations with which they would like to collaborate to realize their future aims on sustainability; the results are compared to the list of organizations with which the companies already collaborated and shown in Figure 4.6.

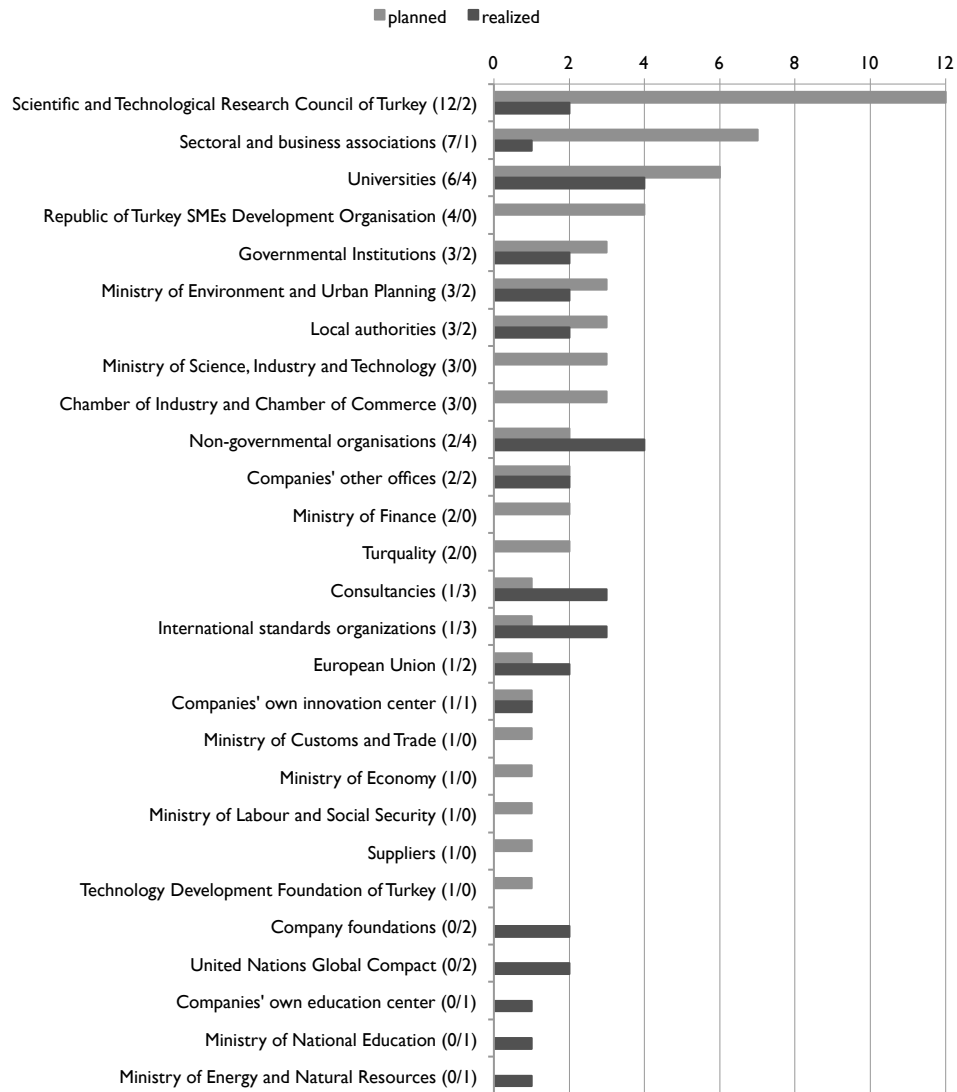


Figure 4.6 : Organizations with which the companies plan to collaborate in the future and with which they already have collaborated (the rate of the former to the latter is shown in brackets) (N=26).

The Scientific and Technological Research Council of Turkey is listed the most often. The participating companies listed several of the country's Ministries, which together amount to the second most listed group. Conversely, the number of companies that have already carried out projects in collaboration with the organizations listed here and the Scientific and Technological Research Council of Turkey is low. In addition, two companies indicated their offices in other countries and one company listed its own "Innovation Center".

Two surprising results are that the Technology Development Foundation of Turkey was cited only once as an institution with which the companies plan to collaborate and that it is yet to collaborate with any of the companies. Founded in 1991, the

Technology Development Foundation of Turkey is a prominent organization with the mission to improve global competitiveness of companies by supporting innovating activities in Turkey. The environment is one of two main foci of the organization, along with research & development, for which they offer support programs both for large and for small/medium enterprises (TTGV, 1991). For these reasons, it was expected to stand out in the survey along with the Scientific and Technological Research Council of Turkey. One reason for the Foundation being cited only once could be that its programs' scope is usually limited to pilot studies and thus, reaches a limited number of companies. Another reason could be that the funding schemes may not be sufficiently encouraging for the companies (Küçüksayraç et al., 2015). Some of the companies, with which the survey was carried out face-to-face, reflected on the issue and stated that they need at least one skilled employee to be able to undertake such collaborations, which they cannot afford, especially small/medium enterprises.

4.3 Conclusions

This study investigated the best performing companies in the sustainability field in Turkey by addressing the scope of their practices, the drivers for these practices, the barriers they face during the process, the benefits they achieve and their further needs on sustainability. The findings expand on, and somewhat differ from, those from previous studies in Turkey, while also differing to a greater extent from previous studies in Europe.

Findings indicate that the sample companies are more active in “producing and manufacturing” and “packaging” among the design for sustainability strategies, while previous studies in European countries show strategy foci such as “selection of low impact materials” and “high reliability/durability” as rated higher. Moreover, the departments that were delegated to complete the survey were predominantly “Production” and “Quality Management” Departments. These findings indicate that design for sustainability is mostly comprehended as an issue of production rather than product development. Therefore, designers and design teams need to be more proactive in the design for sustainability field. The drivers for companies to carry out sustainability practices mostly resulted as benefits, except for “product quality improvement” and “new opportunities for value creation”. Therefore, designers

should direct efforts to “product quality improvement” and “new opportunities for value creation” in design for sustainability activities.

Inadequate “market demand” and “legislation” are cited as by far the biggest barriers. This is consistent to some extent with previous studies in Turkey, but not consistent with studies in the European Union, which show that legislation and customer demand are the most important drivers. Besides, companies’ needs to carry out sustainability activities are mostly for “research & development” but high in all aspects regarding sustainability. It is difficult for companies to find specific organizations with which to collaborate and from which to receive support. These findings indicate the urgency to take action at the policy level for achieving sustainability at all levels. Furthermore, support mechanisms and intermediaries on design for sustainability need to be developed to meet companies’ needs, especially on “research and development”. In addition, the existing services need to be better communicated to companies.

A notable finding is that the sample companies are driven to “boost brand value and reputation” and to be pioneers in the field. This is consistent with the sample companies being selected among best performing companies in Turkey. Although previous studies cited it as the most important driver in Turkey, this study found “increase exports” to be considered the least important driver among the surveyed businesses. Moreover, the sample companies mostly export to European countries. This might indicate that their sustainability practices are not dependent on specific market conditions. This finding is in line with the literature suggesting that the internal drivers are stronger stimuli than the external ones. It is thus promising for overcoming barriers and providing a base for developing initiatives on supporting design for sustainability.

Although a 67% response rate is high, the results must be used cautiously because the total number of sample companies is limited. Additionally, this study reflects the participants’ responses to the survey but does not evaluate the implementation process or output. As seen in the literature review, more concrete results can only be achieved by implementing projects on design for sustainability.

This study provides a background for future research on design for sustainability in Turkey, as well as projects and support programs undertaken by universities and intermediary organizations for which it is crucial to understand the practices, barriers

and needs of the companies for designing efficient support services. Companies can benefit from the experience of best performing companies, which suggests that design for sustainability, even if its practices are limited, assures benefits. For greater impact, design for sustainability should be diffused into the industry and society.

This study answered the first research question of the thesis: “What is the current situation of best practice companies’ design for sustainability activities in Turkey?” However, the second research question, “How do the companies in Turkey succeed in implementing design for sustainability despite the inadequate legislation and market demand?” remains unanswered. Therefore, a consequent study that investigates two outstanding examples among the sample companies of this study in depth, one large and one small business, follows in Chapter 5.

5. DESIGN FOR SUSTAINABILITY IN COMPANIES: TWO CASE STUDIES FROM TURKEY²

This study investigates how companies practice design for sustainability in Turkey, where conditions are cited as insufficient, by studying one large and one small best practice company. It focuses on the role of designers, companies' design for sustainability practices and collaborations with third parties in these practices. It aims to develop the results of the first empirical study further through in-depth case studies. The conceptual understanding following the literature review and the scope of this empirical study are shown in Figure 5.1.

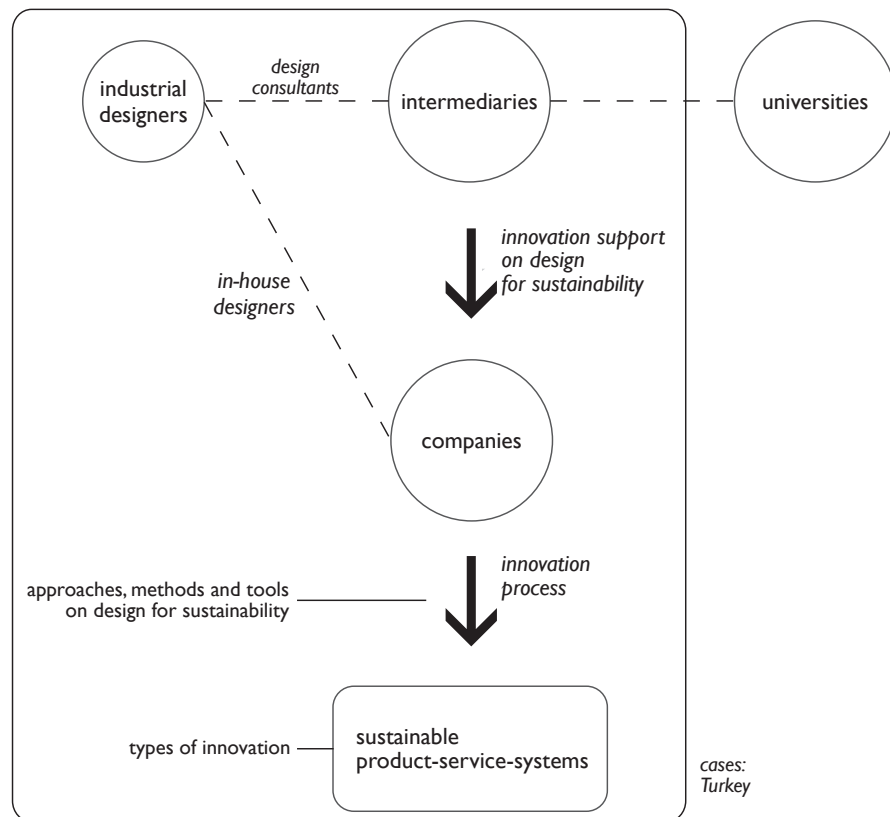


Figure 5.1 : Scope and initial conceptual understanding.

² This chapter is based on a submitted journal paper by Küçüksayraç, E.

The main research question of the study is: How do some companies in Turkey succeed in implementing design for sustainability despite the barriers? Three sub-questions are: (1) How do these companies practice design for sustainability? (2) How do the companies' in-house designers and external design consultants without a relevant educational background practice design for sustainability? And (3) How do these companies collaborate with third parties on sustainability?

The study aims to contribute to the literature on design for sustainability in Turkey described in Section 2.7 and further elaborated in Chapter 4, and to the literature on design for sustainability in companies and designers' roles in design for sustainability described in 2.1.

5.1 Research Method

Case study was selected as the method by aiming at particularization rather than generalization and to understand the design for sustainability process of the sample companies in depth (Stake 1995). Case studies do not provide the opportunity for the researcher to be actively involved in the process, to participate, test ideas and discuss solutions, but they provide independence and an objective research process (Svengren, 1993).

Case selection in this study is of the “best practice” type, which aims to improve the practice, while focusing on prizewinners is a common strategy (Langrish, 1993). The cases were selected through a former empirical study presented in Chapter 4. The case selection criteria in this study were that (1) the company should have more than one certificate and/or award on sustainability, (2) the company should be incorporating all three pillars of sustainability, and (3) the company should be working actively with industrial designers. Among the three small/medium enterprises that met the criteria, Steppen was selected, as it was the only company that has built a corporate strategy based on sustainability. And among eight large enterprises that met the criteria, VitrA was selected because of its advanced organization for sustainability, such as its Innovation and Sustainable Development Department, which filled out the questionnaire. The data gathered on the companies and their design and sustainability practices during the empirical study in 2011 that was presented in Chapter 4 are summarized in Table 5.1.

Table 5.1 : Summary of company profiles in 2011 derived from the empirical study presented in Chapter 4.

	Steppen	VitrA
Sector	Promotional products, particularly pens from biodegradable plastics	Bathroom products (VitrA is a company of Eczacıbaşı Group – Building Products Division)
Size	Small enterprise	Large enterprise
Number of employees	10 – 49 employees	> 250 employees
Turnover between 2008-2011	1 – 5 Million Turkish Lira	> 25 Million Turkish Lira
Export percentage	10%	40%
To how many countries export takes place and the countries to which the most of the export happens	To 25 countries in total 1. Russia 2. Belgium 3. Poland	To 85 countries in total 1. Germany 2. The United Kingdom 3. Italy 4. The United States 5. Switzerland
In house designers	-	+
Collaborations with external design consultants	• Gamze Güven and İnci Mutlu (1995 – 1998) • Ümit Altun - DESIGNUM (1998 – today)	Has been collaborated with internationally acclaimed designers and design consultancy companies
Design Awards	Design Turkey, Good Design Award, 2010, with 'Karaçam' Pen	Many design awards
Collaborations with NGOs	• TURMEPA • TEMA • ZİÇEV	Eczacıbaşı Group has found many Foundations functioning in arts, medicine, sports [for a complete list see Eczacıbaşı (2011a)] and has been collaborating with many NGOs
Collaborations with Universities	Istanbul Technical University Department of Industrial Product Design, Industrial Design Project Course, 2010 Spring	With many universities in Turkey

Table 5.1 (continued) : Summary of company profiles in 2011 derived from the empirical study presented in Chapter 4.

	Steppen	VitrA
Awards and certificates and projects on sustainability	• Part-time/home-office job creation for women in Ümraniye, (1996-today) • Istanbul Chamber of Industry, Environment-friendly Product Award, 2009 • ASTM5511 Certificate for the Biodegradable plastics used in the production • UN-GC Participant (2010) • Europe Business Awards Finalist, 2011	Among many awards and certificates, • ISO16001 Energy Management System Certificate, 2010 • Waterless Urinal, 11. Awards for Energy Efficiency in Industry, 2nd Prize in Product Category, 2010 • European Business Awards for Environment, 3rd company in product category (2.5/4 lt. Toilet), 2010

The evaluation process was qualitative so that criteria are not measured, but quality of practices is described and interpreted, as suggested by Stake (1995). The main data source for the case studies were semi-structured interviews and their details are shown in Table 5.2. Multiple data sources and multiple interviews with various interviewees from each company ensured data triangulation (see Yin, 2009). Each interview was transcribed and the data was reported by answering the sub-questions. The interviewees later checked the case studies for respondent validation and credibility (see Bryman & Bell, 2003).

Table 5.2 : Data sources.

	Steppen	VitrA
Interviews (Approximately 1 h each)	Co-Founder, R&D Manager 03.05.2011; 03.06.2013 Design Consultant 18.04.2012	Manager of Innovation and Sustainable Development Department Manager 07.12.2012; 11.12.2012 Industrial Design Department Manager 07.12.2012; 11.12.2012
Reports	Sustainability Report	Annual Reports; UNGC Communications on Progress; Sustainability Reports
Literature Additional data	Küçüksayraç & Er (2011) Catalogue on biodegradable plastics	Topaloglu and Er (2010) Environmental Product Declarations; Product Catalogues

In each case study, along with the background information on the company and organization and on design, sustainability and innovation, the development processes of products were elaborated. The aim was to elaborate and exemplify the companies' design processes and sustainability practices. The interviewees and researcher selected these products according to the impact achieved on sustainability and to represent various product development processes in terms of the role of industrial designers and the critical decisions on design for sustainability they encompassed. By these means, this study is explanatory, and the results are indicative.

5.2 Case Study I: Steppen

Steppen, which was founded in 1992, develops and manufactures promotional pens. Until 1995, they re-designed existing pen designs with achieving good quality, rather than design and innovation, as the emphasis. In 1995 they encountered the notion of industrial design while attending a Turkish Patent Institute (TPE) seminar. Following the advice by the Industrial Designers Society of Turkey (ETMK), they started to collaborate with İnci Mutlu and Gamze Akay, both acclaimed industrial designers from Turkey.

In 1998, during an exhibition of the Scrikss Pen Design Competition, the co-founder of Steppen, Tuna Yetkin, met first-prize winner Ümit Altun (BA in Industrial Design). Commissioned by Steppen, Altun designed a pen called "Carisma" with a rotating stalk mechanism. The product brought Steppen much commercial success, particularly in exports. Carisma's patent license was later violated in the international market and an influx of cheap counterfeits flooded the market. Steppen could not compete in price with the counterfeits causing sales to drop over time, but the pen design is still in production. However, after investing in design, Steppen's export rates grew as the company began to compete in a higher price segment, both in domestic and international markets.

In 2003, Altun founded his design consultancy company DesignUM though collaboration with Steppen continues. During the new product development processes, they collaborate on every step from ideation to prototyping. Altun provides Steppen with industrial design while also retaining the role of a design manager. DesignUM provides Steppen with consulting services on every design decision, such as graphic design, even if it is out of the scope of DesignUM's

services. Their mutually understanding and trust-based relationship exemplifies the “family approach” in the taxonomy of the external design consultant and client relationships (see Bruce & Docherty, 1993). Steppen never employed in-house industrial designers, but it works with a graphic design technician, who applies corporate logos on promotional pens.

DesignUM has been working in various sectors such as automotive, electronics, home appliances and furniture, and Altun indicates transferring knowledge between sectors, usually on production methods, as the consultancy company’s biggest contribution to client companies. Moreover, his experience with Steppen of providing comprehensive industrial design engineering services to a small/medium enterprise, and witnessing the resulting benefits also shaped DesignUM’s services and success. According to Altun, small/medium enterprises in Turkey usually do not have the resources (time and budget) for both design and engineering.

It was Steppen who introduced Altun to sustainability in practice. In time, DesignUM started to share the technical data on biodegradable plastics with other clients, such as in a recent project on food packaging, and in some cases, Altun consults Yetkin about the properties of materials.

5.2.1 Examples of design for sustainability applications

Steppen’s first exploration with biodegradable plastics started in 2008, after a client criticized the amount of plastics used and then discarded of every year. In 2009, they produced their first pens “Erguvan” and “Kökнар” from biodegradable plastic (cornstarch) and recycled paper (Figure 5.2) and received the “Environment-Friendly Product” Award from the Istanbul Chamber of Industry (İSO). With these pens, Steppen also won the Turkish Airlines bid for environment-friendly products, which enabled them to promote biodegradable plastics throughout the domestic market.



Figure 5.2 : Köknar / Karaçam / Bio-eraser.

Following production these two generic designs, Altun designed “Karaçam” (Figure 5.2), which received the highly publicized Design Turkey – Good Design Award. Karaçam is made of biodegradable plastic and recycled paper, and contains seeds inside its cap. Users can plant the cover into the soil after using the pen; the biodegradable plastic degrades, and the seeds grow into flowers. With the Karaçam pen, Altun aimed at one step higher from just being harmless to actually being beneficial to the environment and to better emphasize the pens’ environmental aspect. The design also offers solutions to the challenges biodegradable plastics bring, such as with labeling and composting (Ren, 2003).

The success of biodegradable plastic products both in production and sales enabled the company to convert the entire plastic production cycle to biodegradable plastics with FDS and ASTM5511 Certificates in 2011, which they also promote via the catalogues they publish (Figure 5.3). And recently, they started expanding their portfolio by producing sets, such as pencil trays, cardholders and erasers from biodegradable plastics (Figure 5.2).

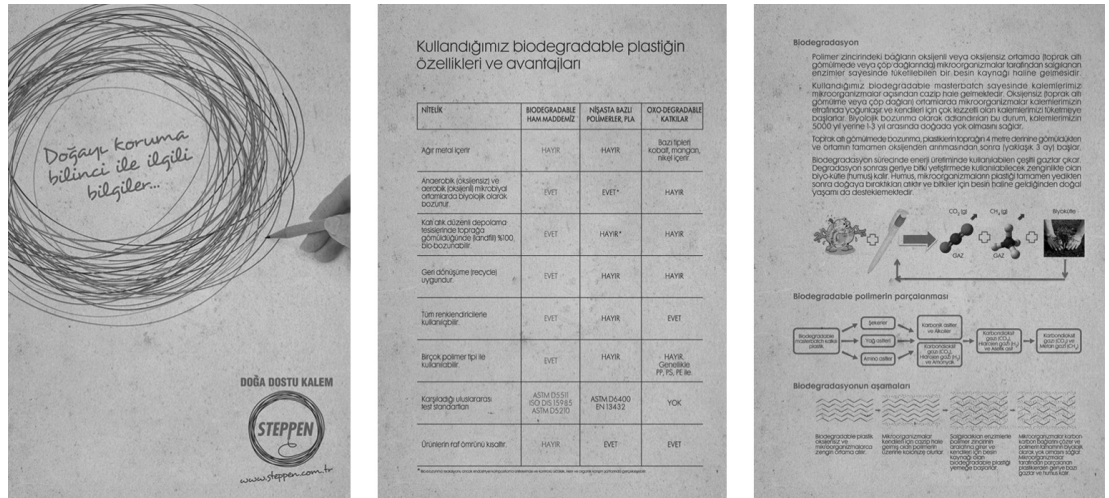


Figure 5.3 : Pages from the catalogue.

5.2.2 Collaborations on sustainability

In addition to the collaborations with the TPE and the ETMK on design and ISO on sustainability, Steppen has also been collaborating with NGOs, to which it donated a portion of the profits from Karaçam and recycled pens. Moreover, Steppen has been employing 200 women for the assembly of the pens in part-time and home-based job since 1996 in Ümraniye, where the factory is located.

An important milestone in Steppen's sustainability practices was signing the *United Nations Global Compact* initiative (UNGC, 1999) in 2008. When they first read the Compact, they realized that they had already been practicing most of its principles though their initial motivation for signing it was to improve corporate identity. In 2012, they started to commission the consultancy company Kıymet-i Harbiye for their sustainability reports (Steppen, 2013).

Acting for sustainability not only differentiated the Steppen's brand, but also opened new markets. In 2010, Metro retail group approached the company for collaboration after hearing Steppens' marketing manager on a radio program as a guest speaker following receipt of the İSO award. Until then, Steppen had yet to enter the retail sector. It was working business-to-business, as the commercial terms were difficult for them to meet. But Metro made Steppen an attractive offer to support their sustainability practices, which Steppen accepted.

Steppen currently benefits from government support loans for small/medium enterprises. It does not receive any other support because it finds the application and reporting processes too demanding. The company indicated marketing support and establishing vis-à-vis business relations as its most important needs, which were partially fulfilled in 2011 when Steppen was selected as one of the Turkey's 25 representative companies at the European Business Awards.

Behind numerous collaborations that Steppen has built are proactive individuals, particularly the co-founder, Tuna Yetkin. He has been proactive in the sector too, by co-founding "Promotürk" – the sector's organization for producers of promotional goods, which he chaired for three terms. Promotürk also organized design competitions in 2008, 2009 and in 2011 in collaboration with the ETMK, to diffuse design and innovation into the sector.

5.3 Case Study II: Vitra

Vitra manufactures bathroom products, is one of 39 companies in a prominent industrial group – Eczacıbaşı, and operates within its biggest division, Building Products (EBPD). Other primary sectors of the group are healthcare, consumer products and finance. International partnerships make up the core of the Group's growth strategy, which has six international joint ventures and numerous cooperation

agreements. The Group has also been influential in Turkey's social and cultural contexts through numerous projects, organizations and scholarships they have implemented or supported since the 1950s on arts, culture, policy, education, research, sports and health (Eczacıbaşı, 2006, 2011a, 2011b).

The roots of the Eczacıbaşı Group extend to 1912. Their first ceramic workshop was established in 1942, and their first plant for ceramic sanitary ware in 1958. Starting in the 1990s, EBPD developed a “multi-brand, multi-production site and multi-market” structure; and today, it operates globally with 12 companies, 15 production-sites and more than 2,000 retailers. The Group also achieved the highest export volume from Turkey to the European Union (Eczacıbaşı, 2001, 2011a).

EBPD and Vitra are dynamic in organizing and developing their capacity for innovation and sustainability. In 2009, Vitra received an award from the TPE for having the most patent applications. In 2011, they established a 5,000 m² R&D center called “Vitra Innovation Center”, where 75 experts work in collaboration with universities, research centers and consultants from Turkey and abroad. Moreover, methods for managing innovation have been adapted within the Group and EBPD starting in 2007, such as an idea generation and evaluation system called “Inocino”, and a product development program called “Blue Ocean”. In 2012, product development processes started to be managed by adapting a Stage-Gate model (e.g., Cooper, 2008). In addition, the group has been organizing the Eczacıbaşı Innovation Awards within the group since 1999 with the award categories “Product”, “Efficiency”, “Communication” and “E-Transformation”, to which “Sustainable Development” was added in 2011 (Eczacıbaşı, 2009, 2011b).

The group has been building its innovation processes for over ten years, with the approach on sustainability more recently integrated into the innovation processes. They consider sustainability as the new driver for innovation, growth and competitive advantage, particularly in developed markets. Their activities on eco-efficiency date back to the early 1990s, but their first concrete step was signing the UNGC in 2006. In 2007, the Group started establishing Sustainable Development Working Groups: (1) Environment and Workplace Safety and Health, (2) Efficiency in Buildings and (3) Product Responsibility, in which 70 employees recently participated (Eczacıbaşı, 2011b). In 2010, the position of “Vice President of Corporate Communications and Sustainable Development”, and in 2012, the

“Innovation and Sustainable Development” Department were established within the EBPD. They are the first examples of sustainable development in Turkey in terms of corporate organization.

EDPD, as a manufacturer of water-using products, invests both in technology to reduce the environmental impact during production and in design to reduce the environmental impact during use and to promote sustainable lifestyles. They call their approach to sustainability in production, design and management “Blue Life”. It was implemented by Vitra in the 2000s and developed into a labelling and cataloguing method in 2009. Following this, Vitra gained its international recognition and became the first manufacturing partner of the Environmental Protection Agency (EPA) (Eczacıbaşı, 2008a, 2011b). Blue Life products also contributed to the certification of green buildings such as LEED and BREEAM, and the product catalogues are compatible with the certificates’ rating systems.

5.3.1 Design processes

Vitra’s design activities started with an in-house design team in the 1960s and were limited to adaptations of both traditional and licensed foreign products to the needs of the domestic market until the 1980s. Vitra’s design capacity developed when they started to export and matured in the 1990s through collaboration with external design consultants from both Turkey and abroad. Following the strategy to make Vitra a global brand, in 2004, the company collaborated with designer Ross Lovegrove on three bathroom series, the first and most successful of which is called “Istanbul” (Figure 5.4). Designer selection as well as the size of the project indicated both increased financial resources allocated to design and increased importance of design within the corporate strategy. The projects earned the company both high commercial returns and global brand recognition (Topaloğlu & Er, 2010). Moreover, Vitra received national and international awards and was selected for the global branding program “Turquality” by the Turkish Undersecretariat of Foreign Trade in 2007 (Eczacıbaşı, 2007).



Figure 5.4 : “Istanbul” series designed by Lovegrove.

VitrA’s Industrial Design Department was reorganized in 2011. Designers had been working for the Product Development Departments of four production-sites until 2008, when separate Marketing and Sales Directorates merged into one, which included the Industrial Design Department. The reorganization aimed to better align the products better with corporate communications and various markets’ demands. The Department currently employs five industrial designers, who have undergraduate or graduate degrees in industrial design, and two technical documentation specialists.

Between 2011 and 2013, the Industrial Design Department won 16 international awards, including Red Dot and IF Design Awards. The in-house design team proved its mastery by also changing VitrA’s design strategy. Today, although more selectively, the company prefers to work with external design consultants because of marketing-related, rather than design-related, concerns.

VitrA, neither in its industrial design department nor in the VitrA Innovation Center, employs an expert on design for sustainability. Rather than aiming at sustainability in specific projects, they approach sustainability as an integral part of each project. *The FSC Certificates* (pertaining to bathroom furniture) and *the LEEDS Manuals* (pertaining to bathroom products) in particular lead the specification of product sustainability in VitrA.

5.3.2 Examples of design for sustainability applications

Examples of Blue Life products include a wide range of 240 products, such as water-saving flushing systems, waterless urinals, flow-regulating faucets, self-cleaning tiles and sanitary ware (Eczacıbaşı, 2011b).

Low-water consuming flushing systems were first launched with a three-liter half flush / six-liter full flush, enabling VitrA to become the first manufacturing partner

of the EPA. Later in 2008, Vitra launched a 2.5 liter half flush / four-liter flush system (Figure 5.5), which was the first Landesgewerbeanstalt Bayern (LGA)-approved system in the EU (Eczacıbaşı, 2009). A supplier developed the flush system, which was adapted to Vitra's products in the industrial design process. As in this example, the suppliers hold an important role in Vitra's product development and design for sustainability processes.

In 2004, Vitra developed "non-splash" urinals, an idea derived by the EBPD General Manager, who was inspired by the coastal structure in an Israeli town. The waves, however forceful, were not reaching the sidewalk as a result of the coast's concave surface. He shared this with the product development team and started a project for developing such a surface on urinals. A consulting company calculated the parameters of a non-splash surface and developed simulations, which Vitra adapted to ceramics. Aiming to strengthen the innovativeness of the series, with a design brief for creating the cognition of a non-splash surface and applying the pre-determined surface dimensions, the non-splash urinal was first introduced in the Istanbul Series designed by Lovegrove (Figure 5.5). The surface and the dimensions were later applied to lower segment products as well.



Figure 5.5 : Low water consuming flushing system / Non-Splash Urinal / C-line faucet.

In 2007, Vitra further developed non-splash urinals to be used without flush. Vitra was aware of the existing waterless urinal system that uses cartridges containing a special liquid that seeps into the drain to prevent bad odours and thus provide hygiene without using water. However, this system had disadvantages, such as the need to replace the cartridges regularly, hence creating waste, and dependency on the supplier. Thus, Vitra developed a mechanical cartridge that locks the urine inside preventing it and its odour from flowing back. This system requires only a

maintenance cleaning with 0.5-litres of water a couple of times a year, depending on the usage frequency, to prevent pipe damage. This way, it uses a negligible amount of water compared with the regular systems, which use 2.5-litres of water for each flush.

Another product example is the C-line faucet (Figure 5.5), which focuses on changing users' behavior towards more sustainable water consumption. Users need to first turn the C-line faucet 90 degrees to be able to start the warm water flow and then adjust the temperature by turning it backwards. This way, the C-line pushes users to make a conscious choice when selecting the water temperature. Its designer and Industrial Design Department's Manager, Seden Arzu Tek, observed that people tend to use warm water unconsciously by slightly turning the faucet to the warm side, which starts the heating system that consumes a high amount of energy, especially at the onset. Moreover, warm water might never reach users who only need a small amount of water; instead lingering in, hence causing damage to, the pipes. As the C-line was aiming to change user habits, the Sales Department retained some doubts and opted out of applying to the redesign of the company's mostly sold series. However, in time, the C-line received great returns, and Vitra recently discussed applying the system to each faucet. The industrial Design Department's Manager stated that they proposed incremental changes in the design because of the concerns, but the concept is promising for more radical changes, which they are currently exploring.

5.3.3 Collaborations on sustainability

After signing the UNGC, the Eczacıbaşı Group started reporting its sustainability activities through *the UNGC Communication on Progress Report* in 2007. Since 2009, they have been publishing a yearly Sustainability Report, for which they have commissioned PricewaterhouseCoopers (Eczacıbaşı, 2011b).

Appreciating the UNGC as a “good-intention” agreement, to work on sustainability more proactively, the Eczacıbaşı Group became the first member of the World Business Council for Sustainable Development (WBCSD) and joined its Turkey chapter in 2007. Between 2008 and 2011, the Group achieved a reduction of 7.2% in energy consumption, 8.6% in carbon emissions and 19.5% in water consumption. In 2010, they signed the *WBCSD Manifesto for Energy Efficiency in Buildings* and

promised a 15% reduction of their total energy consumption in five years (Eczacıbaşı, 2008b, 2011b).

EDPD also aims to be a leader to meet international standards regarding sustainability. For example, Vitra was the first company in Europe that produced faucets and components with Chrome+3 technology in 2004, which was in line with the EU's Integrated Pollution and Prevention Control Directive. Another example, in 2012, Vitra prepared *the Environmental Product Declaration* for the clays that are used in production, which was a first in the European Union. First the category was developed, and then EDPD became the first to receive the certificate from the Institut Bauen und Umwelt (Eczacıbaşı, 2004, 2011b).

5.4 Discussion

Steppen started with incremental innovation by experimenting with biodegradable plastics and moved to radical innovation by changing its production, and corporate strategy and identity towards sustainability. They benefited from the simplicity of their core product in the initial R&D process, but they were able to complete product development in one year and convert their whole production to biodegradable plastics in the following three years. Steppen engaged both marketing and management in sustainability, and later collaborated with an external design consultant on the company's design for sustainability brief. Design for sustainability practices earned Steppen new opportunities to create value and product innovation, differentiating the brand and raising its reputation. Although the pen's unit cost of production rose, a wider than expected new consumer-base was reached.

Vitra, with the aim to become a pioneer in its sector, invested in sustainability at many levels from developing the corporate philosophy "Blue Life" to developing and adapting standards. The company's sustainability-related operations are organized along a top-down hierarchy, starting from the executive management and spreading to departments and employees. Although design, which is one company's leading assets of the company, is not yet well integrated with sustainability aims, and the company does not employ an expert on design for sustainability, Vitra's Industrial Design Department takes the corporate philosophy on sustainability as a leading design input. The dynamic organization in the company for design,

innovation and sustainability is promising to develop more radical approaches in the near future and also hopes to secure the company's position as a pioneer.

In both cases, the commitment from the companies enables the designers to have a strategic role in design for sustainability decisions (Bakker, 1995) though the operational roles in design for sustainability need to be developed further. Although design for sustainability is a rather recent concept for both companies who are yet to fully develop the expertise to implement it, the case studies provide real life opportunities to observe recent issues discussed in the literature, such as the process of leading users towards sustainable consumption (Lilley, 2009). As the designers in the study have educational backgrounds in industrial design, this might support that ecodesign as a design process with additional considerations of environmental issues (Lofthouse, 2004). Nevertheless, rigorous applications of ecodesign, LCA and more integrative approaches such as PSS are not yet observed in the scope of design for sustainability practices of the case companies.

Based on the organizational issues that Deutz et al. (2013) listed as prerequisites for companies to incorporate environmental concerns into product design, both companies have overcome context-dependent constraints. Among the products described, Vitra's C-line faucet and Steppen's Karaçam pen exemplify design innovation in use. The C-line employs a "coercive" strategy (Lilley, 2009) as it pushes users to make a conscious decision before using hot water, a strategy that was accepted by users and has overcome the Sales Department's resistance. Karaçam, however, is more "informative" (Lilley, 2009) in its use of material resources, but it achieves a "meaning innovation" (Rampino, 2011) in the emotional and symbolic aspects of a pen.

Considering the three most important success factors for communicating ecodesign information within companies (Boks 2006), both companies use manuals (e.g., BEEM, LEEDS in Vitra) and standards (e.g., ASTM5511 in Steppen), and their managements are committed to sustainability. However, they lack a customized ecodesign tool, although not observed as a need in Steppen, would benefit Vitra should they decide invest in it.

The UNGC played an important role for both companies by implementing sustainability into corporate strategy, as also reflected in the literature (Çetindamar & Husoy, 2007). However, both cases consider the UNGC a "good intention"

agreement and aim to achieve more ambitious sustainability goals. Vitra developed its own capacity for innovation at Vitra Innovation Center, collaborates with many national and international partners and is even actively involved in developing new standards on eco-labelling. Although Steppen is a small company and according to the literature, expected to have limited capacity to implement sustainability (Hillary, 2000), the proactive individuals in the company accomplished many steps towards sustainability in a short time. They could benefit from public support in networking and commercialization, which they fulfilled to an extent through the awards they have received.

Previous case studies investigated pioneer companies such as Philips operating in the Netherlands, a country that aims to take the lead in the sustainability field and its knowledge-generation process (Cramer & Stevels, 1997; Stevels, 2007). The companies in developing and emerging countries were studied within projects aiming at diffusing design for sustainability through knowledge transfer from developed countries (e.g., Crul, 2003; Diehl, 2010). The case studies in this thesis differ from previous ones according to the countries in which they operate and the organization and processes they developed to overcome the limiting factors of the context.

5.5 Conclusions

This study explained how companies practice design for sustainability in Turkey, where conditions for sustainability such as legislation, market demand and support mechanisms are cited as insufficient. It aimed to inspire and inform other companies in Turkey, where the number of best practices on design for sustainability is very limited, and there are opportunities for new pioneers in many sectors.

The findings on the innovation types achieved in the sample companies indicate that companies can overcome limiting factors related to legal, economic and business issues and implement radical innovation on design for sustainability. If company managements are committed to sustainability, experienced and successful designers can practice design for sustainability by approaching the issue as a design problem, even if they lack a formal education and experience on the issue. Nonetheless, application of more radical strategies and rigorous operations can be achieved as long as knowledge and experience on design for sustainability are developed.

Moreover, for companies to overcome limiting factors on sustainability, national and international institutions offer necessary initial support. The biggest drivers in the process are proactive individuals and management's commitment to sustainability. Although large enterprises might be capable of developing their own capacity, small/medium enterprises are more in need for support from third parties. The case studies indicated that companies with available resources generate their own support mechanisms and processes.

Chapters 4 and 5 focused on the companies, which form the demand side of innovation support processes. Chapter 6 investigates the supply side of innovation support processes, namely intermediaries.

6. INTERMEDIARIES AND INNOVATION SUPPORT IN THE DESIGN FOR SUSTAINABILITY FIELD³

This empirical study (Küçüksayraç et al., 2015) investigates the state of the art of innovation support on design for sustainability in developed countries and in Turkey, with a focus on the services and support they offer, the approaches and drivers that shape them, as well as the challenges of the intermediation process, particularly concerning sustainability and design. To do this, 14 intermediaries from the Netherlands, the United Kingdom and Turkey were investigated through case studies. Based on the findings, a framework for a group of intermediaries that meets the needs of all types of companies regarding design for sustainability was suggested. The conceptual understanding following the literature review and the scope of the study are shown in Figure 6.

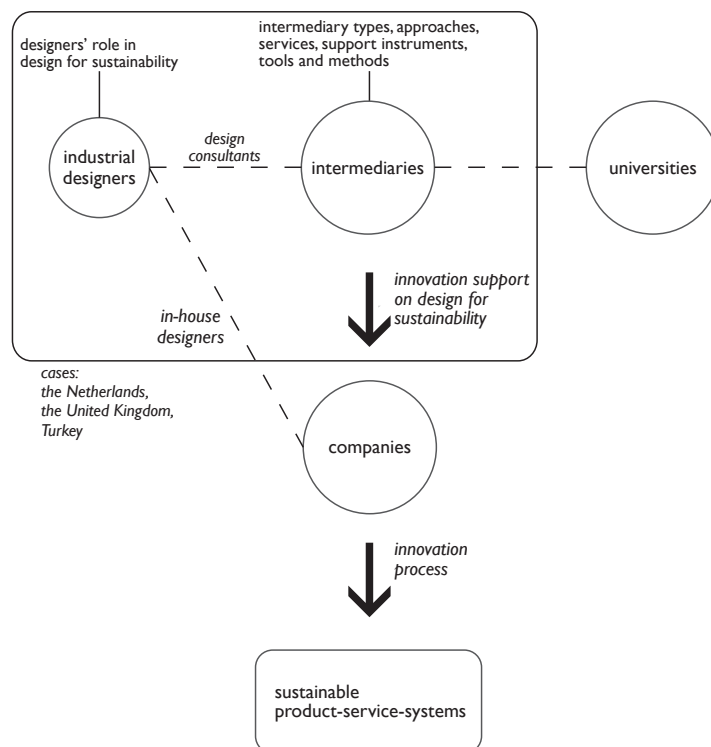


Figure 6.1 : Scope and initial conceptual understanding.

³ This chapter is based on Küçüksayraç, E., Keskin, D., & Brezet H. (2015). Intermediaries and innovation support in the design for sustainability field: cases from the Netherlands, Turkey and the United Kingdom. *Journal of Cleaner Production*, 101, 38-48.

6.1 Research Method

The literature on intermediaries focuses on their types, approaches, services, and support instruments but the question of how intermediaries function in the specific field of design for sustainability remains unanswered. Therefore, this study follows an inductive approach by developing theory in light of empirical data (see Saunders et al., 2009). It uses multiple case studies, which are useful in building theories by providing replications, extensions and contrasts (Eisenhardt, 1989). Case studies can be retrospective, real time or a combination of these two types (Eisenhardt & Graebner, 2007). The ones discussed here are retrospective. In addition, they are of the embedded rather than the holistic type, as they investigate multiple units of analysis (see Yin, 2009).

The study investigates 14 intermediaries with experience in the design for sustainability field in three countries, the Netherlands, United Kingdom and Turkey. The literature cites the intermediaries from the Netherlands and the United Kingdom as good examples, based on the “structural diversity and the growth of the types and variety of their organizations and institutional frameworks” of the two countries (Van der Meulen & Rip, 1998; Howells, 2006). In contrast, the report on sustainable consumption and production in Turkey cites the support mechanisms as being of limited variety and amount compared to the examples from the European Union (TR-MoEF & TTGV, 2010; Küçüksayraç, 2015). Therefore, the cases from the Netherlands and the United Kingdom are examined for “literal replication”, while the cases from Turkey are reviewed for “theoretical replication” with “contrasting conditions”. The replication logic is needed for external validation and for increasing the generalizability (see Yin, 2009) and the transferability (Bryman & Bell, 2003) of the results to other cases.

During case selection, theoretical sampling was utilized and most suitable cases were searched (see Eisenhardt & Graebner, 2007). Case selection started with intermediaries from the Netherlands and the United Kingdom that participated in the *Ecomind Project* mentioned in the literature review in Chapter 2 (Ecomind, 2009). The initial participants suggested other organizations, enabling a snowball technique (see Saunders et al., 2009). The selection process in Turkey was launched with a prominent intermediary, which focuses on the two main fields of sustainability and entrepreneurship, and by discussing a list of potential participants with the

interviewees. In total, five intermediaries from the Netherlands, five from Turkey and six from the United Kingdom were invited to participate in the study and except for two intermediaries from the United Kingdom, all of them accepted (Table 6.1).

Table 6.1 : List of participating intermediaries.

Organization	Country	Interviewees and date of the interviews
BECO	NL	Founder and Director, 11.01.12
BSK- CIC	UK	Project Manager, 15.12.11
THE CENTRE FOR SUSTAINABLE DESIGN	UK	Director, 15.12.11
DESIGNUM	TR	Founder and Director, 18.04.12
DYNAMO	NL	Former Manager, 12.01.12
ENVIU	NL	Manager Research & Innovation, 21.12.11
GIRAFFE INNOVATION	UK	Co-founder and Director, 01.05.12
IDEAL&CO	NL	Co-founder, 12.12.11
ISTANBUL CHAMBER OF INDUSTRY	TR	Manager of Environment Department; Environmental Engineer, 23.03.12
REGIONAL ENVIRONMENTAL CENTER - TURKEY	TR	Corporate Communications Manager; Project Assistant, 14.03.12
SUSTAINABILITY ACADEMY	TR	(Three) Board Members, 09.04.12
SYNTENS INNOVATIE	NL	Adviser, 19.12.11
CENTRUM TECHNOLOGY	TR	
DEVELOPMENT FOUNDATION OF TURKEY		Expert, 16.04.12
WSX ENTERPRISE	UK	Project Manager, 16.12.11

An important issue encountered during case selection was the low number of intermediaries operating exclusively in the design for sustainability field. Therefore, the cases were selected with a wider criterion, namely those working on sustainable consumption and production and having experience in the design for sustainability field. Their experience on design for sustainability was necessary to ensure a common understanding of design for sustainability. The main focus fields of the participating intermediaries are listed as part of general information about the intermediaries later in this sub-section (Table 6.4).

During data collection, multiple sources of evidence were used for data triangulation (Yin, 2009). They are a survey (Appendix B), structured interviews (Appendix C), web sites of the intermediaries and additional sources provided by the intermediaries

such as the tools they developed, case studies and reports on support processes. The topics of analysis, the studies in the literature that investigated them previously and the their descriptions are listed in Table 6.2. The topics of analysis were determined following the research question and the literature review. They served as the starting point to designing the survey and interview questions. Only one topic of analysis – the approaches of intermediaries, was not asked to the interviewees because of time limitations and the time required for explaining each single definition. Instead, the researcher evaluated if the cases fit the approaches or not, which are described in the literature review in sub-section 2.2.3 (see Van Lente et al., 2003; Winch & Courtney, 2007; Klerkx & Leeuwis, 2008). Table 6.2 is revised according to the findings from the study.

Table 6.2 : Conceptual understanding following the literature review.

Unit of Analysis	Study	Description
Services of intermediaries	Not studied	workshops / consultancies / conferences / educational programs / incubation programs / governmental projects / EU projects
Support instruments used by intermediaries	EC (2009b)	financing / networking and cooperation / awareness raising / internationalization / technology and knowledge transfer / identifying potentials and needs / innovation management / creation of specific skills
Types of intermediaries	EC (2009b)	innovation and business development agency / university and research centre / chamber of commerce and business association / incubator and science park / cluster organisation / private consultants
Approaches used by intermediaries	Van Lente et al. (2003) Winch & Courtney (2007) Klerkx & Leeuwis (2008)	hard / soft / systematic top-down / bottom-up public interest / private interest
Drivers that shape the approaches used by the intermediaries	Not studied	

Table 6.2 (continued) : Conceptual understanding following the literature review.

Unit of Analysis	Study	Description
Challenges that the intermediaries face during the support process and regarding sustainability	Backhaus (2010)	more attention to the context, stakeholders, monitoring, evaluation and learning is needed / building longer-term implementation plans and funding schemes is needed
Tools and methods that the intermediaries utilize	Bakker (1995) Crul & Diehl (2006)	operational / strategic redesign / benchmarking / new product design / product-service-systems
	Bovea & Perez-Belis (2012)	qualitative / semi-qualitative techniques / quantitative
The role of design in the support process	Hargadon & Sutton, 1997	‘brokers of technology’

The interviews with all the intermediaries in the Netherlands and four out of five of the intermediaries in Turkey were carried out face-to-face, whereas the rest of the interviews were carried out via online meetings. They lasted between 30 and 90 minutes and were recorded and transcribed for reliability of the study (see Bryman & Bell, 2003). Following a preference for anonymity by most of the participants, the intermediaries are referred to with codes (INT-A, INT-B, INT-C, and so on) throughout this study. The anonymity especially helped the interviewees to elaborate their answers about the challenges.

Ten out of 14 interviewees reviewed the information in an earlier version of this study for respondent validation and to ensure increased credibility and data triangulation (Bryman & Bell, 2003). In the analysis, pattern-matching logic is utilized for internal validity (see Eisenhardt & Graebner, 2007; Yin, 2009). The repeating and contrasting patterns within and across the cases as well as between theory and empirical data are reported in the findings and discussion. In addition, revised conceptual understanding is presented in Section 6.2.9.

General information on the intermediary cases is summarized in Table 6.3 and Table 6.4.

Table 6.3 : General Information on the Intermediaries – Part 1.

Cases	Cou ntry	Year of establis- ment	Nature of the institution	Main target group	Type
INT-A	NL	2009	Social Enterprise	Start-ups	Incubator
INT-B	NL	2004	Hybrid	Start-ups	Innovation and business development agency, Incubator
INT-C	NL	1998	Public	SMEs	Innovation and business development agency
INT-D	NL	1990	Private	SMEs, LEs, Government, NGOs, sectorial organisations	Private consultant
INT-E	NL	2004	Private	All	Private consultant
INT-F	UK	2007	Community Interest Company	SMEs, start-ups, Government, NGOs	Innovation and business development agency, Private consultant
INT-G	UK	1995	Public	SMEs, LEs	University and research centre
INT-H	UK	2006	Private	SMEs	Innovation and business development agency
INT-I	UK	2001	Private	SMEs, LEs, Government, NGOs	Private consultant
INT-J	TR	2004	International diplomatic organisation	All	International diplomatic organisation
INT-K	TR	1991	NGO	All	Innovation and business development agency, Private consultant
INT-L	TR	1952	NGO	SMEs, LEs, Government, NGOs	Chamber of Industry
INT-M	TR	2010	Private	All	Private consultant
INT-N	TR	2003	Private	SMEs, LEs	Private consultant

Table 6.4 : General Information about the Intermediaries – Part 2.

Cases	Funding source	No of employees	No of in-house designers	Field of focus	Is sustainability the main focus?
INT-A	Service receivers, Subsidies, Sponsors	5	1	Innovation, Sustainability, Technology	YES
INT-B	Service receivers, Funds, Sponsors, Co-founders, Investors	20	3	Business, Innovation, Sustainability	YES
INT-C	Ministry of Economic Affairs	350	60	All	NO
INT-D	Service receivers, Funds	45	5	Business, Innovation, Sustainability, Technology	YES
INT-E	Service receivers, Funds	5	5	Design, Innovation, Sustainability	YES
INT-F	Service receivers, Funds	50	-	Business, Innovation, Sustainability	NO
INT-G	Service receivers, Funds, Fund generated from conferences	3	-	All, mostly Innovation, Sustainability	YES
INT-H	Funds, commercial arrangements	16	3	All, mostly Business, Design	NO
INT-I	Service receivers, Funds	5	2	Business, Design, Sustainability	YES

6.2 Findings and discussion

The topics of analysis listed in Table 6.2 form the following subsections. As not all the intermediaries focus solely on design for sustainability, most of the findings cover the broad scope of sustainability. Hence, specific aspects of design for sustainability are discussed separately in Section 6.2.7 as well. In addition, country specific findings are discussed separately in Section 6.2.8. The responses of each sample intermediary to each topic of analysis are listed in Table 6.5 and Table 6.6.

Table 6.5 : Analysis of the interviews – Part 1.

Cases	Strategies of intermediaries	The drivers that shape the intermediaries' approach:	Challenges that the intermediaries face during the support process:
		1. Proactive individuals 2. Pioneer companies 3. Demand of companies 4. Policy	1. Uncertainty (mainly financial) 2. Inadequate funding sources 3. Meeting the goals in limited time
INT-A	Focusing only on sustainable products and services.	1, 3	1
INT-B	Focusing on developing their own sustainable projects.	1	1, 2, 3
INT-C	Utilizing AIDA model.	3, 4	2, 3
INT-D	Challenging companies' business models, products and process. Having partners worldwide	1, 2, 4	1
INT-E	Focusing on realizing sustainable ideas.	1, 2, 4	1, 2, 3
INT-F	Focusing on business benefits of integrating sustainability.	4	3
INT-G	Being project-driven	3	1, 2, 3
INT-H	Focusing primarily on companies' needs	4	2, 3
INT-I	Aiming to inspire companies	1, 4	3
INT-J	Being a think tank, which also runs projects	3	3
INT-K	Focusing on pilot studies for introducing new concept and projects	1	3

Table 6.5 (continued) : Analysis of the interviews – Part 1.

Cases	Strategies of intermediaries	The drivers that shape the intermediaries' approach:	Challenges that the intermediaries face during the support process:
		5. Proactive individuals 6. Pioneer companies 7. Demand of companies 8. Policy	4. Uncertainty (mainly financial) 5. Inadequate funding sources 6. Meeting the goals in limited time
INT-L	Aiming to transfer knowledge to the industry	1, 2, 4	3
INT-M	Aiming at creating platforms for networking	1	3
INT-N	Delivering a research-driven new product development	1, 2	3

Table 6.6 : Analysis of the interviews – Part 2.

Cases	Challenges the intermediaries face regarding sustainability:	Tools and methods that the intermediaries utilize:	Role of design in the support process:
	1. Reaching target group with the right message 2. Assessment and monitoring, 3. Sustainability perception 4. Only few good examples exist	1. Uses qualitative tools, 2. Uses both qualitative and quantitative tools, 3. Develops tools 4. Directs companies to third parties	1. Industrial design, 2. Design thinking 3. Operating design for sustainability tools and methods. 4. Does not employ in-house designers
INT-A	1	1, 4	2
INT-B	2, 3	3	2
INT-C	1	3	2
INT-D	3	2, 3	2, 3
INT-E	1, 2, 3	2	1, 2, 3
INT-F	1, 3, 4	2	4
INT-G	1	4	4
INT-H	3	3, 4	2, 3
INT-I	3	2	1, 2, 3
INT-J	1, 4	1	4
INT-K	3, 4	2	4
INT-L	1, 4	4	4
INT-M	1, 3, 4	1	4
INT-N	3, 4	1, 4	1, 2

6.2.1 Services and support instruments provided by the intermediaries

In the survey, the interviewees were asked to evaluate the services and support instruments that were listed in Chapter 2 (EC, 2009a) according to the frequency with which they utilize them (Table 6.7).

Table 6.7 : The most frequent services and support instruments that the intermediaries offer (ranging from 0=never to 4=always).

	Services							Support instruments								
	Workshops	Consultancies	Conferences	Educational programs	Incubation programs	Governmental projects	EU projects	Financing	Networking and cooperation	Awareness raising	Internationalisation	Technology transfer	Knowledge transfer	Identifying potentials and needs	Innovation Management	Creation of specific skills
INT-A	3	2	2	3	4	1	1	4	4	4	2	4	4	4	4	4
INT-B	3	4	1	3	4	1	2	1	4	3	1	1	3	4	2	2
INT-C	4	4	4	2	2	4	2	4	4	4	4	4	4	4	3	3
INT-D	4	4	2	2	1	4	2	1	4	4	4	4	4	4	4	4
INT-E	2	4	1	1	0	2	0	0	1	2	1	4	4	4	1	2
INT-F	4	3	1	3	1	2	4	4	4	2	4	2	2	4	3	2
INT-G	4	4	4	4	0	0	4	3	3	3	3	3	3	3	3	3
INT-H	3	3	0	2	2	3	3	1	4	3	1	2	2	4	4	1
INT-I	4	4	0	2	0	4	1	0	0	4	0	4	4	4	4	2
INT-J	4	0	4	4	0	4	4	2	4	4	4	1	4	1	4	4
INT-K	2	2	1	2	2	3	4	4	4	4	4	4	4	2	2	1
INT-L	3	3	3	3	0	2	3	2	3	3	3	3	3	3	1	3
INT-M	4	4	4	4	4	2	2	0	4	4	2	0	4	3	4	4
INT-N	2	4	2	2	0	2	0	0	1	1	1	3	3	4	2	2

Table 6.7 indicates that some intermediaries, such as INT-C, INT-G and INT-J, aim to provide a wide range of services, while some intermediaries, such as INT-E, INT-I and INT-N focus on delivering only specific types of services. The same is relevant for support instruments. Nonetheless, it is also possible to focus on one type of service and still offer a wide range of support instruments, such as those realized by INT-K.

When evaluating the list of services and support instruments (Table 6.7), the intermediaries were also asked to expand it if necessary. They suggested including

“contests” and “publications” in the list of services and “business development” and “co-creation” in the list of support instruments. As they also suggested evaluating technology and knowledge transfers separately, the results are shown accordingly (Table 6.7). Among the services, the intermediaries offer “workshops” and “consultancies” the most, and “incubation programs” the least. Among the support instruments, they offer “knowledge transfer” and “identification of potential and needs” the most and “financing” the least.

Interview responses indicate that the sample intermediaries develop their services to suit specific target groups, regions, sectors and issues. Tailor-made services are developed either according to the needs of companies or the requirements of funding organizations. Organizing educational programs such as seminars and workshops helps intermediaries to build networks of companies and to promote their more comprehensive services such as consultancies. The educational programs usually aim to be informative and inspiring. The sample intermediaries frequently include case studies of best practices, which exemplify the underlying principles while also illustrating practical implementation for the companies.

The scope of consultancy services offered by the sample intermediaries depends on the type of intermediary and the scope of the support programs. If the intermediary aims to reach a broad group of companies, the service is limited in terms of support time. This kind of consultancy services aims at identifying potentials and needs, determining the business and sustainability goals for the company, and developing a strategy for achieving them. They are common in funded projects, such as European Commission-financed Programs. As in funded projects the services are drawn with clear definitions, some intermediaries prefer working on more than a single project at the time to be able to better direct companies to various services within different programs according to their needs. The intermediaries also collaborate with each other in directing companies to a suitable intermediary and the programs they run. Another way to overcome the time limitation is to direct companies to third parties for a comprehensive consultancy, such as to private consultancy companies that work on new product development or the life cycle assessment of products. One intermediary summarized this approach with the marketing model “awareness, interest, desire and action (AIDA Model)”, limited consultancy services aiming at

generating “awareness” and “interest” and comprehensive consultancy services aiming at creating “desire” and “action”.

According to intermediaries, in providing comprehensive consultancy services, the intermediary is able to design the support process tailor-made to meet the needs of the companies, so that the scope and span of the project is decided together with the company. The sample intermediaries prefer to participate in designing the whole process with the companies from the early stage, to ensure a more integrative approach. But companies usually consult intermediaries once they have defined their goals and started the innovation process. The consultancy companies surveyed work mostly on sustainability reporting, which includes detailed assessment and advice but stops short of implementation. The companies’ R&D departments usually implement the advice. Among the cases, INT-D from the Netherlands is an experienced consultancy company, which has been working on sustainability with large enterprises and multi-national corporations since 1990. It builds teams specialized in specific fields and improves its own overall capacity by multiplying these teams. It emphasizes that for working with multi-national corporations a global delivery system is needed. This way, if a client’s supply chain is abroad, the intermediaries can provide on site consultancy via the international partners.

The sample design consultancy companies are, by contrast, concerned mainly with the implementation process. For example INT-E’s company mission is based on the difference between advising and implementing. Its founders used to work mainly on sustainability reporting before establishing the company. With time they realized that the consultancy reports and recommendations, although much appreciated by the clients, usually were not implemented. Moreover, the consultancy services and reporting already consumed most of the companies’ budgets. Therefore, INT-E decided to focus on the implementation process and changed the scope of its services. Similarly, thanks to its team’s educational backgrounds in industrial design engineering and environmental science, INT-I offers a wide range of services, from life cycle assessment to design consultancy, product’s eco-certification and PR campaigns.

6.2.2 Types of intermediaries and their approaches

The sample intermediaries stated that they have either built their services with sustainability as the main focus, or have gradually integrated sustainability into their innovation support services. Sustainability is seen as a competitive tool, therefore as a need.

The classifications on intermediary approaches by Van Lente et al. (2003) and Winch & Courtney (2007) cited in the literature review are not adequate to fully describe the sample intermediaries. They focus on the approaches and study them in two or three groups but do not focus on the more general intermediary attributes. Therefore, listing a set of intermediary attributes is necessary (see Table 6.3 and Table 6.4) to be able to fully grasp the intermediary types. Each case differs from others when considering the set of attributes. It should be noted that the study did not aim to cover every possible type of intermediary, as it followed a theoretical sampling logic (see Eisenhardt & Graebner, 2007) as explained in Section 6.1.

Considering the types and approaches of intermediaries, listed in the literature review, one intermediary, INT-B, was found to be an emerging intermediary type, which needs to be studied further. INT-B creates sustainable business ideas with the contribution of a huge network of volunteers, experts, investors and entrepreneurs and develops them further into start-ups by targeting radical innovation for sustainability. INT-B relies on its team of entrepreneurs to establish the start-up companies with which it then partners. With almost ten years of experience in the sustainability business, it also recently started providing consultancy services to other companies.

6.2.3 The drivers that shape the intermediaries' approach

According to the interviewees, proactive individuals within intermediaries, pioneer client companies, policies and companies' needs are drivers that shape the services and approaches offered by intermediaries.

Among the drivers, policies have a pivotal role in generating and shaping support processes through legislation and funds. They require companies to adopt new legislation, while the funding opportunities require intermediaries to work on the defined subjects. Intermediaries need to translate legislation for the companies and align them with their business goals. While legislation is a way of pressuring

companies, sustainability goals should be approached as an opportunity for innovation.

Moreover, although sustainability is becoming mainstreamed in European countries, its rank in the list of priorities differs according to time and geography. INT-B observed that recently political agendas have prioritized entrepreneurship and innovation over sustainability, while investors have become more interested in sustainability projects. To find a balance, the path INT-B follows starts with a strong business idea on sustainability and eventually integrates it with the entrepreneurship and innovation angle.

Proactive individuals within intermediaries and pioneer companies are important drivers in shaping best practice examples and in raising the quality of support processes. The intermediary with longest experience in sustainability, INT-D, started operations in 1990 with pollution prevention. When the concept of cleaner production gained importance in the early 1990s, demand from companies rose enormously. Nonetheless, the scope and quality of their services developed further mainly while working with pioneer companies that also aim to take the lead in the sustainability field.

6.2.4 Challenges that the intermediaries face during the support process

According to the interview responses, the interconnected challenges that the intermediaries face during the support process are financial uncertainties, inadequate funding sources and meeting the goals within limited time and budgets. These challenges are in line with the conclusions offered by the *Changing Behaviour* project on supporting intermediaries (Backhaus, 2010) mentioned in the literature review.

Some of the sample intermediaries observed that full funding sources on sustainability have been decreasing in recent years, following the economic recession. Thus, sustainability targets need to be realized with diminished funding resources. INT-B stated that they now focus on simpler projects that can be tested and prototyped in short time, and are service-oriented and not capital-intensive. They however still keep the same aims on sustainability. They need to choose the projects they work on wisely, both to be able to develop the portfolio and credibility for which they aim and to find the “exciting” projects that match and reflect their aims.

Interview responses showed that, the challenges the intermediaries face depend on their structure as well. For example INT-G described as challenging efforts to run a 100% externally funded entrepreneurial unit within the university's bureaucratic apparatus, until they compiled a portfolio. Another intermediary complained about the challenges inherent with growth and expansion, for example finding people with the right skill set and experience on sustainability to join the core team.

6.2.5 Challenges the intermediaries face regarding sustainability

The challenges that the sample intermediaries face regarding sustainability are: Reaching the target companies with the right message, companies' understanding of sustainability, and low number of studies on best practice. Some interviewees cited "assessing and monitoring the sustainability impact" as an important challenge, especially in evaluating the social impact of the practices. This issue is elaborated further in Section 6.2.6.

The first challenge regarding working on sustainability is mostly relevant when small/medium enterprises are the target group. The sample intermediaries indicated that to elicit interest from a large number of small/medium enterprises, the right message should be developed by aligning sustainability goals with the enterprises' needs and by emphasizing the economic benefits of the support programs. According to INT-G, which worked with a high number of small/medium enterprises (around 600), attracting companies to attend workshops is becoming harder. E-marketing and social media are necessary, but time-consuming.

The second challenge, related to the first challenge, is the companies' limited understanding of sustainability. Most of the intermediaries explained that companies usually do not fully grasp sustainability with all its environmental, economic and social dimensions. They instead perceive it simply as a cost driver. Within the support programs, there is a need for rewording "sustainability" and emphasizing the opportunities that the program aims to create. The same challenge is relevant for consumer perceptions. To help companies deliver the right message on sustainability to consumers, the intermediaries organize workshops on sustainable marketing.

The third challenge, the low number of studies on best practices, concerns mostly intermediaries from Turkey. INT-F from the United Kingdom also mentioned this challenge, but from another perspective. They observed that the companies working

in the sustainability field are struggling to find like-minded companies to work with, such as marketing agencies and suppliers. For that, they pointed to “Sustainable Business Partnership” (Sustainable Business, 2012) in the United Kingdom as an effective initiative offering an online network of companies working on sustainability.

6.2.6 Assessment tools and methods that the intermediaries utilize

The sample intermediaries use qualitative and quantitative methods or a combination of these for preparing the sustainability assessment, depending on the needs of the companies and scope of the projects. The most common methods and tools they employ are cradle-to-cradle, life cycle assessment tools, carbon foot print tools, and smart meters. When these tools are too restrictive for the support process, the intermediaries prefer flexibility by monitoring company processes intuitively. For that, they discuss each step of the support process with the company and advise it on the ideal direction to follow.

Some of the cases developed their own assessment tools by addressing several concerns. These are: integrating social impact into the assessment, allowing reassessments during the dynamic support process, adapting the existing tools to the companies’ specific needs and better integrating the design process into the assessment. The new tools they develop are usually qualitative. One intermediary developed a tool in the form a game.

Another common solution adopted by the intermediaries is directing companies to third parties such as official labels, verification and accreditation institutions and outsourcing the assessment rather than employing in-house experts for carrying it out.

6.2.7 Role of design in the support process

Among the cases, six of them employ in-house designers. Three of these intermediaries are design consultancy companies. All three of them see sustainability as integral to industrial design and as a challenge to practice, while at the same time providing opportunities for creativity. Nevertheless, the scope of design for sustainability practice depends mostly on the educational background of the industrial designers working for the consultancy companies. In the Netherlands and

the United Kingdom universities offer both undergraduate and graduate courses, modules, and programs on design for sustainability. In addition, team members with a background in environmental sciences enable the design consultancy companies to also carry out complex data analysis in sustainability assessments.

The other three intermediaries employ in-house industrial designers, although they do not offer design services (all of them are from the Netherlands). The role of the industrial designers in this case is to act as “design thinkers” (see Section 2.2.1), who contribute design knowledge and experience to the support process. INT-D indicated that they have been employing industrial designers since 1995, when they started to work on product optimization. Today, the in-house industrial designers mainly work on life cycle, cradle-to-cradle and eco-design assessment and strategies, but not on designing and implementing products and services. Similarly, INT-C explained that their in-house designers are working in the front end of the support process, which specifies the design process rather than delivering industrial design services. They do not offer direct product design services in order not to interfere with design consultancy companies in the market. This also stems from the fact that in the Netherlands public organizations do not compete with the private sector, which is strictly controlled by the Netherlands Competition Authority and society.

The six above-mentioned cases collaborate extensively with universities in the industrial design field. These collaborations take several forms. One form entails industrial design students involved in the support process of design project courses for designing and prototyping products and services. Another form entails collaborating with students from more than one discipline, such as industrial design and economics, with the aim to explore the process of collaboration and interaction. On a more advanced level, universities enter research-based collaborations either as partner institutions in funded projects, or by commissioning researchers for projects such as on developing a tool to be used by the intermediary.

Other cases that do not employ in-house industrial designers direct companies to third parties, if they need design services. Third parties are also connected through design programs such as *Designing Demand* in the United Kingdom, *CLICKNL* in the Netherlands, and networks of designers such as “the Association of Dutch Designers” in the Netherlands and “Industrial Designers’ Society” in Turkey. The

companies are not always able to detect their specific industrial design-related needs. Rather, the intermediaries identify them during the support process.

6.2.8 Country-specific findings

Although it is beyond the scope of this study to compare the capacities of intermediaries in each country systematically on a broad basis, some differences can be observed. Intermediaries in the Netherlands have defined roles and scopes, and operate within established boundaries they are all careful not to intersect. Moreover, here the intermediaries cover a full spectrum of design for sustainability services to meet companies' needs. In the United Kingdom, the participating intermediary services overlap more in target groups and scopes than in the Netherlands. This could be explained to some extent by comparing the countries' population, but is actually more dependent on the policies and cultural backgrounds of the respective countries.

By contrast, the data indicate that intermediaries in Turkey still need to build their capacity. The services are mostly informative, and implementation programs are limited. Promoting sustainability through competitions and awards is also a common and important strategy for raising awareness, as the legislation is inadequate and company practices are mostly non-mandatory and voluntary. Although knowledge and experience on design for sustainability is not developed yet, recently it started to expand into innovation support. For example, INT-J published a Turkish language manual on eco-design in 2011 and INT-M has been including design for sustainability as a theme in their regular conferences. Furthermore, international collaborations were established to transfer knowledge and expertise on design for sustainability. To further illustrate this, the interviewee for INT-G was a guest speaker at a conference hosted by INT-M, and INT-I has client companies in Turkey.

These results were expected as the literature cites that Turkey's institutional capacity for sustainability is limited compared to the examples from the European Union (TR-MoEF & TTGV, 2010; Küçüksayraç, 2015). INT-K suggested an important aspect for improving the services on sustainability in Turkey. They work on implementation through pilot studies and whenever public funds support them further, they develop the projects into a bigger scale. Still the number of projects and the companies involved are limited. Furthermore, demand from companies for design for sustainability is not developed yet in spite of available funds in the field. For

example INT-K's services cover the design for sustainability field, but they are yet to receive requests specifically for design for sustainability from companies. They stated that the existing funds come from R&D support and they do not take the benefits of sustainability for both the companies and society into account. Yet, investing in sustainability is less risky than investing in R&D, especially in areas such as energy efficiency. For the programs, companies usually need to pay half of the investment themselves. The intermediaries usually offer loans and investigate the applications very carefully to ensure repayment ability while they cannot offer attractive support to the companies. For that they suggest redesigning the existing support services or creating new and more flexible funds. Furthermore, INT-N from Turkey stressed that meeting the needs of a greater number of companies, generating an information-database on sustainability, as well as a network of intermediaries that can meet companies' needs in collaboration are urgent needs in Turkey.

6.3 Discussion

Findings for some of the topics of analysis are summarized in Table 6.8, and the rest of them will be discussed in detail in the following paragraphs. Among these, the role of designers were grouped under three themes based on the findings: (1) industrial design, (2) design thinking, (3) operating design for sustainability tools and methods. This distinction is useful as some of the designers in the sample intermediaries do not carry out new product development processes, but contribute to the processes as "design thinkers" and some operate mainly the tools of design for sustainability.

Table 6.8 : Revised conceptual understanding.

Topics of analysis	Description
Services of intermediaries, Support instruments used by intermediaries, Types of intermediaries, Approaches used by intermediaries	Will be discussed in the following paragraphs
The drivers that shape the intermediaries' approach	• Proactive individuals within intermediaries, • Pioneer companies, • Policies, • Companies' needs.
The challenges that the intermediaries face during the support process	• Financial uncertainties, • Inadequate funding sources, • Meeting the goals within limited time and budget

Table 6.8 (continued) : Revised conceptual understanding.

Topics of analysis	Description
The challenges that the intermediaries face regarding sustainability	• Reaching the target companies with the right message on sustainability, • Companies' understanding of sustainability, • Assessing and monitoring sustainability practices of companies, Low number of studies on best practices (in Turkey).
The tools and methods that the intermediaries utilize	Qualitative / semi-qualitative / quantitative techniques The intermediaries develop their own assessment tools for: • Better integrating social impact into the assessment, • Allowing reassessments during the dynamic support process, • Adapting the existing tools to specific needs of companies and Better integrating design process into the assessment.
The role of design in support processes aiming at sustainability	• Industrial design, • Design thinking Operating design for sustainability tools and methods.

Regarding the first topic of analysis, types of intermediaries, a set of intermediary attributes was needed to be able to fully grasp the intermediary types and approaches, as explained in Section 6.2.2. In addition, the lists of services and support instruments utilized in this study were found to be accurate by the interviewees, except most of them demanded separating the support instrument knowledge and technology transfer. Services on sustainability can be analyzed in four main groups:

1. Educational services such as seminars, conferences and workshops that aim at raising awareness and knowledge transfer.
2. Consultancy services, which should further be distinguished as follows;
 - a. Limited consultancy services that aim at identifying potential and developing a business plan in a short time.
 - b. Comprehensive consultancy services that include intensive assessment and reporting, and management support.

- c. Design consultancy services that include intensive assessment and reporting, and management support, but focus more on implementation of the strategies developed.
- 3. Incubation of start-ups.
- 4. An emergent type of service that aims at developing start-ups by beginning with an idea and then relying on a network of investors, experts and volunteers with the aim of achieving radical innovation for sustainability.

It should be noted that all of these services were observed in the set of cases from the Netherlands.

As observed in the cases, each sample intermediary usually focuses on one of the above described service group. Nevertheless, one intermediary, that aims to reach a large number of companies, also supplies the service types “1” and “2a” together. Based on this observation and the findings, a minimum set of five intermediary functions for meeting the needs of all types of companies working in sustainability and design for sustainability are suggested as follows;

Intermediary function-1 Awareness raising and identifying potentials and needs for sustainability and design for sustainability for small/medium enterprises

Intermediary function-2 Comprehensive consultancy and reporting on sustainability for large enterprises

Intermediary function-3 Design for sustainability consultancy and implementation for both large enterprises and small/medium enterprises

Intermediary function-4 Incubating start-ups that work on sustainability

Intermediary function 5 Creating and implementing business plans for radical innovation on sustainability

The five intermediaries that undertake the listed intermediary functions and the set of possible and alternative intermediary attributes are matched according to the findings of this study and presented as a framework in Table 6.9. These services can be supplemented by other services such as official labels and verification and

accreditation, which are usually supplied by international organizations. The first row comprises the intermediary functions listed above.

Table 6.9 : The framework suggested for describing the minimum set of five intermediaries that meets the needs of all types of companies working on sustainability and design for sustainability*.

Intermediary function		1	2	3	4	5
Type	Innovation and business development agency	●				
	University and research center	●		●	●	
	Chamber of commerce and business association	●				
	Incubator and science park				●	
	Private consultant		●	●		
	Other					●
Nature	Public	●			●	
	Private		●	●	●	●
	NGO	●				
	Social Enterprise					●
Target group	Start-ups				●	●
	SMEs	●		●		
	LEs		●	●		
Services	Workshops	●				●
	Consultancies	●	●	●		●
	Conferences	●				
	Educational programs	●				
	Incubation programs				●	●
Support instruments	Financing	●			●	
	Networking and cooperation	●	●		●	●
	Awareness raising	●				
	Internationalization	●	●		●	●
	Technology transfer	●	●	●		●
	Knowledge transfer	●	●	●		●
	Identifying potentials and needs	●	●	●		●
	Management support	●	●	●	●	●
	Creation of specific skills	●	●	●		
Designer's role**		2	2, 3	1, 2, 3	2	2

* More than one symbol or number in one column refers to alternative options for one intermediary

** (1) Industrial design, (2) Design thinking, (3) Operating design for sustainability tools and methods.

6.4 Conclusions

This empirical study investigated the state of the art of innovation support for design for sustainability in developed countries and in Turkey. It aimed to help intermediaries working on sustainability to improve their services while also

developing the capacity of those aiming to start working on sustainability. Other actors in innovation systems such as governmental organizations would also benefit from the findings on the support processes, especially in designing support programs for companies. A framework for a set of intermediaries that meet the needs of companies working on design for sustainability was proposed, also defining their attributes. Furthermore, the services and support they offer, their approaches and the drivers that shape them, the challenges they face during the intermediation process and while working on sustainability, and the role of design in the support process were discussed in light of the existing literature.

While the framework differentiates between different roles of intermediaries, collaborations and network building offer benefits for both the companies and the intermediaries. According to the findings, the collaborations are built in several forms. Intermediaries build networks of intermediaries for meeting the needs of companies collaboratively and by complementing each other. They also build networks of companies both for long-term collaborations and to be able to connect them with each other for meeting the challenges and needs in the innovation processes. Collaborating with universities is crucial for the intermediaries, and the collaboration structures vary according to aims. In addition, collaborating with a wide range of stakeholders, from experts to volunteers, investors to entrepreneurs is crucial in exploring and experimenting for creating new business models and achieving radical innovation for sustainability. Lastly, international collaborations are pivotal in raising the capacity of innovation support for design for sustainability where the concept is not yet diffused.

The findings indicate that the main role of design in the innovation support process is during implementation of sustainability practices. Besides, the role of design thinking can be observed both in building strategies for companies in early innovation processes and in operating the tools and methods, which overlap for sustainability and design for sustainability to a great extent. The scope of the services in design for sustainability mainly rests on the scope of the educational background of the intermediary and designers in the team.

As the findings show, intermediary services for design for sustainability are emerging in Turkey, but at the moment they are mostly limited to educational services with an aim to raise awareness. This is expected in the early stages of

developing innovation support, but specific services and intermediaries on sustainability and design for sustainability need to be developed at a faster pace. This study benefited from international research collaboration and can provide the background for future projects on the issue.

For further research, conducting real-time and in-depth case studies would allow for monitoring the interactions between the intermediaries and the companies. The number of intermediary types studied can be expanded for testing and developing the framework further as well. For example, although universities are among the main actors of innovation systems, they are also cited as a type of intermediary. In this study, only one center within a university was among the cases. A consequent study explores the intermediary role of universities in diffusing design for sustainability into society and industry via outreach activities in the next chapter. Furthermore, strategies can be built upon this study and developed to diffuse design for sustainability into the industry, specific to the conditions of regions and countries. Such a study focusing on Turkey was undertaken within the scope of this thesis and is discussed in Chapter 8.

7. INTERMEDIARY ROLE OF UNIVERSITIES IN DIFFUSING DESIGN FOR SUSTAINABILITY INTO THE INDUSTRY⁴

This empirical study investigates the intermediary role of universities in spreading design for sustainability into the industry through three case studies. The process and evolution of the intermediary roles, as it relates to the cases, are explained. Moreover, via the cases, three types of structures, through which universities undertake the intermediary role are investigated, a program, a center and an individual scientist. The conceptual understanding following the literature review and the scope of this empirical study are shown in Figure 7.1.

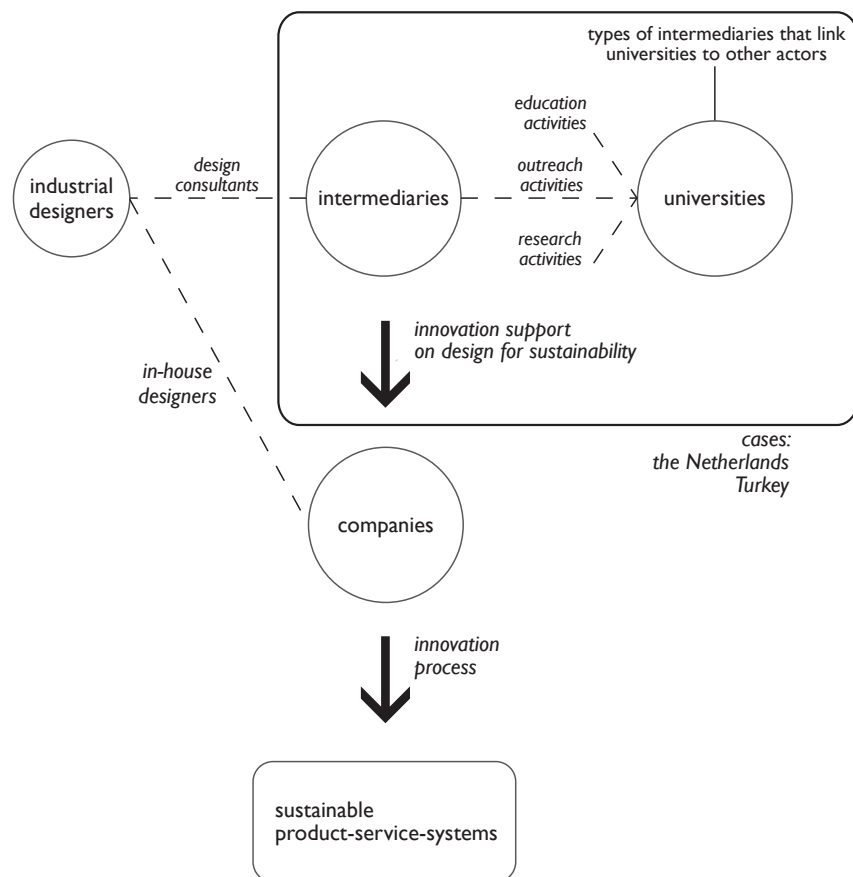


Figure 7.1 : Scope and initial conceptual understanding.

⁴ This chapter is based on a submitted journal paper by Küçüksayraç, E., Wever, R. and Brezet, H.

7.1 Research Method

This study investigates how universities contribute to spreading design for sustainability into the industry by undertaking intermediary roles, through three case studies. The cases are selected from the Netherlands and Turkey, the former as a best example and the latter as an emerging example. This allows for a “theoretical replication” with “contrasting conditions”, which increases the generalizability (see Yin, 2009) and transferability of the research results (see Yin, 2009; Bryman & Bell, 2003). The first case is the Design for Sustainability Program at Delft University of Technology from the Netherlands. From Turkey, one case is Boğaziçi University’s Sustainable Development and Cleaner Production Center and one case is Prof. Göksel Demirer from Middle East Technical University’s Environmental Engineering Department. Case selection exemplifies three of the four types of structures through which universities undertake intermediary roles (Figure 7.2): (1) internal, (2) external, (3) hybrid intermediaries, and (4) individual scientists (Youtie & Shapira, 2008). The first case is a section within a university department, the second case is an internal center and the third case is an individual scientist within a university. It should be noted that the term “individual scientist” does not refer to a scientist independent from the department and the university; rather it emphasizes the scientist’s leadership role.

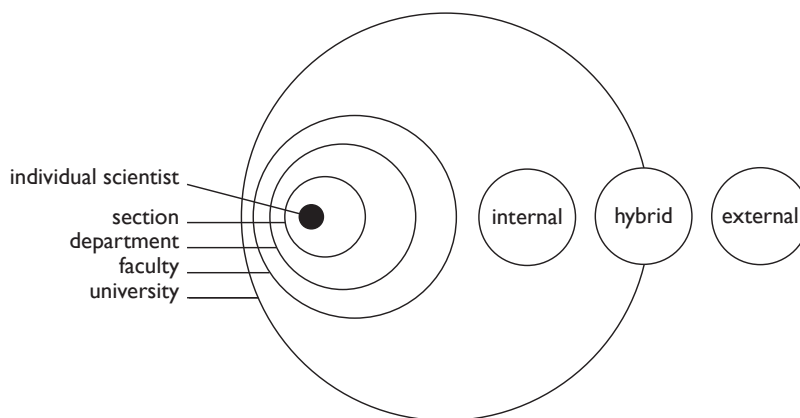


Figure 7.2 : Units of universities and types of intermediaries.

Design for sustainability is not yet diffused into higher education in Turkey (Erkaslan, 2013), but the closely-related approach to sustainable consumption and production is diffused, especially in two of the prominent universities in Turkey, which also undertake outreach activities. Therefore, the selection criterion for the cases in Turkey entailed contributing to the country’s sustainable consumption and

production practices and two cases were selected: Boğaziçi University's Sustainable Development and Cleaner Production Center and Prof. Göksel Demirer from Middle East Technical University's Environmental Engineering Department.

The Design for Sustainability Program at Delft University of Technology in the Netherlands was selected as it co-published the United Nations Environment Programme's Manuals (Brezet & Van Hemel, 1997; Crul & Diehl, 2006; Crul et al., 2009b; Vezzoli et al., 2014) and because of the outreach activities it carried out that are cited in Chapter 2 (Van Hemel, 1998; Crul, 2003; Diehl, 2010). Furthermore, established in 1992, it is one of the first and still one of the few higher education and research programs on design for sustainability worldwide.

The case studies analysed in this empirical study are qualitative; the practices are described and interpreted (see Stake, 1995). Case study data (see Stake, 1995; Yin, 2009) were mainly gathered through semi-structured interviews that are listed in Table 7.1, and the interview guide is presented in the Appendix D. Additional data were gathered from publications, manuals, reports, catalogues and web-sites. For validity, the chapter was sent to the interviewees for a final review to confirm data accuracy.

Table 7.1 : Data regarding the interviews.

Case	Interviewees	Affiliation and projects cited in the study	Date and duration of the interviews
I	Marcel CRUL, PhD	Project Manager at DUT-DFS Co-author of two UNEP manuals (Crul and Diehl, 2006; Crul et al., 2009)	28.05.2013 (60 min.); 15.01.2014 (30 min.)
	Asst.Prof. Jan Carel DIEHL, PhD	Assistant Professor at DUT-DFS Co-author of two UNEP manuals (Crul and Diehl, 2006; Crul et al., 2009)	02.04.2014 (30 min.)
II	Assoc.Prof. Nilgün CILIZ, PhD	Associate Professor at BU, Institute of Environmental Sciences Founder and Director at BU-SDCPC	26.03.2014 (60 min.)
	Asst.Prof. Ali COŞKUN, PhD	Assistant Professor at BU University, Department of Management Vice Director at BU-SDCPC	
	Hacer YILDIRIM, MSc. Şila TEMİZEL, MSc.	Researchers at BU-SDCPC	

Table 7.1 (continued) : Data regarding the interviews.

Case	Interviewees	Affiliation and projects cited in the study	Date and duration of the interviews
III	Prof.Dr. Göksel DEMİRER	Professor at METU, Environmental Engineering Department National expert of the SCP Report on Turkey (TTGV & MoEF, 2010) and many projects	10.07.2013 (40 min.); 15.01.2014 (120 min.)

7.2 Case I: Design for Sustainability Program at Delft University of Technology

Delft University of Technology (DUT) is the oldest of three technical universities in The Netherlands. It consists of seven Faculties offering 15 Undergraduate Programs with approximately 2,500 academic staff and 18,000 students (DUT, 2013). DUT has been cited among leading examples of universities that adopted sustainable development principles (Lozano, 2006). The university first affirmed its commitment to sustainable development in 1994, by adopting a new vision it called *Towards a new commitment* (Kamp, 2006). In 1998, the Board of DUT approved both the *Sustainable Development Education Plan* and implementation of three operations; (1) developing an elementary course “Technology in Sustainable Development” for all DUT students, (2) integrating the concept of sustainable development in all regular disciplinary courses, and (3) developing a graduate specialization in sustainable development within the framework of each department. The Technology Assessment group at DUT was asked to carry out these activities and started a six-year project called *Education in Sustainable Development*. Within the project, additional activities were carried out, such as publishing academic papers and textbooks, and organizing discussions and lectures open to all students and faculties (Kamp, 2006; Peet et al., 2004; Quist et al., 2006).

The Design for Sustainability Program at DUT (DUT-DFS) is an education and research program at the Faculty of Industrial Design Engineering. DUT-DFS is a section within the Design Engineering Department, one of three departments of the Faculty of Industrial Design Engineering. The other two departments are “Industrial Design” and “Product Innovation Management” offering five and three programs respectively. In addition, the Faculty offers three Joint Master Programs, “Integrated Product Design”, “Design for Interaction”, and “Strategic Product Design” (DUT-IDE, 2014). DUT-DFS has an annual budget of approximately 1.5 Million Euros.

Until 2015, 35 dissertations and over 1000 master theses were completed within the program.

7.2.1 Intermediary role of DUT-DFS

DUT-DFS offers undergraduate and graduate courses on design for sustainability, and is responsible for “providing students and teaching staff from other departments with knowledge and understanding of how to integrate sustainability issues into regular product development processes” (Boks & Diehl, 2006). In 2014, five academic staff carried out research along with four post-doc researchers and 15 PhD candidates. The sub-themes that the program works on are listed as: (1) materials systems, (2) energy, (3) emerging markets, (4) knowledge exploration and decision support, and (5) context variation by design (DUT-DFS, 2014).

The outreach activities of DUT-DFS are examined in three categories. First category projects are funded by national (both from the Netherlands and abroad) and transnational organizations (e.g., the United Nations Environment Programme, the European Commission). Second category projects are carried out in collaboration with single or several companies within the scope of undergraduate and graduate courses. Scientific outputs of both types of projects include manuals, journals and conference papers, MSc and PhD Theses. The third category, which emerged more recently, includes new ventures that are developed during elective courses offered by DUT-DFS.

DUT-DFS started coordinating or contributing to the first category – funded projects – with the *IC Ecodesign Project* that ran between 1995 and 1998. The aim of the project was to diffuse ecodesign into the practice of small/medium enterprises. The project’s details are elaborated in Chapter 2. A PhD candidate from DUT-DFS was involved throughout the project and the data she collected comprised the empirical studies of her PhD thesis (Van Hemel, 1998). Several intermediaries, such as consultancy companies and TNO – an independent research organization from the Netherlands, were among the partners of the project. During the project, the team from DUT-DFS also delivered design-for-sustainability training to experts, who continued implementing it in the industry after the project was completed. DUT-DFS’s main aim for being engaged in the project was to develop methodology on ecodesign, write a handbook, and to build networks with research institutions and

companies. One of the project outputs, *Ecodesign: A Promising Approach to Sustainable Production and Consumption* (Brezet & Van Hemel, 1997) was the first among the manuals that DUT co-published with the United Nations Environment Programme.

Two following manuals on the broader concept of design for sustainability, *Design for Sustainability: a practical approach for Developing Economies* (Crul and Diehl, 2006) and *Design for Sustainability: A Step-by-Step Approach* (Crul et al., 2009) were developed based on several long-term projects that the DUT-DFS team undertook in Central America, Africa, Eastern Europe and South Asia between 1998 and 2006. The preceding manual is available in English, French, Spanish, and Vietnamese as well. Recently, the book *Product-Service System Design for Sustainability* (Vezzoli et al., 2014) was published as an output of the project *LeNS: The Learning Network on Sustainability* funded by the Asia Link Programme of the European Commission. Seven partners from China, Finland, India, Italy, the Netherlands, and Thailand contributed to the book.

Each project that DUT-DFS carries out both follows and enhances the prior projects, while also exploring new fields. For DUT-DFS to be involved in a project, it either has to promise theory building or radical innovation in the market. For example, DUT-DFS was a partner of Interreg Project *EcoMind: Environmental Market & Innovation Development* along with eight partners from the Netherlands, the United Kingdom and France. The project was considered as a later stage of diffusing ecodesign into the industry, this time aiming to reach a wider group of SMEs. The focus of DUT-DFS's research in this project was the innovation process of sustainability-driven new ventures (Keskin et al., 2013).

The aim of one funded project that DUT-DFS undertook in a developing country is listed as: (1) demonstration, (2) awareness raising, (3) capacity building at a university, (4) capacity building in the industry, (4) dissemination, (5) curriculum development. Except for the last educational aim, they matched some of the intermediary functions listed in Chapter 2 (EC, 2009a). In developing countries, DUT-DFS works with local universities, their students, and intermediaries such as research centers and NGOs. They aim to transfer knowledge and determine potentials for future projects that can be continued by the local stakeholders. Local partners also provide local input during the projects.

DUT-DFS designs the project's processes according to research-specific aims, which are also influenced by the aims of the funding scheme. Two potential "gaps" can arise during the projects. The first one is between the objectives of the funding program and those of the research team. For example, the funding program might require the involvement of 500 companies for a widespread impact, while the research team might need to work with only 50 companies to fulfil research aims. The second potential gap is between the objectives of companies and those of the research team. For example, companies might be interested in only a specific part of the project's process, while the research team needs to follow a stepwise process and the involvement of participating companies. DUT-DFS aims to overcome these gaps by carefully predetermining the project's process and requirements.

In 1997, DUT-DFS established a "Joint Center for Sustainable Product Innovation" called "Kathalys" in collaboration with TNO. The mission of the center was to initiate and introduce leapfrog sustainable product-system innovation and it was funded in part by the Ministry of Economic Affairs and the Ministry for Housing, Regional Development and the Environment (Brezet et al., 2001b). In the collaboration, DUT-DFS contributed with its research experience, while TNO contributed with its know-how in developing innovative products (Joore, 2010). The center employed 20 graduates of industrial design engineering and marketing/business administration programmes (SDO, 1997). The outcomes from the project that lasted for more than ten years are a number of product-service-system development projects that were undertaken with prominent companies, the Kathalys Method that was developed through practice, a book on the projects undertaken and the Kathalys Method (Brezet et al., 2001b), and two dissertations (Berchicci, 2005; Joore, 2010). Moreover, the experts who worked in Kathalys, spread their expertise into the industry after the project was completed. Kathalys exemplifies a hybrid type of intermediary (see Figure 7.2; Youtie & Shapira, 2008).

With regard to the second type of outreach activities, DUT-DFS collaborates with companies on sustainable product and service development within the scope of various undergraduate and graduate courses. The academic staff, companies or students initiate these projects and the brief is developed with the contribution of all of these actors, also taking into consideration the best-fitting course to carry out the project. The project is then assigned to a student or a student team. If the project is

carried out within the scope of the “Joint Master Project”, students from different master programs work as a team and focus on the different stages of the design process. This way, the student team works on the whole innovation process, including the development of the business plan. If the project is exploratory, students develop a range of product and service ideas. Or if the project’s requirements are specific or technical, it is directed to a relevant course, such as “Advance Embodiment Design”. Company projects are carried out through more than one course simultaneously or the collaboration continues for several semesters through a series of projects. In short, with regard to the second type of outreach activities, collaborations with companies are designed according to the aims and scope of both the projects – needs of companies, and the courses – and educational needs.

DUT-DFS has been conducting approximately 50 of such projects per year and publishing catalogues on the projects. The catalogues document the project outputs and enable the Faculty to communicate the activities. The projects also serve as lecture examples for the Faculty of Industrial Design Engineering at DUT. The criteria for DUT-DFS to engage in collaborations with companies are that the project should explore new directions, promise innovation and offer projects that the companies cannot carry out themselves. DUT-DFS also collaborates with prominent companies such as Philips (Stevens, 2007; Wever et al., 2007). Sometimes the program approaches specific companies with the aim to learn from them.

In the scope of the third category, projects that started more recently than the previous two, ideas for new sustainable product-service-systems and ventures are being developed in elective design for sustainability courses and during master thesis trajectories. In several cases, this has led to the co-creation of new ventures, based on sustainable product-service combinations, such as the “Vrachtfiets” transportation bike, “Epyon” fast-loading electric appliances and electric cars, “Sustainable Dance Club” electric generation dance floor for night clubs, “Shift” games for energy use reduction and “Evening Breeze” energy efficient cooling of recreational homes. The unique selling point of these new services and ventures is the original physical product with its specific functionality, making a difference with service competitors, and using existing products for their product-service-systems. In recent years, the existence of the university incubator YES!Delft has accelerated and facilitated the

design for sustainability students' entrepreneurial and design-for-sustainability outreach process.

DUT-DFS undertakes a crucial role in the initial phase of intermediation when introducing new concepts into the industry. According to academic staff from DUT-DFS, the intermediary roles support education and research. For instance, several individual MSc projects have directly resulted in scientific publications (e.g., Petala et al., 2010; Bakker et al., 2010; Bakker et al., 2012; Große-Hering et al., 2013; Visser et al., 2015). Data gathered during the outreach activities are utilised in PhD theses, academic journal papers and for developing manuals. The product-service-system outcomes serve as the examples examined in the undergraduate and graduate course. The main challenge faced with being engaged in all of the tasks of education, research and outreach is time management. Another challenge is to align all of the stakeholders' understanding of the concepts on sustainability, innovation and design.

7.3 Case II: Boğaziçi University, Sustainable Development and Cleaner Production Center

Founded in 1971, Boğaziçi University (BU) is a state university (formerly Robert College, founded in 1863), and consists of four Faculties, six Institutes and two Schools with approximately 500 academic staff and 12,000 students (BU, 2010).

7.3.1 Intermediary role of BU – SDSCPC

The Sustainable Development and Cleaner Production Center (BU-SDCPC) was established at BU in 2007 by Assoc.Prof. Nilgun Ciliz, who is the Center's Director. Ciliz holds a PhD in chemical engineering. Before her academic career, Ciliz worked as a senior researcher at the Turkish Scientific and Technical Research Council, Marmara Research Center (TÜBITAK-MAM), and the Institute of Energy and Environmental Research. During this period, she completed a three-year applied training from the Danish Technological Institute and her post-doctoral studies on LCA at Technical University of Denmark's Institute of Product Development. She has carried out a number of projects on integration of eco-labelling approach and life cycle assessment studies for the production sector and has worked on the advisory committee or evaluation board of various international and national associations, advising on sustainable production and consumption patterns and resource

conservation issues. At BU, she lectures on environmental pollution, pollution prevention, global environmental systems, and energy, and will soon start a course called “Sustainable Development” for both undergraduate and graduate programs. In addition, she has been co-chair of the United Nations Sustainable Development Solutions Network (UN-SDSN) – Turkey since 2014.

The BU-SDCPC was established at BU for two reasons, for creating a platform for academics from different departments to collaborate, and to be able to lighten the administrative burden when running funded projects. BU-SDCPC has an executive and an advisory board consisting of academics from a wide range of departments at BU, mostly from the Faculty of Economics and Administrative Sciences, and the School of Applied Sciences. They supervise eleven researchers who carry out the projects. The projects vary in scope and scale but are gathered under the umbrella theme of sustainable development. The aims of the center (BU-SDCPC, 2014) are listed as follows:

- Supplying technology support for sustainability in production and service industries,
- Building new links, networks and collaborations between decision makers in terms of policy and regulations in order to ensure and enhance sustainable consumption and production patterns,
- Implementing the globally recognized product accreditation standards, mainly focusing on LCA as the decision-making tool,
- Promoting sustainability in campus and community life by providing waste and energy management strategies and integrating sustainability into continuing education programs,
- Developing and implementing regional strategies, plans and programs with regard to integrated resource conservation by using environmental decision-making tools and frameworks,

BU-SDCPC ensures sustainable development on a global scale through integration of interdisciplinary knowledge and experience and innovative technology transfer in close cooperation with related stakeholders. The Center mostly collaborates with intermediaries, ministries, municipalities, universities and research centers, companies, industrial associations and financial institutions. The projects’ funding organizations are mainly EU, UNEP, Ministries, TÜBİTAK, BU-Scientific Research

Projects, and National Development Agencies. The project outputs also comprise data for the researchers' graduate (MSc & PhD) theses. The Center is selective in the projects it carries out and aims to raise the number of international collaborations.

In 2012, the project *Evaluation of Ecological Criteria for Cotton Textile Products* that was carried out at BU-SDCPC was selected as “One of the best applications at a national scale” in the “Sustainable Development” and “Green Economics” categories at Rio+20 UN Conference on Sustainable Development. Moreover, because of having the same scope, BU-SDCPC was selected as UN-SDSN's Turkey Office. UN-SDSN has a new project called *SDSN-Y*, in which there are two researchers from BU-SDCPC who are working as Network Representatives for Turkey. It is the youth partition of the UN-SDSN, a new initiative to engage youth globally in the post-2015 agenda.

BU-SDCPC is one of 55 partners of the “University Educators for Sustainable Development Consortium” that aims to integrate sustainable development into higher education curriculum. The Center also carries out projects on green campus within the university. The projects include investigating and developing management plans regarding the carbon footprint, waste and water, and energy efficiency of the university as well as consulting the Environment Club, which is run by member students. The Center has developed a methodological approach for sustainability monitoring, evaluation and a reporting system for the university in order to integrate eco-design concepts within campus life including managerial, academic, and technical aspects. Recently, similar initiatives started at BU in the scope of sustainability, such as a center on climate change and environmental policy currently being established. The Center hosted the international joint conferences, the 16th Conference of the European Roundtable on Sustainable Consumption and Production, and the 7th Environmental Management for Sustainable Universities Conference in 2013; both with design for sustainability as one of the main foci.

7.4 Case III: Prof. Göksel Demirer

Prof. Göksel Demirer works at Middle East Technical University (METU)'s Environmental Engineering Department. Founded in 1956, METU is a state university consisting of five Faculties and 43 Undergraduate Programs with approximately 26,000 students (METU, 2014).

7.4.1 Intermediary role of Prof. Göksel Demirer

Demirer has engaged in cleaner production projects and studies since the first ever such project was carried out in Turkey in 1999 by the Chamber of Environmental Engineers, *Integrated/Preventative Environmental Management for Municipalities: Training and Dissemination*. He specializes in biotechnologies and waste management. He first developed his expertise on sustainable consumption and production by participating in the 1999 “Educate-The-Educators Program” organized by Lund University’s International Institute for Industrial Environmental Economics in collaboration with the United Nations Environment Programme’s Working Group for Education and Training on Cleaner Production. The program aimed at facilitating the integration of cleaner production and preventive environmental management concepts into undergraduate and graduate education. Demirer was the only participating academic from Turkey (Huisinigh & Mebratu, 2000). Following the program, he developed the undergraduate elective “Cleaner Production – Pollution Prevention” course and has continued lecturing it since then (Demirer, 2002). Moreover, in collaboration with his colleagues from the METU Environmental Engineering Department, Demirer has been publishing papers in academic journals, supervising MSc and PhD theses in the field, and conducting projects both as a primary and a co-primary investigator – mostly cited as a consultant or national expert. In addition to his academic roles, he also gives less-knowledge-intensive talks at various organizations with the aims of raising awareness and of discussing possible actions with the participants.

For the projects, Demirer and the department have been collaborating with international organizations, such as the United Nations Industrial Development Program, the Swiss Agency for Development and Cooperation, Korea Development Institute’s Directorate General for Productivity, various European universities, regional development agencies, and national organizations, such as the Ministry of Environment and Forestry, the Scientific and Technological Research Council of Turkey, the Technology Development Foundation of Turkey (TTGV), and the Small and Medium Enterprises Development Organization (KOSGEB). With some of these organizations Demirer has collaborated frequently. He also frequently collaborates with both his current and former students who work in these organizations. This helps in establishing an efficient project and research team.

Some of the projects that Demirer consulted, such as United Nations Industrial Development Organisation, *Eco-efficiency Programme* and *Dissemination of Eco-efficiency Applications in Izmir* are comprehensive and consist of several sub-projects, such as identification, implementation, training programs and also policy advice. The projects' scopes, among other recommendations for the industry and public sector, emphasized the need for moving beyond barriers and enabling policy reforms (TR-MoEF, 2010). Following that, legislation on cleaner production in the textile sector was enacted and planned as a pilot legislation to be spread to other industries in due time. Except for a few instances, Demirer usually does not initiate the projects; rather, he is invited largely because of the legitimacy he established through his publications. Among his criteria for engaging in a project is that it has to be new for Turkey, in terms of sectors, scales, and scope. Demirer also consults companies wishing to practice and test theoretical work in the field. Demirer includes ecodesign as a subject in his "Pollution Prevention" course and emphasizes design for sustainability, as one of Turkey's important needs in the reports and publications to which he contributes or that he writes.

As one of Turkey's biggest challenges, Demirer indicates the low number of academics working in the sustainability field who are able to apply their academic skills in real life to meet the demands of the stakeholders. This raises the number of aims that need to be achieved in a short amount of time, by adding the responsibility to communicate the issue to all stakeholders in the society. Another challenge is that the industry in Turkey does not take the necessary steps in spite of having the resources. For examples, some companies that are involved in the projects belong to important business groups in Turkey, with the capacity to initiate projects without having to wait for opportunities to arise. Another challenge is the low transparency in the decision-making processes of public organizations. Furthermore, delays are common during projects' implementation, usually resulting from ineffective project management. For example, in public institutions, due to high employee turnover, educational trainings need to be repeated or new stakeholders become involved once the project's process is well underway, disrupting the workflow of project stages.

Demirer stated that the intermediary role he undertakes, mostly consulting projects, supports both his educational and research activities threefold. The projects allow testing theoretical work, expanding theory with research through practice, and

creating change in society and the industry. Therefore, he considers the intermediary role as one of his core tasks.

7.5 Discussion

The framework on intermediaries that was developed in Chapter 6 was utilized for discussing the intermediary role of the cases studied. The focus field, type, target group, services and support instruments that the cases supply in their outreach activities are shown in Table 7.2. It should be noted that the framework reflects the qualities of the projects but not their quantities.

Table 7.2 : The framework developed for describing intermediaries (Chapter 6).

	Case	DUT-DFS	BU-SDCPC	Prof. Göksel Demirer
	Focus field	Design for sustainability	Sustainable consumption and production	Sustainable consumption and production
	Type	Section in a university	Research center	Individual scientist
Target group	Start-ups	●		
	SMEs	●		●
	LEs	●		●
Services	Workshops	●	●	●
	Consultancies	●		●
	Conferences	●	●	●
	Educational programs	●	●	●
	Incubation programs	YES!DELFT		
Support instruments	Financing			
	Networking and cooperation	●	●	●
	Awareness raising	●	●	●
	Internationalization	●		
	Technology transfer	●	●	●
	Knowledge transfer	●	●	●
	Identifying potentials and needs	●	●	●
	Management support	DUT-IDE		
	Creation of specific skills	●	●	●
Designer's role*		1, 2, 3		

* (1) Industrial design, (2) Design thinking, (3) Operating design for sustainability tools and methods.

Within the framework, financing is considered as the role of the funding organizations, and therefore none of the cases supplies this support instrument. The

first case, DUT-DFS supplies all the services and support instruments and spans all target company groups, except one type of each. These, they supply in collaboration with other units at DUT. For management support, they collaborate with the Department of Product Innovation Management at DUT-IDE and for the incubation programs, they collaborate with the YES!Delft Center. This way, DUT-DFS fulfils the intermediary role in an innovation system through the various outreach activities its academic staff undertakes. This role is temporary and for sustaining it, they educate experts during the projects.

The types of outreach activities that DUT-DFS undertakes are: (1) funded projects, (2) company collaborations, and (3) facilitating new ventures. The education, research and outreach activities feed each other through various flexible processes, which are described in previous sections and are illustrated in Figure 7.3.

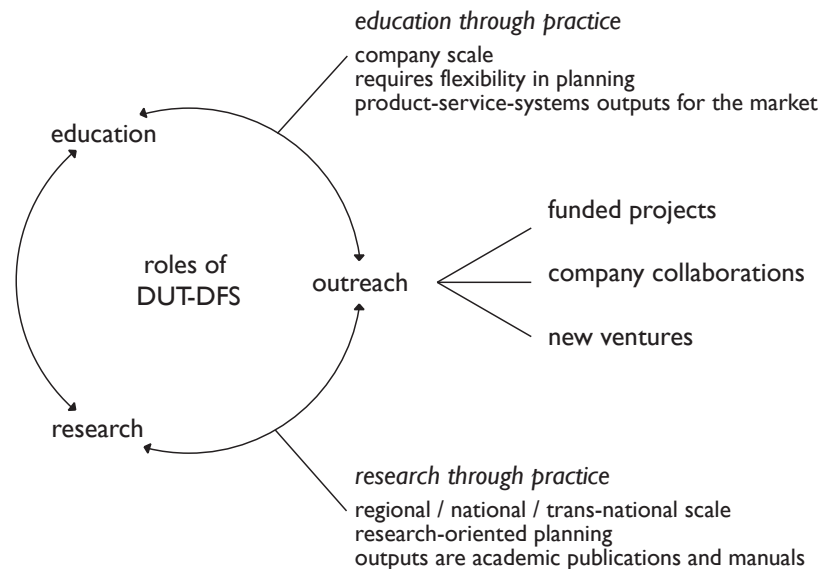


Figure 7.3 : The relationship between DUT-DFS's various roles.

BU-SDCPC from Turkey, with its interdisciplinary team, draws its scope with the aim to create a distinguished impact on the state-of-the-art sustainable development issues with its available resources. The Center continuously collaborates with the relevant stakeholders for sustainability. The Center also takes on an active role in sustainability practices of its host university.

The extent of the outreach activities that Prof. Göksel Demirer undertakes as an individual scientist is comparable to the ones of a center or university department. He achieved effective relationships linking education, research and outreach activities. For outreach activities, he collaborates with his colleagues from the department and

his current or former students, which earned him long-term success in overcoming knowledge translation gaps within the teams (see Major & Corde-Hayes, 2000).

For funded projects, PhD candidates are the main human resource in the research-driven outreach activities of all cases. Furthermore, they are both potential partners in future projects when employed in relevant organizations, and experts in spreading the knowledge to other actors and organizations within innovation systems.

7.6 Conclusions

This empirical study investigated the intermediary role of universities in spreading design for sustainability and sustainable consumption and production through three case studies. DUT-DFS from the Netherlands exemplified a section within a university department. The Kathalys Center that the DUT-DFS co-established with TNO exemplified a hybrid structure. From Turkey, BU-SDCPC exemplified an internal center, and Prof. Göksel Demirer exemplified an individual scientist.

The cases' outreach activities were mostly project-based and therefore temporary. This result is more consistent with the classification of universities as separate actors of innovation systems that take temporary intermediary roles, rather than the classification of universities as knowledge intermediaries. The list of intermediary support instruments (Table 7.2) also constitutes the outreach aims of universities, but in addition they have research aims within outreach activities to gather data for research, and test, validate and expand theories through practice, and the educational aim to develop curriculum.

DUT-DFS fulfils the intermediary role in its outreach activities by supplying all services and support instruments to all three kinds of target companies. This can be utilized as a best example by the universities operating in the design field and aiming to work on design for sustainability.

Both cases from Turkey are experienced in the sustainable consumption and production field and exemplify two different structures, which can set an example for the design for sustainability activities of universities working in the design field in Turkey. Furthermore, two main recommendations can be drawn for the stakeholders of sustainability practices in Turkey; one is to ensure an effective and transparent

management process, while the other is enabling the stakeholders that have the resources to take action on sustainability.

For further research, cases that exemplify each category of universities' intermediary roles and also that are from other countries can be studied for expanding the research results.

8. DIFFUSING DESIGN FOR SUSTAINABILITY THROUGH INTERMEDIARIES: MAPPING STRATEGIES FOR TURKEY⁵

This study investigates how companies in Turkey should be supported in their innovation processes for applying design for sustainability. The framework developed in Chapter 6 was taken as a starting point for proposing strategies to build the capacity of intermediaries in Turkey. The strategies were discussed and revised via experts' interviews. The study aims to inform and inspire stakeholders of future programs on design for sustainability, such as intermediaries, universities, and governmental institutions. The conceptual understanding following the literature review and the scope of the study is illustrated in Figure 8.1.

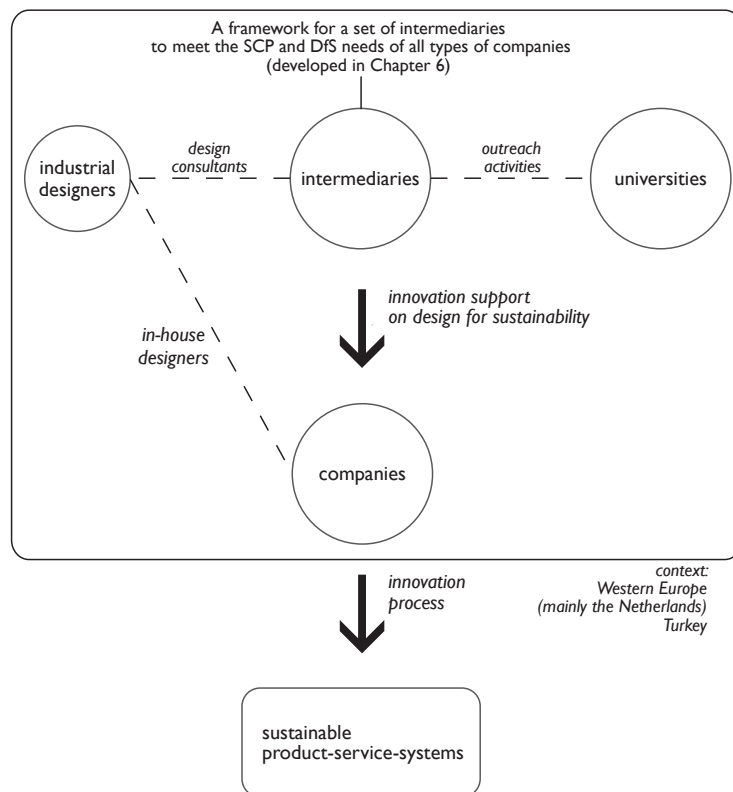


Figure 8.1 : Scope and initial conceptual understanding.

⁵ This chapter is based on a submitted journal paper by Küçüksayraç, E., Wever, R. and Brezet, H.

8.1 Research Methods

As it proposes strategies for the future, this can be considered as a forecasting study. Forecast studies are undertaken in many fields including policy and innovation management. The methods most utilized in forecasting studies are scenarios (see Van Notten et al., 2003; Kok et al., 2011), roadmaps (see Saritas & Aylene, 2010; Carvalho et al., 2013; Jeffrey et al., 2013) and backcasting (see Vergragt & Quist, 2011). All these methods require the involvement of the stakeholders in the studies. Instead of involving stakeholders, this study engaged experts on design for sustainability and sustainable consumption and production from Europe and Turkey for two reasons. First, expertise on design for sustainability is not yet well-developed in Turkey and the contribution resulting from the participation of only the stakeholders might be limited. Second, this study's time and budget for coordinating a forecasting study by involving relevant stakeholders were limited. It should be noted that this study was not undertaken within a project or program but it was initiated within the scope of a PhD study. For these reasons, this study utilizes experts' interviews.

Furthermore, this study utilized a “designerly” approach as a research strategy. “Designerly ways of knowing” (Cross, 1982; 2001; 2007) or “designerly inquiry” (see Horváth, 2008) relate to design epistemology. The approach contributes to an ongoing discussion that stems from the description of the design process as a “reflective action” (Schön, 1983). Accordingly, some scholars argue that research is a design activity and hence a branch of design, to which the designer is central, and through which the world of scientific knowledge is designed and constructed (Glanville, 1999). Some scholars describe policymaking as “a form of design that tends to focus on changing the norms that govern social activities” (Ehrenfeld, 2008). Some studies utilized the designerly approach for building analogies of processes such as in policymaking (Kopecka et al., 2012) and software development (Du Bois, 2013).

The “designerly” approach entails study steps (Figure 8.2) being partly akin to the basic design cycle (Roozenburg & Eekels, 1995; Figure 2.1). It starts with determining functions, and continues with analysis, synthesis, simulation, and evaluation steps in iterations. However, in this study, the research steps stop before a final decision on a single strategy is made, in contrast to the basic design cycle. The

aim is to develop strategies to be utilized in future studies and projects on design for sustainability as guidance. The report by the European Design Innovation Initiative, *Design for Growth & Prosperity* was also an inspiration source for this study, in so far as, at first, values are determined and then strategies and recommendations are developed for the stakeholders (EDII, 2012).

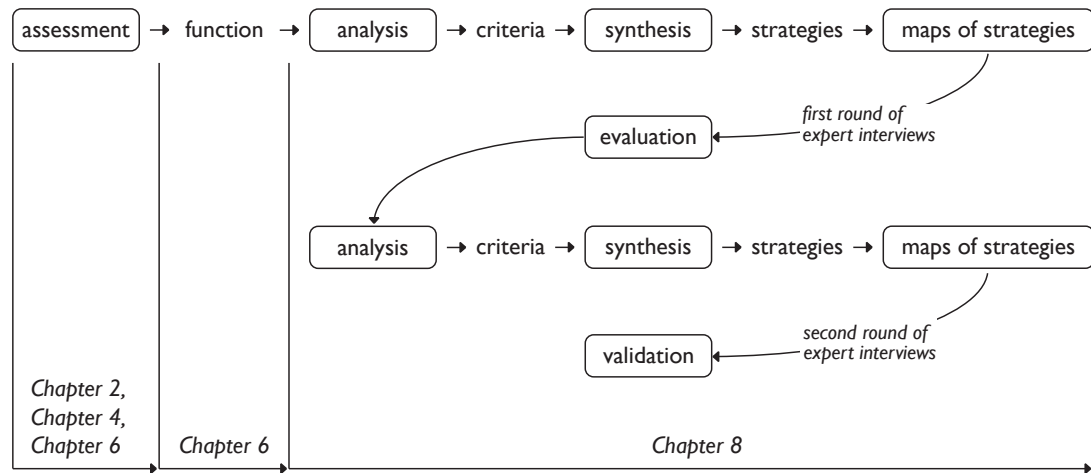


Figure 8.2 : The research steps of this study.

As shown in Figure 8.2, the first step of this study, assessment, was undertaken in the literature review discussed in Chapter 2 and the empirical studies discussed in Chapters 4 and 6. Chapter 4 assessed the state of the art sustainability practices of companies, while Chapter 6 assessed the state of the art of intermediaries functioning in the design for sustainability field. The five intermediary functions that meet the needs of all types of companies working in sustainability and design for sustainability were suggested in Chapter 6. This study starts with the analysis of the literature review and findings from previous studies. Next, criteria are determined based on the analysis, followed by a synthesis, after which strategies are proposed. The strategies are illustrated in maps. The process is repeated following the evaluation of the experts and the second stage is finalized with validation through a second round of experts' interviews.

For discussing and improving these strategies in the evaluation step, experts' interviews were carried out. During the interviews, results from previous studies, the framework (Table 6.9) and preliminary strategy maps were shared and discussed with the experts. By these means, the first rounds of interviews were semi-structured. The interviews lasted 45-75 minutes, were transcribed and coded. The findings from the experts' interviews are reported in Section 8.3. Following the findings, the

criteria and strategies were revised; the study was written in the form of an academic paper (an earlier version of this chapter), which the experts evaluated during a second round of interviews. This second evaluation served mostly as data validation of the findings. The criteria and strategies were revised further with their suggestions.

Nine experts from four main expertise areas were invited to contribute to the study and seven of them accepted. Their areas of expertise are design for sustainability, innovation systems, innovation support in practice, and sustainability practices in Turkey. Prof.Dr. Göksel Demirer, from Turkey, was a consultant to the report on sustainable consumption and production in Turkey (TTGV & MoEF, 2010) cited throughout this study. His work is described in greater detail in the preceding chapter. Also from Turkey, Dr. İdil Gaziulusoy, has written a master thesis on the design for sustainability practices of a prominent company in Turkey, and continues her academic work on sustainability in Australia. The experts from Europe are mostly from the Netherlands, except for Prof.Dr. Arne Remmen from Denmark, who is an expert in the organization management field and on sustainable consumption and production. The experts from TUDelft's Faculty of Industrial Design Engineering and Technology, Policy and Management. Last but not least, Saskia Bosch is an expert from practice – an innovation supervisor in a public intermediary with more than 15 years of experience. By including experts from various countries, universities, and disciplines and from both theory and practice, an independent evaluation process was aimed. The experts, their affiliation(s) and the information related to the interviews are listed in Table 8.1.

Table 8.1 : Information about the experts and interviews.

Name of the expert and date of the interview	Country	Affiliation and relevant work
Dr. Marcel Crul 28.05.2013 and 15.01.2014	Netherlands	Project Manager at Delft University of Technology, Design for sustainability Program Co-author of two UNEP manuals (Crul and Diehl, 2006; Crul et al., 2009)
Prof.Dr. Arne Remmen 07.06.2013 and 14.11.2013	Denmark	Professor at Aalborg University, Department of Development and Planning Co-author of an UNEP Manual (Remmen et al., 2007)

Table 8.1 (continued) : Information about the experts and interviews.

Name of the expert and date of the interview	Country	Affiliation and relevant work
Saskia Bosch 09.07.2013 and 04.12.2014	Netherlands	Innovation Supervisor at Syntens, 15 years of experience working on innovation support
Dr. İdil Gaziulusoy 02.07.2013 and 25.11.2013	Australia, Turkey	Principal Researcher at University of Melbourne, Victorian Eco-innovation Lab (VEIL) Worked on design for sustainability in Turkey during her MSc Thesis (Gaziulusoy, 2003)
Prof.Dr. Göksel Demirer 10.07.2013 and 05.02.2014	Turkey	Professor at Middle East Technical University, Environmental Engineering Department Consultant of the sustainable consumption and production Report on Turkey (TTGV & MoEF, 2010) and several pilot projects
Prof.Dr. Jo van Engelen 11.07.2013 and 20.11.2013	Netherlands	Professor at Delft University of Technology, Integrated Sustainable Solutions, and University of Groningen, Business Development Department Co-author of <i>Corporate Sustainability Management</i> (McElroy & Van Engelen, 2011)
Dr. Jaco Quist 22.07.2013 and 22.11.2013	Netherlands	Assistant Professor at Delft University of Technology, Technology Dynamics & Sustainable Development Department Works on sustainable development, system innovations and backcasting (Quist, 2007)

8.2 Initial Strategies

In Chapter 6, a framework of five intermediaries, their functions and attributes is developed. The intermediaries that undertake each intermediary function are illustrated in a map (Figure 8.3). In the map the intermediaries and the target groups of companies are shown in an innovation system. A map of innovation systems suggested in the literature included the actors, firms, research institutes and universities, infrastructure and demand, by placing the intermediaries in the center of all actors and displaying the interactions of intermediaries with all actors (Van Lente et al., 2003; Figure 2.7). As described in Chapter 3, this study focuses mainly on two actors for reducing the complexity and uses a perspective whereby intermediaries surround companies for fulfilling their needs.

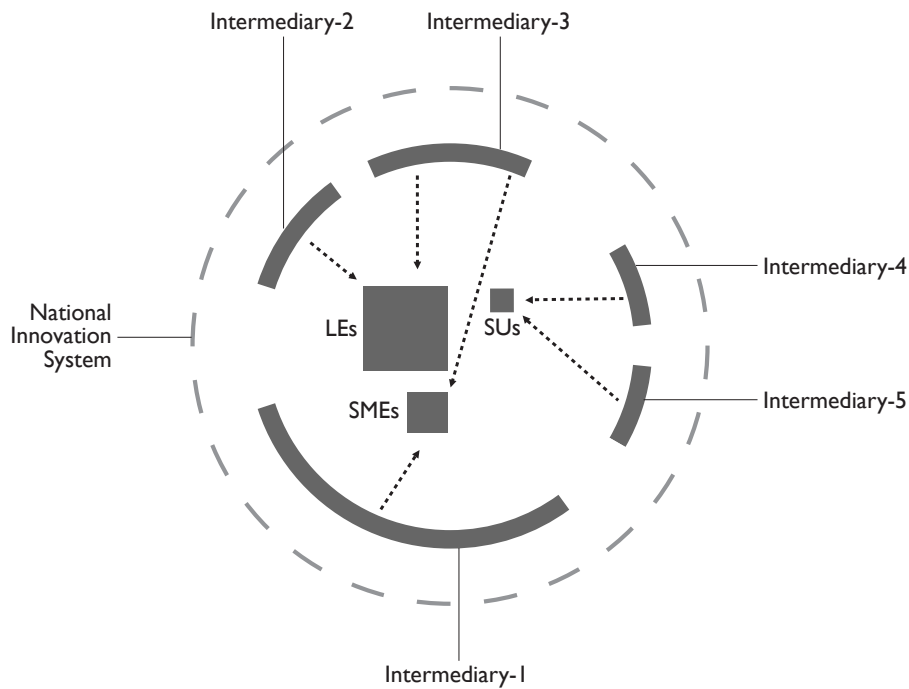


Figure 8.3 : Map of the intermediaries and their target company groups.

Although the set of intermediaries, their functions and attributes are described in more detail in Chapter 6, they are summarized here. Intermediary-1 is proposed as a public intermediary that supports a high number of small/medium enterprises (“SMEs” in the figures). Intermediary-2 and -3 are both consultancy companies. While Intermediary-2 focuses on a wider perspective of sustainable consumption and production and mainly provides advising and reporting services, Intermediary-3 focuses on design for sustainability and its implementation in developing products and services. It is usually difficult for small/medium enterprises to afford the services of Intermediary-2; therefore it mainly supplies services to large enterprises (“LEs” in the figures). In contrast, Intermediary-3, as a design for sustainability consultancy, matches the needs of small/medium enterprises to launch projects within a limited time and budget. Intermediary IV and V target startups (“SUs” in the figures). The type of Intermediary-4 is incubator with a specific focus on sustainable consumption and production. Intermediary-5 is an emerging type of intermediary, which generates and implements business plans on sustainable consumption and production with the specific aim of radical innovation.

The gaps in innovation systems are explained in the literature review (see Section 2.2.3). In Figure 8.3, it is assumed that each intermediary undertakes a specific intermediary function and does not interfere with the others. The distance between

each intermediary can be viewed as a “gap” in services. Nevertheless, among the intermediary functions some “overlaps” can be observed, where they interfere with each other. This tends to happen between closely related intermediary functions, such as between Intermediary Function-2 and -3, or Intermediary Function-4 and -5, whenever considering the scope of the services and target company groups.

The map of intermediaries (Figure 8.3) illustrates the assessment on Turkey is (Figure 8.4) upon which the strategies are drawn to fulfill the intermediary functions in the country. Although the first four types of intermediaries exist in Turkey, they are of limited capacity on sustainable consumption and production (see Section 6.2.8; Küçüksayraç et al., 2015). Regional chambers of industry fulfill the Intermediary Function-1 to a limited extent. Intermediaries that undertake the Intermediary Function-2 and -3 are emerging but both their services and the number of projects they undertake are limited. It was observed that some companies in Turkey that can afford to invest in the services do hire international intermediaries. Incubators with a specific focus on social entrepreneurship are emerging. They can fulfill the Intermediary Function-4 to a limited extent. Evidence of an intermediary that undertakes a function akin to Intermediary Function-5 was not found for Turkey during this research.

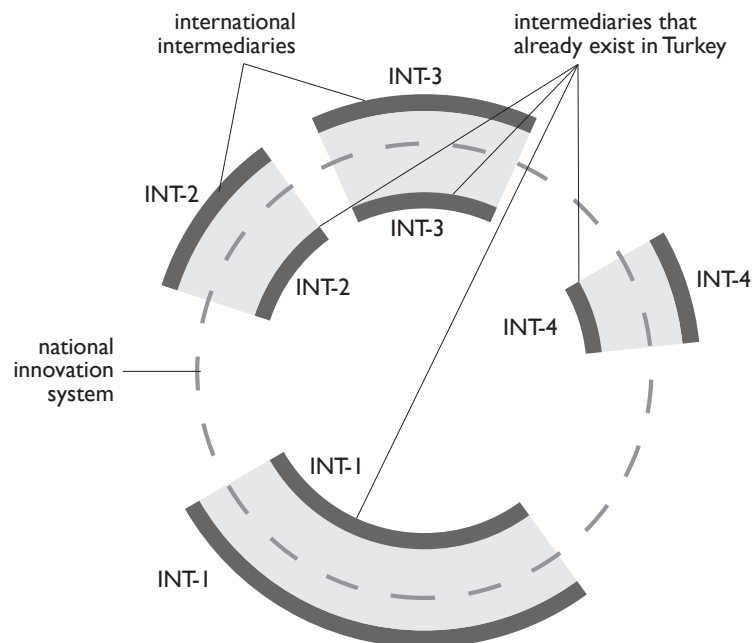


Figure 8.4 : Map of the existing intermediaries in Turkey.

As some intermediaries are missing in Turkey and some are functioning in a limited capacity (Figure 8.4), three strategies were developed to build the design for sustainability innovation system in the country.

The first strategy follows the functional approach on innovation systems (see Section 2.2.2; Hekkert et al., 2007; Bergek et al., 2008), and explores how the missing intermediary functions can be embedded into the existing intermediaries in Turkey (Figure 8.5).

CRITERIA-1 Utilizing the existing intermediaries in Turkey.

STRATEGY-1 Embedding the intermediary functions into the existing intermediaries (Figure 8.5) (the intermediary functions are represented with the circles)

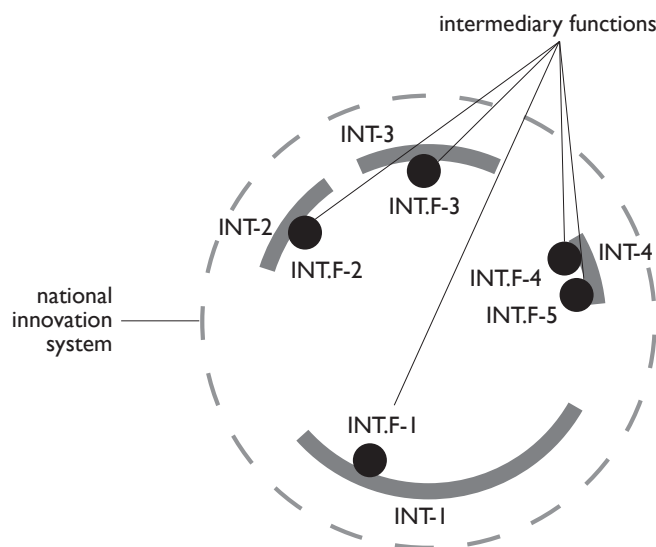


Figure 8.5 : Map for Strategy 1.

The second strategy is based on the observation that international collaborations with intermediaries that work on design for sustainability have already started in Turkey (see Section 6.2.8; Küçüksayraç et al., 2015), and explores, whether the design for sustainability innovation system in Turkey can be established through international collaborations (Figure 8.6).

CRITERIA-2 Utilizing international intermediaries.

STRATEGY-2 Building collaborations among national and international intermediaries (Figure 8.6)

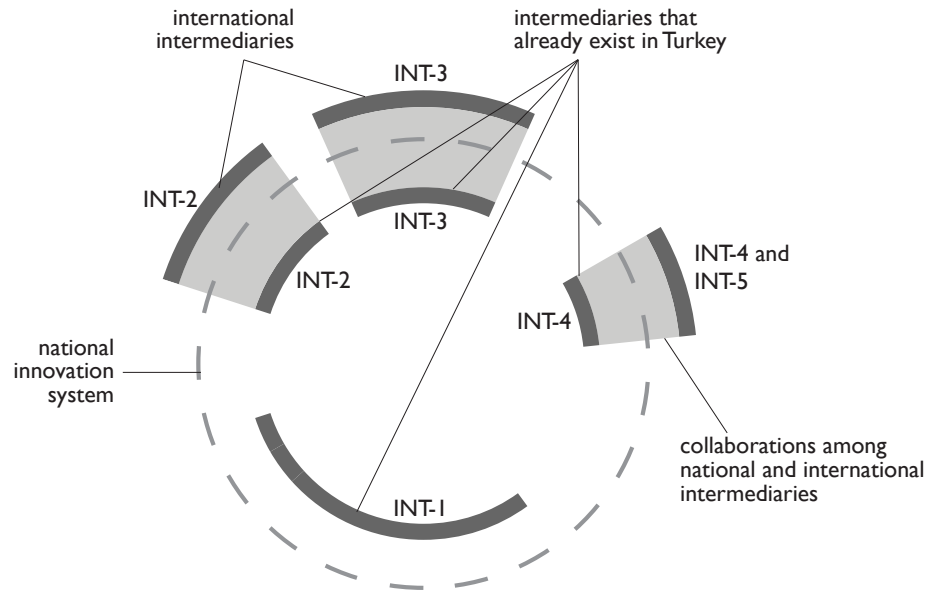


Figure 8.6 : Map for strategy 2.

The last strategy aims at achieving a desirable future (see Vergragt & Quist, 2011) – all companies in Turkey are knowledgeable of, and implement, design for sustainability (Figure 8.7). It proposes the intermediaries be multiplied in time, based on the finding that multiplying a core team that can provide, a given set of services to a company is a strategy for an intermediary to grow its capacity (see Section 6.2.1; Küçüksayraç et al., 2015). This strategy also assumes that in a saturated innovation system, gaps between intermediary services will diminish and overlaps between them will be observed.

CRITERIA-3 Fulfilling all intermediary functions and meeting all needs of companies in Turkey

STRATEGY-3 Developing a system via international alliances and multiplying successful intermediaries (Figure 8.7)

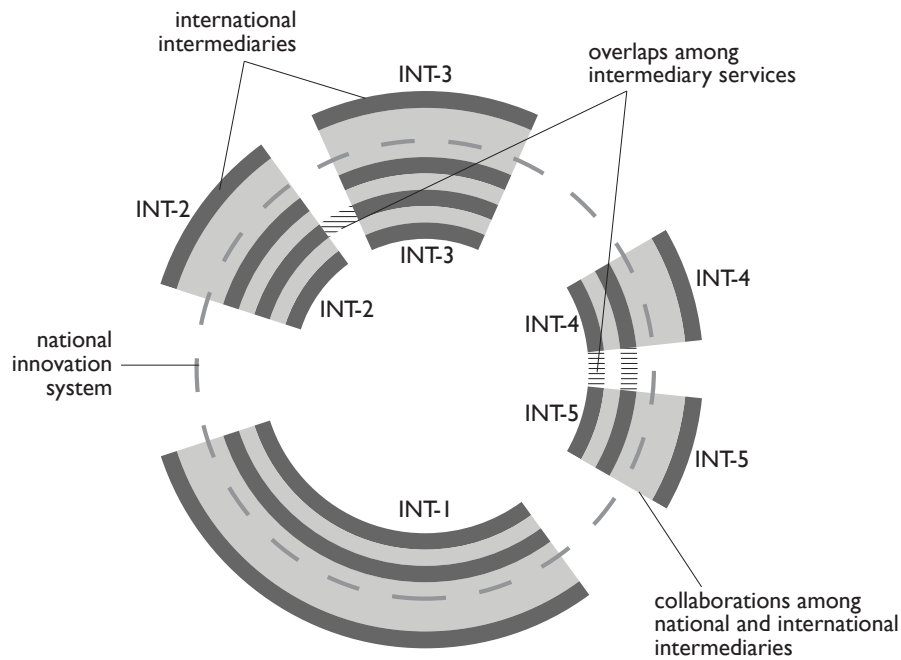


Figure 8.7 : Map for strategy 3.

8.3 Findings from the Experts' Interviews

The findings from the experts' interviews were grouped under four main themes, (1) intermediaries, (2) the other actors in innovation systems (3) variations in the roles of innovation systems' actors, and (4) specific suggestions for Turkey. The contributions of each expert to these themes are shown in Table 8.2.

Table 8.2 : Contribution of each expert to the themes.

Expert	Intermediaries	The other actors in innovation systems	Interchanging roles of innovation systems' actors	Specific suggestions for Turkey
Dr. Marcel Crul		●		
Prof.Dr. Arne Remmen	●	●	●	
Dr. İdil Gaziulusoy				●
Saskia Bosch	●	●		
Prof.Dr. Göksel Demirer			●	●
Prof.Dr. Jo van Engelen		●		●
Dr. Jaco Quist	●	●		●

8.3.1 Intermediaries

On the one hand the importance of intermediaries is acknowledged in the literature, especially in supporting small/medium enterprises (Major & Cordey-Hayes, 2000;

Kaufmann & Tödtling, 2002; Nieto & Santamaria, 2007; Backhaus, 2010); and on the other hand, the relevance and effectiveness of intermediaries were found to be below expectations (Doloreux, 2004; Massa & Testa, 2008; Zeng et al., 2010). While intermediaries may delay the innovation process due to time delays and lock-ins in decision-making (Samara et al., 2012), they can articulate and align interests of different actors, and support the establishment of networks of a variety of actors within innovation systems (Backhaus, 2010). Recently, rather than the value of intermediaries, the literature discusses their role, which needs to be communicated to service-providers effectively (Kirkels & Duysters, 2010).

While nevertheless acknowledging their significance, most of the experts questioned whether the role of intermediaries in innovation systems is crucial, however. One discussion point focused on the power of intermediaries. Some actors in innovations systems can be so powerful as to disqualify a company not fitting a given agenda. However, intermediaries mostly catalyze the innovation processes (Remmen interview, 07 June 2013). Furthermore, while intermediaries are helpful in realizing goals, they might be adhering to other actors such as the government policy and its programs mainly because of funding schemes. Because of this reason, funding schemes are important instruments for enabling intermediaries (Quist interview, 22 July 2013).

Another discussion point stressed that intermediaries could also create setbacks, especially on sustainability, if the support provided is inadequate or misleading (Remmen interview, 07 June 2013). Official labels, verification and accreditation are effective ways to hinder mistakes in the intermediation of sustainable consumption and production (Quist interview, 22 July 2013; Remmen interview, 14 November 2013). Another way to secure the innovation process is for a public intermediary to control the support processes of private intermediaries. Syntens, a public innovation agency in the Netherlands, is an example of such an intermediary. They aim to connect companies to private intermediaries and knowledge providers. In addition to other services, they consult small/medium enterprises in the early stage of innovation processes mainly to assess their needs. In the event the company needs more comprehensive consultancy services, Syntens directs it to a private consultant. Syntens then monitors this process and secures it via both a long-term trust-based

relationship previously built with the consultants and by intervening whenever the company reports a critical situation (Bosch interview, 09 July 2013).

8.3.2 Other actors in innovation systems

Although this study focuses on two actors in innovation systems – intermediaries and companies, most of the experts emphasized the importance of the systems' other actors as well. They are the universities and knowledge institutes for generating and diffusing new knowledge into a system, and policies and financial systems for transferring knowledge at a fast pace to the majority of companies. There was a consensus that other actors need to also be engaged for diffusing design for sustainability into an innovation system effectively.

8.3.2.1 Universities and knowledge institutes

The intermediary role of universities is investigated in Chapter 7. Related comments by the experts are included as input. However, two aspects are important for the elements addressed in this chapter and need to be cited again. First, universities and knowledge institutes can undertake a crucial role in the initial phase of intermediation, when generating and diffusing new concepts into the industry. Second, the research-driven aims of universities' outreach activities highlight differences in the roles of knowledge institutes and business associations, in that the former have more research-driven aims whereas the latter are more driven by their members' needs (Crul interview, 28 May 2013).

8.3.2.2 Companies' networks

The importance of building networks of companies both aiming at innovation and generating an agenda on sustainability were emphasized by most of the experts. One such example of a formalized public and private partnership are "product panels" in Denmark, where key actors, companies, business associations, and researchers work together on setting a common agenda, and allocating shared resources on sustainable consumption and production (Remmen interview, 07 June 2013). Product panels were established by the Danish Environmental Agency in 1998 in three sectors – electronics, textiles and transportation of goods, with the aim "to increase the involvement of and cooperation between players" (Knudsen et al., 2003), and were later also applied in other countries such as Spain (Watson et al., 2011).

Another important type of network in an innovation system is between small/medium enterprises, and large enterprises (Van Engelen interview, 11 July 2013). In such networks, the strengths of each company type complement each other. The strength of small/medium enterprises is flexibility to experiment and innovate, especially in the early stages of innovation processes. The strength of large enterprises, on the other hand, is wealth of resources and facilities, such as on production, marketing and distribution. For building networks and starting collaborations, large enterprises can take the lead by approaching small/medium enterprises to partner up during innovation. Philips Electronics, DAF Automotive and their influence on the industry in Southeast Netherlands in the 1990s are examples of such networks (Prud'homme Van Reine & Dankbaar, 2011).

8.3.2.3 Financial systems

A financial system is defined as “the network of institutions, which connects the owners of financial capital to that, which ultimately gives them value” (Tylecote, 1994). The elements of financial systems that affect innovation growth are “soundness of banks, availability of venture capital, financial market sophistication, interest rate spread, financing of national programs, and participation in international programs” (Samara et al., 2012).

The first aspect of financial systems discussed by the experts was their ability to act as a catalyzer in diffusing a sustainability concept into an innovation system, as the sustainability goals of companies and organizations diminish risk and attract investment (Van Engelen interview, 11 July 2013). This perspective is relevant for Turkey in the scope of its accession process to European Union, as Basel II standards became obligatory for the country's banking sector in 2012 (EC, 2012).

Another aspect of financial systems is the necessity of differentiating public and private intermediary functions, services, and funding schemes (Bosch interview, 09 July 2013; Quist interview, 22 July 2013), as also stated in the literature (Klerkx & Leeuwis, 2008). For instance, intermediaries' functions such as “creating new possibilities and dynamism within an innovation system” may be considered public interest, and thus should be publicly funded, which also would help avoiding conflicts such as regarding the unbiased position of intermediaries. Subsequent functions such as “knowledge brokering”, “testing and validation”,

“commercialization”, and “accreditation” should be funded privately by service-receivers rather than publicly, as it might result in overpopulating the intermediary level (Klerkx & Leeuwis, 2008).

An example of differentiating funding sources according to the stages of support process was provided in Section 8.3.1. Syntens directs small/medium enterprises to more comprehensive consultancy services, as needed. In addition they sometimes allocate subsidies for paying the first hours of a private consultancy on behalf of small/medium enterprises, so that they can assess whether the services are matching the company’s needs and expectations. The aim of Syntens is to enable small/medium enterprises to plan their paths for innovation and find the right partners for it, as well as to spread the costs and risks inherent to the innovation process (Bosch interview, 09 July 2013). Moreover, in the Netherlands, the public organizations do not compete with the private sector; as such activities are strictly regulated by both the Netherlands Competition Authority and society in general (Bosch interview, 09 July 2013). This also helps in separating public and private domains during support processes.

Another discussion focused on the lead role of funding schemes for intermediaries in introducing a concept into the industry. Available funding is important for intermediaries, especially in the initial phases of developing their services, and to achieve their target portfolio without compromising their aims (Quist interview, 22 July 2013). When differentiating funding sources, the type of innovation pursued by the programs is also important, and intermediaries should be funded for developing services that aim at radical innovation. These projects usually take a much longer time and their impact cannot be assessed and measured in the short-term (Bosch interview, 09 July 2013).

8.3.3 Variations in the roles of innovation systems’ actors

One expert emphasized that the actors in an innovation system, their roles, importance and complexity of their interactions may vary between countries, sectors and even between and within companies. For instance, one specific type of intermediary might be very influential in one country, whereas, it might not even exist in another country. Moreover, the importance of actors may vary between sectors. For instance, retailers or European Union policies might be the most important actors

for the textile industry, or for specific companies within the textile industry, if they export to European Union countries. However, the most important actors for the construction sector might be the local authorities or the financial systems. In addition, the number of actors in an innovation system and the complexity of their interactions might vary (Remmen interview, 07 June 2013).

Another related aspect is that different actors within an innovation system might understand the same issue differently. By analogy, departments within a company, whose employees have different educational and professional backgrounds, perceive and approach sustainability differently. This lack of uniform perspective or understanding needs to be overcome with a translating and negotiating process between actors, whereby the quality of interactions becomes important (Remmen interview, 07 June 2013).

One strategy to plan an effective innovation system and to align the aims of its actors is first setting a common agenda at the national level and then working throughout sectorial levels to be able to set more specific agendas. The agenda also changes in time, along with the new knowledge acquired and results achieved (Remmen interview, 07 June 2013). This is also the path that the sustainable consumption and production programs follow in Turkey, such as prioritization of sectors within the country reaching important stakeholders within sectors (TTGV&MoEF, 2010; Demirer interview, 10 July 2013).

Alongside the sectorial approach, the experts also acknowledged the importance of cross-sectorial knowledge transfer and the crucial role of designers in achieving it. Design for sustainability consultancy companies are mostly cross-sectorial intermediaries. Moreover, various types of intermediaries, including sectorial intermediaries, employ designers in-house.

8.3.4 Specific suggestions for Turkey

Both experts from Turkey (Demirer interview, 10 July 2013; Gaziulusoy interview, 02 July 2013) emphasized the urgent need to transform the country's mindset towards sustainability. For this to take place, they suggested, long-term and also systematic thinking is required. To this regard, they were concerned about the barriers in embedding a sustainability mindset into existing organizations mainly

because of institutional barriers and lack of expertise on the issue. This comment also relates to the first strategy.

Moreover, also cited as important, proactive individuals working on sustainability for the transformation of Turkish organizations and society need to be empowered. Designers can contribute into the transformation first through activism and second by helping intermediaries to better communicate sustainability services and projects (Gaziulusoy interview, 02 July 2013). For activism, existing frameworks specific to the design field may be helpful for the designers (e.g., Chapman & Gant, 2007; Fuad-Luke, 2009; Middlemiss & Parrish, 2010). A second important aspect, as also illustrated by the empirical study described in Chapter 4, even the best performing companies in Turkey's design for sustainability field are not aware of the public support schemes available (Küçüksayraç, 2015).

According to the experts, one of the biggest problems in Turkey faces achieving sustainable consumption and production is that the government's inability to fully enforce companies' compliance with the existing laws. However, some companies implement sustainability practices. While large enterprises are aware of the benefits and usually comparatively small investment that sustainable consumption and production requires, the main concern of small/medium enterprises is economic survival. Another problem related to sustainable consumption and production in Turkey is that the Cleaner Production Center was established only recently. Between 2011-2013, the National Productivity Center was assigned this duty, and only recently, TÜBİTAK-MAM took over the responsibility (Demirer interview, 10 July 2013).

Most of the experts emphasized that actors in innovation systems need to take on an orchestration role. According to the literature, universities, and intermediaries can take the orchestration role – mostly in sectorial networks (Howells & Edler, 2011), as well as in “hub” companies (Dhanaraj & Parkhe, 2006). Nevertheless, the government and public institutions should embrace the concept of sustainability and orchestration role towards it, which can be expressed and executed in various ways, from referring to sustainability in a public speech to allocating subsidies and creating legislations, and the same is valid for design for sustainability (Demirer interview, 10 July 2013). Furthermore, most of the experts stated that “champions” and

“ambassadors” in various fields and sectors are needed to influence the decision-makers to take action.

Both experts from Turkey described developing a comprehensive company database for companies on sustainable consumption and production as an urgent need of Turkey both for making the knowledge available, and for overcoming the time and budget limitations (Demirer interview, 10 July 2013; Gaziulusoy interview, 02 July 2013). The sharing of local case studies and results from pilot projects in a concrete and simple way is crucial to convince the companies in Turkey, aim which cannot otherwise be achieved by only sharing examples from other countries (Demirer interview, 10 July 2013).

The experts also suggested that Turkey, being a candidate to European Union membership, is to utilize the room for development to create a well-equipped system for sustainable innovation. This can be achieved with a knowledge-driven rather than a policy-driven perspective, as the ongoing discussion and required policy compromises throughout the negotiation process might create setbacks to sustainable innovation. Furthermore, adapting a single approach to sustainability is not possible. A fertile ground for sustainable innovation can be achieved by targeting a flexible and open system, where evolutions instead of solutions are in search (Van Engelen interview, 11 July 2013).

Another suggestion specific to this study was approaching sustainable consumption and production, and design for sustainability from the wider perspective of a societal change rather than the narrower focus of intermediating design for sustainability, to achieve higher levels of sustainability. To expand diffusion beyond frontrunner companies to the majority of companies, which usually do not show progress beyond complying with the legislations, the government needs to be involved in the process. This usually starts with providing funding and communicating best practices, such as which policies to follow (Quist interview, 22 July 2013).

In addition to these suggestions, all participant experts emphasized the importance of establishing and improving international collaborations and strategic partnerships with intermediaries as well as universities, for mobilizing resources to generate and transfer knowledge and capabilities. Finally, being a candidate to European Union membership, Turkey can better utilize the existing funding.

8.4 Discussion

This chapter explored two actors in innovation systems, intermediaries and companies. Yet, the experts' interviews indicated the need for other influential actors, such as financial systems, universities and knowledge institutes, to be integrated into the framework. In the literature, financial systems are considered as a part of the infrastructure along with legislations, standards etc. (see Van Lente et al, 2003).

The experts from Turkey were concerned about the first strategy and the barriers in embedding sustainability functions into existing organizations mainly because of institutional barriers and lack of expertise on the issue. The reflection on the second strategy was related to the price of services charged by international intermediaries. Building national and sectorial programs and company alliances for such initiatives were suggested for increasing the investment effectiveness. Comments on the third strategy included that it reflects only a snapshot into the desired future and the dynamics need to be studied further.

An important discussion took place on the distinction between the structures of different sectors. While designers are employed in-house by sectorial and other types of intermediaries, and within companies, design for sustainability consultancy companies mostly function cross-sectorially. This study continues with cross-sectorial approach.

The function-specific perspective on national innovation systems in the literature (see Section 2.2.2; Hekkert et al., 2007; Bergek et al., 2008) was utilized in this study for describing the intermediaries. The proposed strategies were based on the findings of previous studies and aimed at developing all intermediary functions at once. During experts' interviews, the discussions focused on different stages of the support process, such as the initial stage of introducing a concept to companies and then spreading it to the majority of companies at a fast pace.

Following experts' interviews, in addition to the intermediary functions determined in Chapter 6, three important functions were determined as: (1) generating design for sustainability knowledge, (2) financing, and (3) orchestrating. The innovation system's actors to fulfill these functions are not primarily intermediaries. Universities and knowledge institutes fulfill the first function. The second function is

fulfilled by public and private funding schemes, such as governmental and European Commission programs, companies allocating their resources, and a combinations of these. The actor that will undertake the third function – orchestration, might vary according to the activity, and to the requirements of the funding schemes. While the Cleaner Production Center in Turkey might be expected to meet the need for orchestration, intermediaries and companies can also be more proactive in initiating projects and undertaking orchestrating roles.

Following this evaluation process, three new criteria and strategies were determined following the second phase of the research. This time, the general criterion for all strategies was identified as fulfilling the five intermediary functions that were proposed in Chapter 6. This criterion enabled other actors in innovation systems to either take or contribute to, intermediary functions. Moreover, while the initially proposed strategies can still be valid, the newly proposed ones aim to offer a more comprehensive and yet focused perspective.

The first new strategy aims to fulfill the Intermediary Function-1 – awareness raising and identifying potentials on sustainable consumption and production and design for sustainability for small/medium enterprises (Figure 8.8). The actors that undertake this function are proposed as Intermediary-1, -2, and -3 and large enterprises, at both the national and international levels and in collaboration. The main service provider is Intermediary-1, whose primary aim is to support a high number of small/medium enterprises, and therefore should undertake the orchestration role. While Intermediary-2 and III can contribute to expanding the support process through a consultancy, international partners might be needed for knowledge and experience-sharing and large enterprises might be needed for networking among companies. As the aim – to raise awareness, is not knowledge-intensive, the role of universities and knowledge institutes might not be crucial at this stage of innovation support. If this stage involves setting a national agenda on sustainable consumption and production, then knowledge institutes should be involved as leading partners.

NEW CRITERIA-1 Fulfilling Intermediary Function-1

NEW STRATEGY-1 Awareness-raising and identifying potentials for sustainable consumption and production and design for sustainability for small/medium enterprises (Figure 8.8)

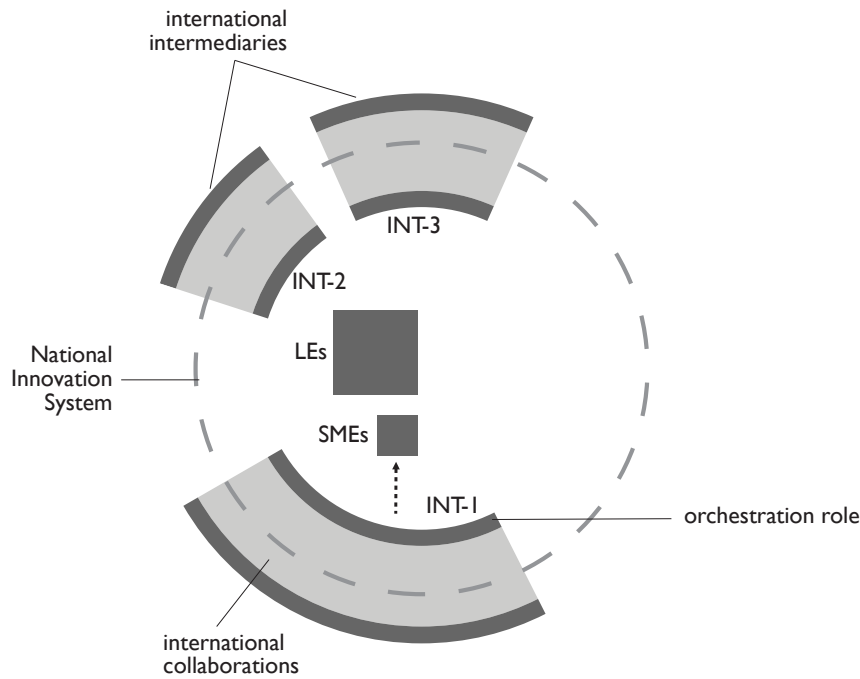


Figure 8.8 : Map for new strategy 1.

The second new strategy aims to fulfill the Intermediary Functions-2 and -3 – sustainable consumption and production consultancy and reporting for large enterprises, and design for sustainability consultancy and implementation for both large and small/medium enterprises. Compared to the previous aim, this strategy needs to move beyond raising awareness and aim at implementation. The actors to undertake these functions are proposed as universities and knowledge institutes – both national and international, and Intermediary-1, -2, and -3, in collaboration. This support process can be divided into two stages. In the initial stage of introducing the design for sustainability concept to the industry, knowledge institutes, especially universities, should be the main service providers. The latter stage consists in continuing diffusion into the industry. In the initial stage, it is crucial to involve and educate the actors that will continue the latter stage, namely intermediaries. This support process is akin to DUT-DfS's projects, consisting in the undertaking of a temporary intermediary role to introduce a new concept into the industry. International partners are also pivotal for knowledge transfer and building upon past experiences in the initial stage. This process needs to be research-oriented and documented, to be applied in the latter stage. In addition, throughout the process, international manuals and standards can be utilized to validate the outputs.

NEW CRITERIA-2	Fulfilling Intermediary Functions-2 and -3
NEW STRATEGY-2	Sustainable consumption and production consultancy and reporting for large enterprises, and design for sustainability consultancy and implementation for large enterprises and small/medium enterprises (Figure 8.9)

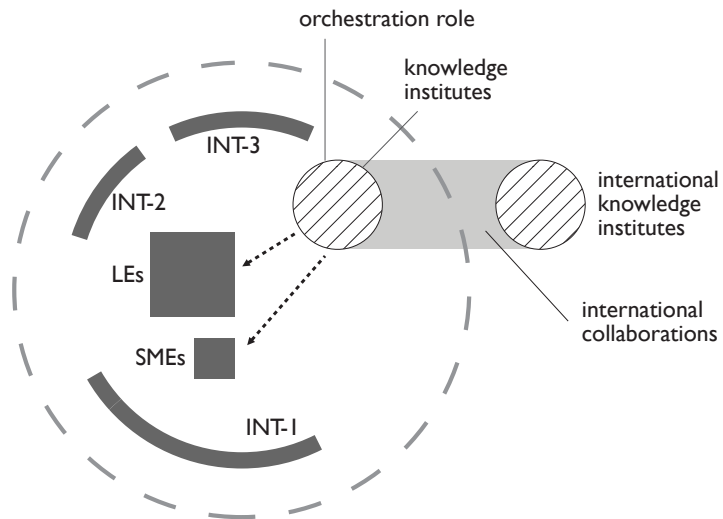


Figure 8.9 : Map for new strategy 2.

The third strategy aims to fulfill Intermediary Functions-4 and -5 – incubating startups that work on sustainable consumption and production, and generating and implementing business plans for radical innovation for sustainable consumption and production. Startups are the main group targeted by this strategy. The existing incubation centers and programs in Turkey can be the main service-providers and undertake the orchestration role. In incubation processes, knowledge institutes and universities are usually highly involved. While initiatives on supporting social entrepreneurship are emerging in Turkey, international networks and collaborations are pivotal for following recent debates. This strategy is most suitable for enabling new business models, open innovation and activism, where the designers can take leading roles (see Chapman & Gant, 2007; Fuad-Luke, 2009; Middlemiss & Parrish, 2010).

NEW CRITERIA-3	Fulfilling Intermediary Function-4 and -5
NEW STRATEGY-3	Incubating startups that work on sustainable consumption and production, and generating and implementing business plans on radical innovation for sustainable consumption and production (Figure 8.10)

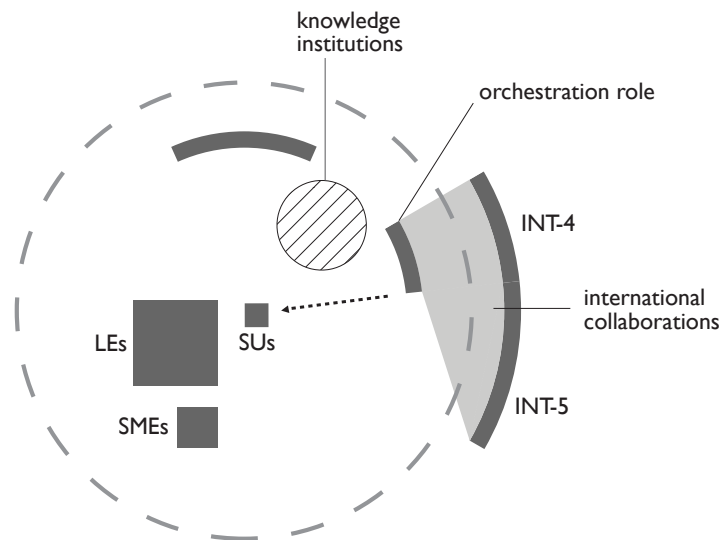


Figure 8.10 : Map for new strategy 3.

8.5 Conclusions

This empirical study investigated how companies in Turkey should be supported in their innovation processes for applying design for sustainability. The study started with two of the innovation systems' actors – intermediaries and companies as its focus. Although isolating actors was needed for reducing complexity in the analysis, the experts interviewed indicated that other actors in innovation systems should be included as well. Knowledge institutes, especially universities, have a crucial role in generating and diffusing design for sustainability knowledge, and financial systems in catalyzing the process. Moreover, including these actors into the innovation processes improves the validity of actions, as competences and possible impact of intermediaries needs to be checked as well.

This study utilizes a functional approach, which enables the involvement of other actors in support processes and their uptake of roles to fulfill the intermediary functions. This way, innovation systems' actors complement intermediaries in

support processes. This aspect is especially important both where the intermediaries are not yet sufficiently developed to the point of being able to provide effective innovation support to companies and when the aim is diffusing new knowledge into innovation systems. It also reflects the dynamism of innovation systems, where the roles of innovation systems' actors are dynamic as well; in some cases the actors interchange roles.

This study proposes strategies based on the criteria to fulfill three groups of intermediary functions. The functions are grouped as: (1) awareness raising and identifying potentials for sustainable consumption and production and design for sustainability for small/medium enterprises, (2) sustainable consumption and production consultancy and reporting for large enterprises, and design for sustainability consultancy and implementation for large enterprises and small/medium enterprises, and (3) incubating startups that work on sustainable consumption and production, and generating and implementing business plans on radical innovation for sustainable consumption and production. Three strategies for realizing these function groups were proposed and the actors required to be involved were mapped. This way, the study aimed to build strategies for future programs on design for sustainability and to inform and inspire stakeholders in intermediaries, universities, and governmental institutions. The proposed strategies reflect two sets of many possible strategies. While the first strategies are based on previous studies and are still valid, the second set of strategies are more comprehensive and focused. The recommendations for each type of stakeholders of future projects are discussed in the final chapter in detail.

This study also focuses on a specific type of knowledge and innovation source, design for sustainability with a cross-sectorial perspective. Contrary to a sectorial perspective, a cross-sectorial one was matched to the role of design and designers in the industry to transfer knowledge among sectors.

Although the study focuses on Turkey, the findings might be applicable to other regions with similar conditions for practicing design for sustainability. For this purpose, an assessment should be carried out to evaluate to what extent the five intermediary functions are fulfilled in each case. As the strategies were developed with the general criterion to fulfill the five intermediary functions, available

stakeholders and their roles, such as orchestrating and financing can be determined following the discussion.

The maps of strategies reflect snapshots, although the initial and latter stages are discussed for each strategy. The dynamic interactions between the actors and processes of innovation support should be explored further in future studies.

9. CONCLUSIONS

The discussion and conclusions of each empirical study are included in the corresponding chapters, which also provide answers to the research questions. This concluding chapter aims to gather the answers to all the research questions, illustrate the contribution of the thesis to theory and practice, discuss the theoretical basis, methods, and limitations of the study, suggest further research topics, and draw recommendations for relevant stakeholders.

9.1 Answers to the Research Questions

This section answers the research questions. Each study is matched to the corresponding research question(s) it helped to answer in Table 9.1 (the level of contribution from each study is grouped as main or secondary contributions and represented with a small and a bigger circle respectively). In the end of the section, the conceptual model is revised following the main findings and conclusions. The model is presented in two figures, the first one reflecting the demand side of innovation support (Figure 9.1) and the second one the supply side of innovation support (Figure 9.2).

Table 9.1 : Answers to research questions (RQ 1-6) from literature review (LR) and empirical studies (ES 1-5)

	LR	ES 1	ES 2	ES 3	ES 4	ES 5
RQ 1	●	●				
RQ 2	●	●	●			
RQ 3	●			●		
RQ 4	●				●	
RQ 5	●		●	●		
RQ 6	●	●	●	●	●	●

RQ 1 What is the state of the art of companies' design for sustainability practices in Turkey?

The first empirical study (Chapter 4) investigated five different aspects of the first research question. The results are compared to the literature review and the previous empirical studies undertaken in the European Union and Turkey. The study aimed to understand the strategies that companies employ in their design for sustainability practices, the drivers for these practices, the barriers they face during the process, the benefits they achieve and their further needs. To this purpose, a survey was carried out with 26 best performing companies from Turkey.

The findings indicate that best performing companies in Turkey mostly employ “producing and manufacturing” and then “packaging” among their design for sustainability strategies. These findings are consistent with the literature on Turkey but not with the literature on the European countries, where strategies such as “selection of low impact materials” and “high reliability / durability” were rated higher. Moreover, companies mostly tasked their “Production” and “Quality Management” departments with taking the survey. This indicates that design for sustainability is mostly comprehended as an issue of production rather than product development in Turkey.

In the study, the drivers for the companies to carry out design for sustainability practices were compared to the benefits they gained from the process. The findings indicate that the drivers for companies mostly consist of benefits, except for “product quality improvement” and “new opportunities for value creation”. These topics can be suggested as foci for designers in Turkey in their design for sustainability practices.

Differing from previous studies in Turkey, the main drivers for the sample companies to carry out design for sustainability practices relate to brand image. Although the literature cites exports as the most important driver, they turned out to be the least important driver among sample companies withstanding the fact that they mostly export to European countries. This result might indicate that the design-for-sustainability practices of companies are not dependent on specific market conditions; rather the companies are driven to be pioneers in the field. This is consistent with the fact that the sample group consisted of best performing

companies in Turkey. Generally, this finding can be viewed as supporting the literature by suggesting that the internal drivers provide stronger stimuli than the external ones and are therefore promising for overcoming barriers and developing initiatives to support design for sustainability.

The lack of legislation and customer demand are cited as the most important barriers, which is to some extent consistent with previous studies about Turkey, but not consistent with the studies about the European Union. Contrary to Turkey, legislation and customer demand in the European Union are cited as the most important drivers. Moreover, the sample companies rated all of the listed needs as high. These findings show the need in Turkey for supporting companies and for taking action at the policy level by developing programs and legislation. An important finding related to intermediaries was the difficulty of companies in finding specific organizations with which to collaborate and from which to receive support.

RQ 2 How do some companies in Turkey succeed in implementing design for sustainability despite the barriers?

The second research question is investigated by the second empirical study (Chapter 5), which aims to expand the findings of the literature review and the first empirical study with an in-depth analysis. Two case studies, one of a large enterprise and one of a small one were carried out. They helped to describe and explain the design for sustainability implementation processes, whereby the knowledge is not yet systematically diffused, and conditions for sustainability such as legislation, market demand and support mechanisms are cited as insufficient.

The findings indicate that for practicing design for sustainability, barriers can be overcome via the commitment of proactive individuals and company management, and via national and international collaborations with intermediaries. Although large enterprises are more capable of developing their own capacity, small/medium enterprises are more in need of support from third parties. The study also explained how some companies that have resources, develop their own support mechanisms and processes.

The industrial designers in the study do not have an educational background on design for sustainability and approach the issue as a design problem. However, their design-for-sustainability practices extend further than merely approaching the issue

as “principles of good design”. The level of innovation they achieve depends on their professional experience, which can reach radical innovation on design for sustainability. The approach they mostly utilize is to “design for sustainable behavior”, which aims at changing the behavior of users with sustainable solutions toward more sustainable lifestyles.

RQ 3 What is the state of the art of innovation support on design for sustainability in developed countries and in Turkey?

The third empirical study investigates the third research question (Chapter 6). Case studies of 14 intermediaries from the Netherlands, United Kingdom and Turkey were undertaken. The examples from the Netherlands and United Kingdom were reported as advanced examples, while the ones from Turkey as emerging examples. It should be noted that it is not implied that the results from the Netherlands and the United Kingdom can be generalized for all developed countries but these countries were selected because cited in the literature as providing good examples of intermediary organizations.

The findings on the services and support instruments that the intermediaries offer, their approaches and the drivers that shape them, the challenges they face during the intermediation process and while working on sustainability, and the role of design in the support process were reported and discussed in the light of the literature review. Moreover, a framework of a set of intermediaries that meets the needs of companies working on design for sustainability is proposed. In the framework, five intermediaries, their main functions and the set of possible and alternative intermediary attributes are matched.

While the framework differentiates the roles of intermediaries, it was observed that intermediaries build collaborations and networks for meeting the needs of companies collaboratively and by complementing each other. They help companies to build networks of companies so that they can support each other during innovation processes. It is also crucial for intermediaries to collaborate with other stakeholders such as universities, experts, volunteers, investors and entrepreneurs, for exploring and experimenting with new business models and achieving radical innovation aims.

The main role of design in the innovation support process was observed to be during the implementation phase. Three types of roles were observed, industrial design

processes of product-service systems, building strategies for companies in early innovation processes, and operating the tools and methods. The last role overlaps with sustainable consumption and production tools and methods to a great extent. The specific role of designers in design for sustainability processes mainly rests on the scope of their educational background.

The findings on Turkey showed that intermediary services for design for sustainability are emerging, but are mostly limited to educational services with the aim to raise awareness. This is expected in the early stages of developing innovation support, but specific intermediaries and services on design for sustainability can to be developed at a faster pace. For achieving that, the framework proposed in this study can be utilized.

RQ 4 What is the intermediary role of universities in diffusing design for sustainability into the industry?

The fourth research question was investigated by the fourth empirical study (Chapter 7). Three case studies were undertaken. DUT-DfS from the Netherlands was studied as a best practice, and BU-SDSCP and Prof. Göksel Demirer as best examples from Turkey. While the focus of the first case was design for sustainability, the focus of the latter cases was sustainable consumption and production, as design for sustainability is not yet diffused into the universities in Turkey. Furthermore, the cases exemplify three organization types that link universities and intermediaries, a section within a university department, an internal center and an individual scientist within universities.

The outreach activities, through which the cases undertake the intermediary role, are explained in the study. The findings showed that because project-based, the intermediary role of universities is usually temporary. The three types of projects were grouped as funded projects, company collaborations and creating new ventures. Moreover, how these outreach activities relate to education and research activities is explained. The intermediary role of universities is especially important in introducing new concepts into the industry and educating future experts and intermediaries that will continue to work on the concept once the temporary intermediary role of universities is completed.

The intermediary support instruments make up the outreach aims of the universities as well, with additional research and educational aims. The research aim of universities in outreach activities is to gather data for research and to test, validate and expand theories through practice while the educational aim is to develop curriculum.

RQ 5 What is the role of designers in the innovation support for design for sustainability?

The fifth question is investigated mainly by the second and third empirical studies (Chapter 5 and 6). The literature cites the intermediary role of designers as “brokering”. The initial conceptual understanding illustrates industrial designers as connected to both companies as in-house industrial designers and to intermediaries as design consultants. The in-house designers at one of the case companies investigated in Chapter 5 exemplify the first type, while the design consultant at the case investigated in Chapter 5 and the design consultancy companies investigated in Chapter 6 exemplify the second type. However, in the third empirical study (Chapter 6), designers are employed in-house employees by intermediaries, hence taking on different roles than the designers listed above.

Following the findings, three main functions of industrial designers in design for sustainability were determined as core industrial design, design thinking and operating design for sustainability tools and methods. The external design consultants that act as intermediaries, undertake all of these roles. The in-house designers in companies mostly undertake the first and second roles, while their engagement in the third role depends on their knowledge and expertise on design for sustainability. As explained when answering the second research question, the designers who do not have an educational background in design for sustainability approach the issue as a design problem. However, their design for sustainability practice depends on their professional experience, which can reach radical innovation. These findings can be expected to an extent when taking the literature review into account.

However, for the large part, the in-house designers at intermediaries that were investigated in the third empirical study (Chapter 6) do not undertake the core industrial design function. Instead, they develop strategies for industrial design

acting as design thinkers, and operate design for sustainability tools and methods. It should be noted that this type of industrial designers, three out of four cases (the fifth case is a design consultant) were only observed among intermediaries in the Netherlands. These intermediaries consider the industrial design and product(-service-system) development as a company function with which they do not interfere but consult.

RQ 6 How should companies in Turkey be supported in their innovation processes for applying design for sustainability? (Addressing Gap 4)

The fifth empirical study investigates the last research question (Chapter 8). In light of former studies, the aim of this study was to propose and map strategies for diffusing design for sustainability in Turkey. The strategies were developed further through experts' interviews. In the study, the functional approach to innovation systems was utilized. In the beginning of the study, intermediaries and companies were the main foci for reducing the complexity in the analysis; while, following experts' interviews other actors in innovation systems became involved in the strategies. It was concluded that universities have a crucial role in both generating and diffusing design for sustainability knowledge, and that financial systems have a crucial role in catalyzing the diffusion.

An important discussion took place on the different innovation systems between different sectors and the variations in roles of their actors. Nevertheless, the cross-sectorial approach that was utilized in the study was matched to the design for sustainability approach and to role of design and designers in the industry, which is to transfer knowledge between sectors. Therefore, the cross-sectorial approach continued to form part of the strategies.

The three final strategies proposed to fulfill the five intermediary functions described in the third empirical study (Chapter 6) by focusing on three different target company groups. The strategies are: (1) raising awareness and identifying potentials on sustainable consumption and production and design for sustainability for small/medium enterprises, (2) sustainable consumption and production consultancy and reporting for large enterprises, and design for sustainability consultancy and implementation for large enterprises and small/medium enterprises, and (3) incubating startups that work on sustainable consumption and production, and

generating and implementing business plans on radical innovation for sustainable consumption and production. These strategies are mapped in figures in Section 8.4.

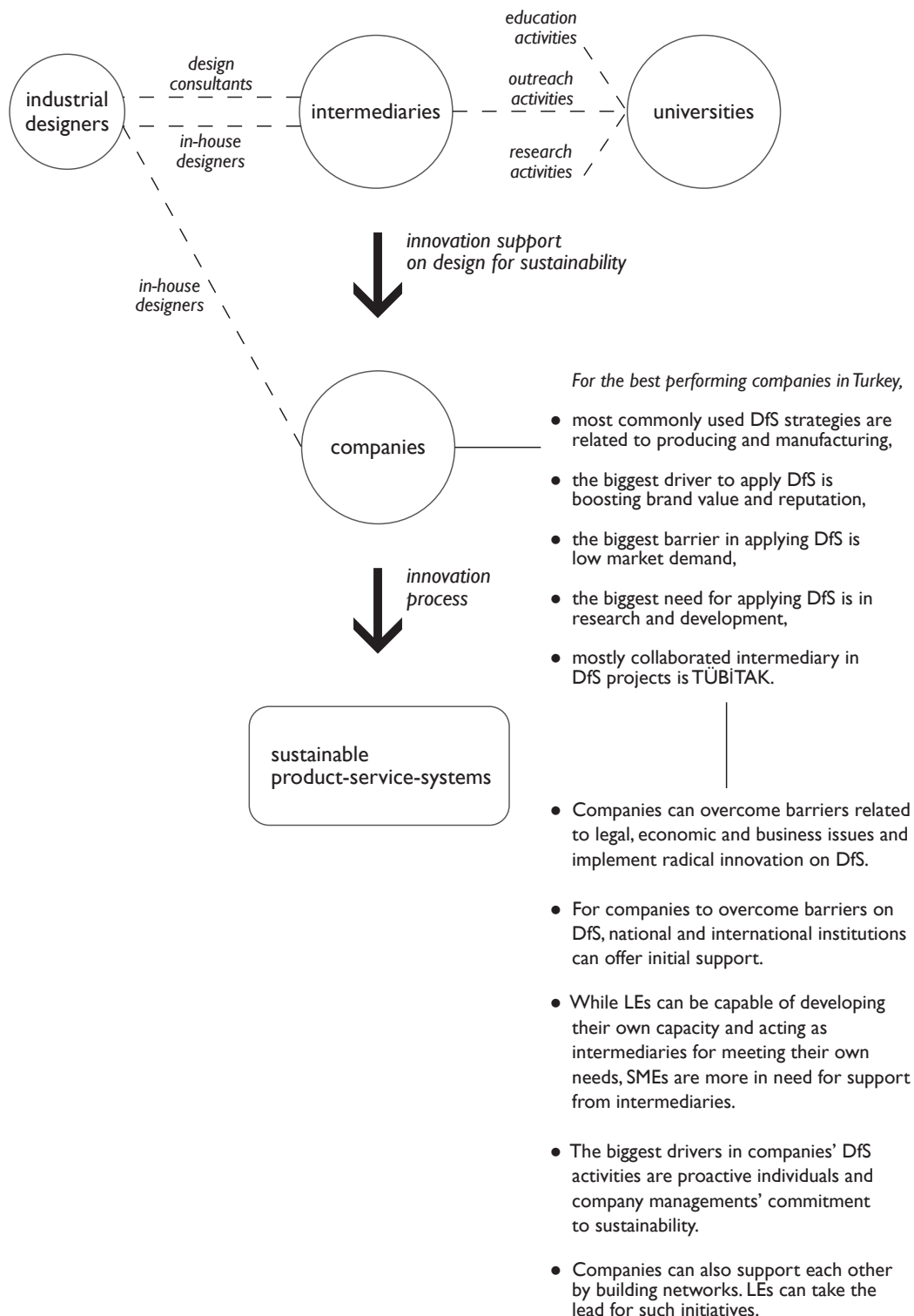


Figure 9.2 : The final conceptual model – The demand side of innovation support.

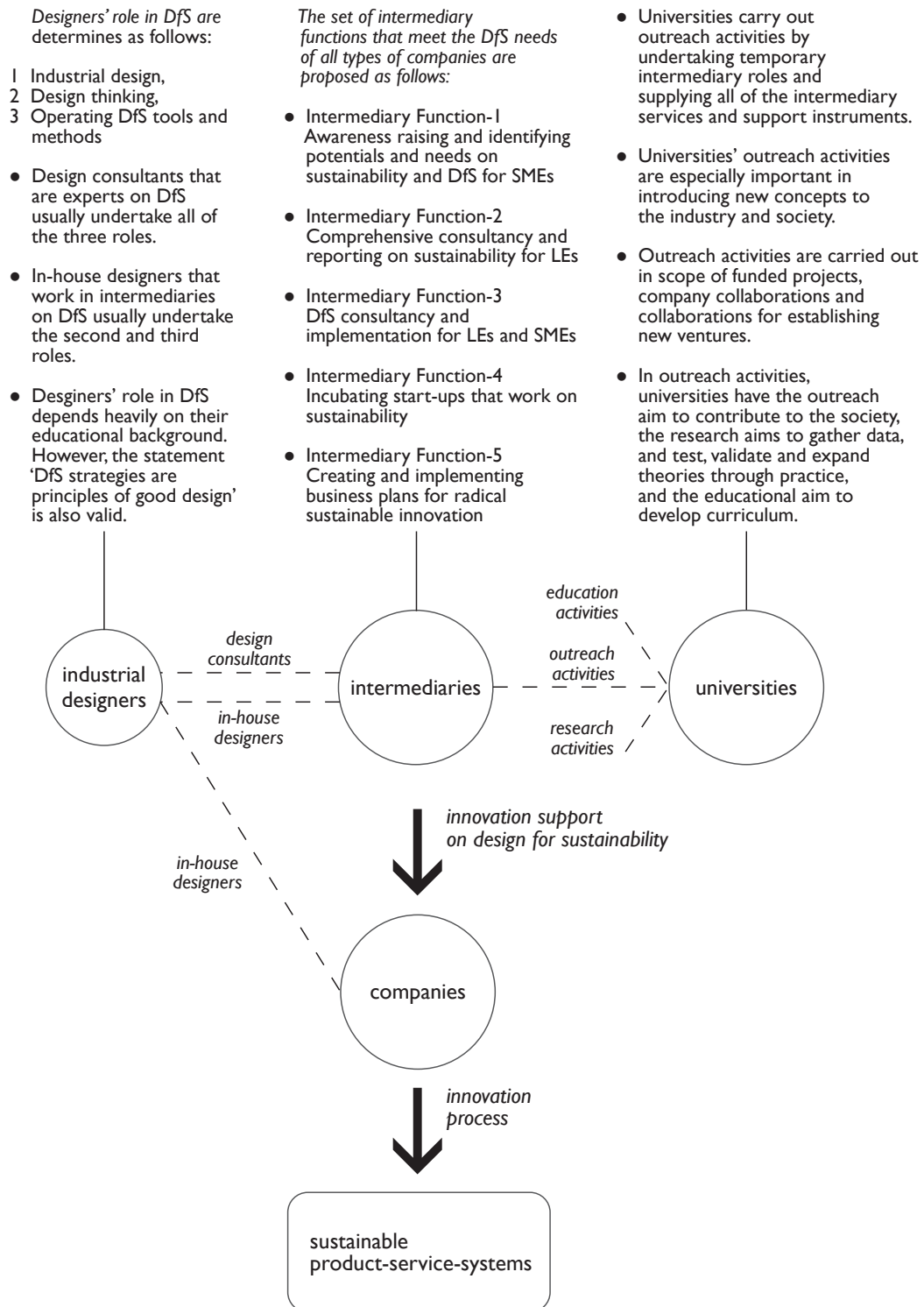


Figure 9.3 : The final conceptual model – The supply side of innovation support.

9.2 Contributions to Theory

One of this thesis' contributions to theory is the framework for intermediaries that meet all needs of companies regarding design for sustainability, which is developed

and presented in the third empirical study (Chapter 6). The framework with the intermediary attributes, type, nature, target group, services, and support instruments, aims to be utilized in identifying intermediaries. The fourth empirical study (Chapter 7) provides one example for such analysis; the framework was utilized to identify the university cases when investigating the intermediary roles of universities. This study (Chapter 7) also contributes to the limited literature on the outreach activities of universities in the design for sustainability field.

This thesis utilizes innovation systems theory. The functional approach (see Section 2.2.2; Hekkert et al., 2007; Bergek et al., 2008) was utilized to explain the roles of intermediaries in innovation systems. The study focused mainly on the two main actors in innovation support, companies in the demand side and intermediaries in the supply side. Nevertheless, other actors in innovation systems were also involved in the proposed strategies by undertaking and reinforcing the functions of intermediaries.

Based on findings from the empirical studies, one theoretical contribution made by the thesis pertains to the interchanging roles of innovation systems' actors. The literature cites universities as "taking temporary intermediary roles" (see Cook et al., 2006). This study revealed that an interchange of roles occurs not only between universities and intermediaries but also between companies. Therefore, the relationship between the actors in an innovation system is defined not only by interactions, but also by interchanging roles. This also suggests that in innovation systems, not only does knowledge flow, but also its actors' roles and functions are dynamic.

Three cases illustrate the interchanging roles among the innovation systems' actors with the innovation system map proposed in the literature (see Section 2.2.3; Van Lente et al., 2003) which places intermediaries in the middle of all innovation systems' actors. When intermediaries in an innovation system are effective, they build interactions between all of the innovation system's actors and catalyze innovation processes (Figure 9.3).

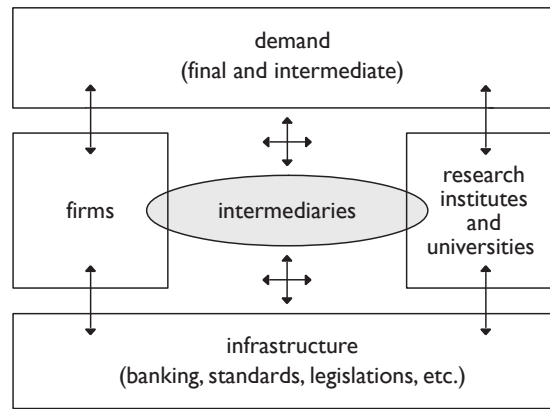


Figure 9.4 : Building blocks of innovation systems (Van Lente et al., 2003).

When introducing a new concept into the industry, universities take on temporary intermediary roles through their outreach activities. In the literature, some studies investigate universities as knowledge intermediaries (e.g., EC, 2009a), and some as taking temporary intermediary roles (e.g., Cook et al., 2006). Data gathered by this study indicates that the outreach activities of universities are mostly project-based and temporary (Chapter 7). Therefore, the cases studied fit more the classification of universities as separate actors in innovation systems that take temporary intermediary roles, rather than the classification of universities as knowledge intermediaries. The three types of projects that the universities undertake in their outreach activities were grouped as funded projects, company collaborations and collaborations for creating new ventures. In implementing these projects, universities act as intermediaries for supporting innovation processes of companies, and in some of the projects they are the only intermediaries with no other intermediary involved (Figure 9.4).

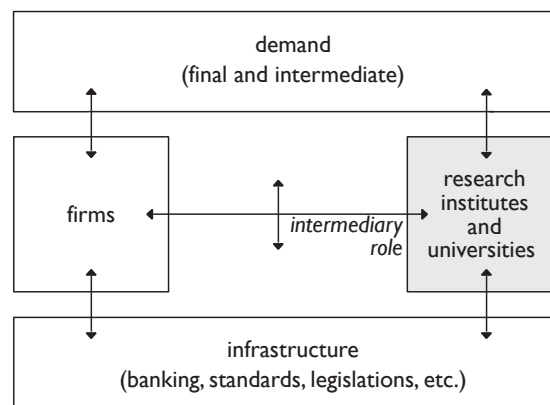


Figure 9.5 : Innovation system – Case 1.

The literature lists the types of intermediaries that link universities to other actors as: (1) internal, (2) external, (3) hybrid intermediaries, and (4) individual scientists

(Youtie & Shapira, 2008). The cases studied in the fourth empirical study (Chapter 7) exemplify three types among these, including an individual scientist within a university. As a consultant at national-level projects, the individual scientist holds an important intermediary role in the sustainable consumption and production practices in Turkey (Figure 9.5). In such projects, another intermediary may or may not be involved.

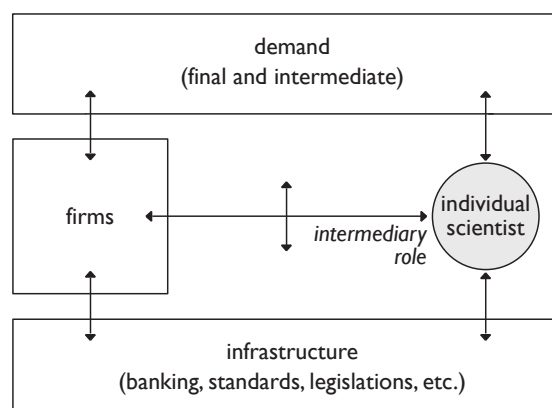


Figure 9.6 : Innovation system – Case 2.

Furthermore, companies, especially large enterprises that have resources, may build their own support mechanisms (Figure 9.6). The large enterprise case in the second empirical study (Chapter 5) exemplifies such a company that has built an internal innovation center. Similar examples exist in European countries as well; prominent companies build their innovation infrastructure internally and through interactions with universities (e.g., Stevels, 2007). In these instances, companies can fulfill their own innovation support demand to a great extent and act as their own intermediaries.

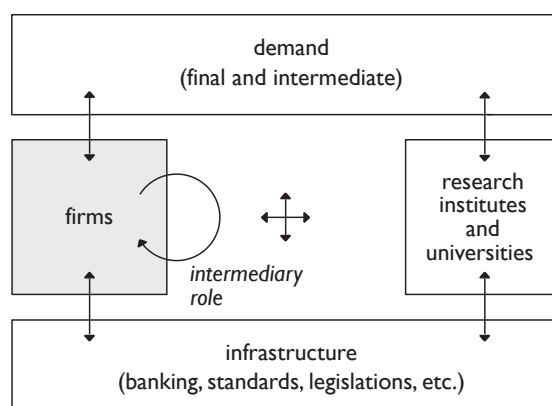


Figure 9.7 : Innovation system – Case 3.

The three cases in the empirical studies described above (Figures 9.4 – 9.6) exemplify the interchanging roles of innovation systems' actors. The examples can

be extended to various cases such as companies acting as intermediaries to other companies and knowledge institutes acting as intermediaries. This means that meeting the intermediary functions in innovation systems is crucial, although not only intermediaries, but also other actors, realize this function.

This is especially the case whenever knowledge is newly developed or innovation system's failures occur (see Section 2.2.2; Klein Woolthuis et al., 2005). The empirical studies indicated that both conditions are relevant for Turkey, where the design for sustainability is a new concept and where the intermediaries for design for sustainability are not well developed yet. Therefore, studying Turkey along with the Netherlands and the United Kingdom, which are cited as hosting good intermediary examples in the literature, was effective in the way that it exhibited contrasting conditions.

The interchanging roles of innovation systems' actors for undertaking intermediary functions are also important from the innovation systems' failures perspective. As discussed in the last empirical study (Chapter 8), intermediaries can also draw setbacks from innovation processes if they fail to articulate the right strategies or supply the right information. In such instances, the actors that experience the least failure (infrastructural, institutional, capability, interaction) should be the ones to undertake either the intermediary or the orchestration role among the other innovation systems' actors.

9.3 Contribution to Practice

This study's contribution to practice is fourfold. First, the activities of best performing companies in the design for sustainability field in Turkey are explained in the first two empirical studies (Chapter 4 and 5). Companies in Turkey can benefit from the experience of best performing companies. Moreover, the findings provide a background by explaining the demand side of innovation support – companies, for future projects and support programs on design for sustainability in Turkey.

Second, the framework of intermediaries that supports all possible needs of companies working on design for sustainability that was proposed in the third empirical study (Chapter 6) can help intermediaries to improve their services. Furthermore, the framework can be utilized when developing new intermediaries and

intermediary groups within innovation systems. In addition, other actors such as universities and companies can contribute to fulfilling the intermediary functions suggested in the framework. One example of the utilization of the framework is presented in the fourth empirical study (Chapter 7), when identifying the intermediary attributes of cases from three universities.

Third, universities and academics can benefit from findings from the fourth empirical study findings (Chapter 7). The study explains the outreach activities of universities and the types of the activities by investigating three different structures in universities. In particular, universities and academics working in the sustainability field would benefit from this empirical study.

Last, the strategies that are developed in the last empirical study (Chapter 8) for diffusing design for sustainability into the industry in Turkey can provide a background for future projects both in Turkey and in other regions. Section 8.5 explains how to apply the strategies in other regions. It should be noted that the strategies are not directives; rather they are snapshots of dynamic processes and can be developed further to be applied to different regional conditions, such as the existing institutional capacity.

9.4 Discussion Regarding the Theory and Research Methods

Innovation support for design for sustainability could be studied through the application of several methodologies. For example, real time case studies of innovation support processes can highlight the interactions between the innovation systems' actors. These case studies can be designed by focusing on the supply side, the demand side, or both. They can investigate companies receiving innovation support from various intermediaries, intermediaries providing innovation support to various companies or specific intermediary and company's interaction types. This study focuses on both the demand side and supply side, but separately. The first and second empirical studies investigate the demand side, while the third and fourth ones investigate the supply side. It was not possible to monitor support processes in real time, as the number of such support programs in Turkey is low, even lower for design for sustainability. The next section recommends real-time case studies on innovation support processes as further studies.

This thesis applies innovation systems theory. Demand and supply side actors in innovation support – companies and intermediaries respectively, are studied separately and based on the combined findings, strategies are developed for innovation systems. By these means, the data gathered at the organization level from the individual interviewees at individual level were projected to a system level. The aim was to overcome this challenge through the selection of cases at organizational level. Although the number of companies studied is low, as they were selected among the best performing companies in Turkey, they are expected to represent the state of the art of companies in the design for sustainability field in Turkey. The intermediaries were selected among the most active ones in the field, representing the state of the art of intermediaries in the design for sustainability field in Turkey. The intermediaries studied in the Netherlands also represent most of the major intermediaries in the field, and the findings influenced the proposed framework on intermediaries (Chapter 6). The same cannot be concluded for the United Kingdom, as the support programs were observed to be mostly at the regional level, and the cases do not reflect the national reality. Still, the sample of companies and intermediaries represent the state of the art of the design for sustainability field in Turkey and the findings were utilized for developing strategies for the country's national innovation system of Turkey. Following the findings from studying the universities in the fourth empirical study (Chapter 7) and the experts' interviews in the last empirical study (Chapter 8) the actors in the innovation system were extended to include other actors as well to be able to further develop the suggested strategies. It should be noted that the discussion with the expert about the strategies in the last empirical study (Chapter 8) engaged both actors in innovation systems, therefore occurring at both the organizational and system levels.

Recent studies look at the societal impact of design with the Multilevel Design Model (Joore & Brezet, 2015). As introduced in Section 2.2.1, the model provides insight when studying the impact of design at different system's levels: (1) product-technology system (P-level), (2) product-service system (Q-level), (3) socio-technical system (R-level), and (4) societal system (S-level). The level of analysis in this thesis can be described as constituting both P-level analysis when studying the design for sustainability practices of companies (Chapter 5) and R-level analysis when developing the strategies for diffusing design for sustainability into the

industry. The P-level analysis is utilized in this thesis to gain an in depth understanding of the companies as actors in innovation systems (Chapter 5). The findings both exemplify the design processes and outputs of the companies' design for sustainability practices, and provide insight into the companies and therefore, demand side of innovation support. An analysis based on the Multilevel Design Model would provide an understanding of the impact of these design processes at the S-level. This is thus suggested as further research in the next section. Such an analysis would also indicate the interchanging roles, through the changes in roles of designers at different system levels.

Another theoretical approach that would provide insight into the interchanging roles of innovation systems' actors would be co-design. If a project where a variety of stakeholders of different innovation system's actors collaborate were available for research, co-design would be effective in mapping the roles of various actors. The decision-making processes would reflect both the interactions between the actors and their interchanging roles. The transdisciplinary nature of co-design processes in the sustainability field can also inform a specific focus of such studies. This approach was not utilized in this study, as design for sustainability is a new concept for Turkey and a project in the field has not been undertaken yet. This is also suggested in the next section as further research in the design for sustainability field, especially for more developed countries that undertake projects such as the ones introduced in Section 2.1.1.

Following this discussion, it can be concluded that innovation systems theory is an effective theoretical basis for this study and for investigating innovation support mechanisms in the design for sustainability field in Turkey. In addition, as cited in the literature, the theoretical basis is expected to provide easy communication of the research findings with the relevant stakeholders and various actors of innovation systems.

Regarding the actors that were the focus of this study, universities were investigated with the aim to explain their intermediary roles. Although an in-depth study could also be carried out on designers and design consultants, universities were instead selected for several reasons. First, the intermediary role of design consultants was studied and elaborated before (Hargadon & Sutton, 1997; Hargadon, 2002). Second, the designers and design consultants were investigated in the third empirical study

(Chapter 6) along with other types of intermediaries and their intermediary role in the design for sustainability field was elaborated. Third, several researchers are currently studying the role of designers and design agencies in the design for sustainability field (e.g., Behrishi et al., 2013; Storaker et al., 2013). Investigating universities' intermediary roles was useful for one more important reason; their intermediary role is crucial when a concept is new to the industry as in Turkey.

9.5 Scope and Limitations of the Study and Further Research

Scope and specific limitations of each empirical study are detailed in the corresponding chapter. One of the limitations was the low number of companies practicing design for sustainability, thus the low number of companies that participated in the first empirical study. Because of this limitation, it was noted that the findings should be used cautiously. The challenge of carrying out research in a country where the design for sustainability concept is newly emerging remained relevant throughout the study.

Another related limitation – that examples of design for sustainability practices are rare in Turkey, was expected to be overcome by extending the conceptual scope from design for sustainability to sustainable consumption and production in some of the empirical studies. Whenever the scope was extended to sustainable consumption and production or narrowed down to design for sustainability, it was noted in the study for avoiding confusion. Extending the scope to sustainable consumption and production was useful in increasing the number of cases of intermediaries and university units that are studied in Turkey. It should also be noted that both concepts are interwoven and share tools and methods, and most of the studies on sustainable consumption and production in Turkey also represent design for sustainability as a topic.

The limitations of empirical studies with retrospective nature, as in this study, can be overcome by undertaking the research within the scope of projects. Examples of such studies are provided in Chapter 7, when investigating the intermediary role of universities and how doctoral studies plan to align with research projects. Thereby, real-time case studies can be planned and required stakeholders can be engaged in the research projects. In these studies, learning theories can also be utilized for monitoring the interaction and knowledge flow among various stakeholders.

In addition, the interchanging roles of innovation systems' actors can be studied further. For that, a theoretical sampling can be utilized for selecting actors that interchange roles in innovation systems. This study discusses the issue by focusing on universities and companies, but other types of innovation systems' actors may be studied as well.

Following the discussion regarding theory and research methods, and the limitations of this study, further research topics can be suggested. Extending the sample sizes in each study, such as investigating a greater number of intermediary types, would also expand the research findings of this study. Moreover, the analysis on the design processes and design outputs of the case companies in this study can be analyzed based on the Multilevel Design Model, which would provide an understanding of the impact of these design processes at the S-level. In addition, real-time case studies can be carried out with a co-design perspective on innovation support processes, in which various innovation systems' actors participate for studying both the interaction among the actors and actors interchanging roles and the transdisciplinary nature of co-design processes in the sustainability field.

9.6 Recommendations

In order to diffuse design for sustainability into society and industry in Turkey, the following actions need to be undertaken simultaneously:

- Design for sustainability should be diffused to universities, including their research, education and outreach activities.
- Design for sustainability should be promoted through available funds and programs.
- The funds and programs should be designed effectively by aiming at sustaining the impact and practices. This can be achieved by including public and private stakeholders and training them during the process. They can later continue transferring the knowledge to new partners and clients.
- A program should be designed with the aim to reach a wide variety of stakeholders, such as developing a public online database of design for sustainability.

- Innovation systems' actors need to be orchestrated effectively in their design for sustainability practices for a faster diffusion.
- When managing funds, programs, and organizations, transparency and accountability should be provided.
- Each innovation system's actor type, such as intermediaries, companies and universities should build networks for complementing, and learning from, each other.
- Each innovation system's actor type should collaborate with international partners for learning from each other. The collaboration processes can be designed for the benefit of not only single organizations, but also organization networks.
- Each innovation system's actor type should validate the outputs with acclaimed labels, verification and accreditation to achieve the desired impact regarding sustainability.
- Innovation systems' actors with available resources, such as prominent companies should start practices and initiatives on design for sustainability.

Lastly in this subsection, recommendations are listed for policy makers, intermediaries, companies, universities, and designers in Turkey and other regions with similar conditions applicable to design for sustainability. These recommendations follow both the conclusions of the empirical studies, and the observations and insight gained during the research.

9.6.1 Recommendations for policy makers

As this study aims to develop strategies for diffusing design for sustainability into the industry in Turkey, the findings can inform policy makers. Chapter 8 is most relevant for policy makers as it builds on the previous chapters and focuses on developing strategies. Moreover, specific actors' practices in the design for sustainability field, which could inform the development of support programs, are elaborated in several chapters, such as those of companies in Chapter 4, those of intermediaries in Chapter 6, and those of universities in Chapter 7.

- *When orchestrating sustainable development practices, embrace design for sustainability*

This study emphasizes the importance of orchestration for achieving sustainable consumption and production diffusion. In Turkey, this task was attained by TÜBİTAK-MAM in 2013. It should be undertaken effectively and by embracing design for sustainability.

- *Ensure transparency and accountability in sustainable development practices*

Transparency and accountability are underlined needs of organizations in Turkey, especially in assessing impact and in assuring that the right stakeholders are involved into the projects and programs.

- *Empower young, competent, proactive individuals*

Empowering young, competent, proactive individuals and organizations is necessary for transforming the mindset of existing organizations into a sustainability-oriented mindset.

- *Manage the resources effectively*

Resources should be managed effectively, for example creating online platforms for knowledge sharing is an urgent need in Turkey, as a variety of stakeholders could benefit from them at once.

9.6.2 Recommendations for intermediaries

Intermediaries that plan to work in the design for sustainability field can learn from the cases described in Chapter 7.

- *Involve designers into the innovation support processes*

The importance of design in innovation support processes, especially during project implementation is explained in Chapter 6. Intermediaries should involve designers into the processes either as in-house or as project partners.

- *Develop flexible services for sustainability by embracing all of its three pillars*

Intermediaries should develop enabling and flexible services for sustainability by taking its economic, social and environmental pillars into account. For developing

services and support instruments the framework suggested in Chapter 6 can be guiding.

- *Build networks with other intermediaries*

Intermediaries should build networks with other intermediaries for complementing each other, which reduces the gaps and inhibits overlaps among the services and support instruments.

- *Continuously develop the tools and methods in use*

Intermediaries should constantly adapt and develop the tools and methods they are utilizing during the support processes in light of state-of-the-art concepts, tools and methods.

- *Validate the outputs with acclaimed labels, verification and accreditation*

When working on sustainability, intermediaries should validate the outputs of innovation support processes with official labels, verification and accreditation, as it is crucial for achieving the desired sustainability impact.

- *Communicate your services better to your potential partners and clients*

Available services should be better communicated to companies. Intermediaries can benefit from collaborating with designers for achieving this.

9.6.3 Recommendations for companies

Companies that plan to start design for sustainability practices can learn from the cases described in Chapter 5.

- *Be aware of state-of-the-art sustainability concepts, tools and methods and the benefits they can offer*

Companies should invest resources for carrying out regular research on state-of-the-art sustainability concepts and investigating the benefits they can achieve when applied.

- *If you have the resources to work on sustainability, act on it*

The companies that have resources for undertaking the practice should strive to become pioneers in the industry, instead of waiting for opportunities to arise.

- *If you do not have the resources to work on sustainability, communicate your needs to intermediaries*

Companies should communicate both their needs and potential, for which they can acquire support from various organizations. Attention should be exercised when choosing the right strategies and partners, including intermediaries with best fitting services.

- *Work with designers to implement sustainability projects*

Companies can benefit from employing designers – either in-house or as external consultants, especially during implementation of new product-service-system development processes.

9.6.4 Recommendations for universities

Universities that plan to be (more) active in the design for sustainability field, especially in outreach activities can learn from the cases described in Chapter 7.

- *Engage in outreach activities for design for sustainability*

Universities should engage in outreach activities and undertake intermediary roles for design for sustainability, without losing the research focus and by integrating them into educational activities. This is especially needed in Turkey as design for sustainability diffusion is still a new concept.

- *Engage with and empower proactive individuals*

During outreach activities, universities should engage with, and enable, proactive individuals and organizations. Educating future intermediaries during outreach activities is one type of this engagement, as it enables diffusion to continue after the intermediary role of universities is completed.

- *Document the outreach activities rigorously*

Rigorous documentation of the outreach processes and publications is crucial for continuing the impact of outreach activities and transferring knowledge to other stakeholders.

9.6.5 Recommendations for designers

Designers who do not have an educational and professional background on design for sustainability can learn from the case studies presented in Chapter 5. Design consultants who aim to work (more actively) in the design for sustainability field can learn from Chapter 6. Furthermore, designers who are in search of various platforms in which to engage for creating impact regarding sustainability can learn from the cases explained in Chapter 6.

- *Improve your design for sustainability knowledge and expertise*

In order to achieve systematic radical innovation and to improve operational roles for achieving incremental innovation in the design for sustainability field, the knowledge and expertise of designers need to be developed. For that, design for sustainability needs to be diffused into design education in Turkey. Designers that do not have an educational background on design for sustainability can benefit from the available checklists and manuals that were cited in Section 2.1.1.

- *Represent design for sustainability strategies as “good design” principles if necessary*

The main guidelines of design for sustainability can also be comprehended as principles of “good design”. It would enable easier communication with stakeholders who do not have an educational or professional background in sustainability while also moving beyond commonly referred strategies such as recycling and reusing.

- *Collaborate with intermediaries and specialists such as environmental scientist*

Designers would benefit from collaborating with environmental scientist to handle complex data such as when applying life cycle assessment. Finding the right partners, including intermediaries, is helpful for achieving the desired impact. Especially design consultants who aim to build such teams can benefit from Chapter 6.

- *Acknowledge, communicate and implement the broader definition of design, including design-thinking*

Designers need to be more active in the industry by acknowledging the broader state-of-the-art definition of design domain. For that, they can take part in various

organizations, in addition to more traditional in-house or consultancy jobs, with the aim to contribute as “design thinkers” to product-service-system design processes.

- *Be proactive and engage in a variety of platforms and organizations*

Designers can also be proactive in offering design for sustainability solutions in a variety of platforms and to a variety of stakeholders. Chapter 6 describes such examples.

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APPENDICES

APPENDIX A : Questionnaire I (Chapter 4)

APPENDIX B : Questionnaire II (Chapter 6)

APPENDIX C : Interview Questions (Chapter 6)

APPENDIX D : Interview Guide (Chapter 7)

Appendix A : Questionnaire I (Chapter 4)

Instead of sustainable consumption and production, the questionnaire uses the phrase “cleaner production”, as it has been utilised interchangeably in leading reports (TR-MoEF & TTGV, 2010).

1. What are the name, affiliation and department of the informant?
2. What is the name of the company, year of establishment, address, telephone, web site, e-mail address?
3. What is the sector in which the company operates (70% of the company practice)?
4. What is the export percentage of production?
5. To how many countries does the company export?
6. Which are the first five countries to which the company exports the most?
7. How many employees does the company have?
8. Number and profession of the employees in the product development department (Engineer / Industrial Designer / Technician / Other)
9. Does the company work with external design consultants? If so, could you list three of them?
10. Did the company receive any design awards during the last five years? If yes, when and from which institution?
11. Could you list five projects that the company undertook on sustainable consumption and production during the last five years, the partner institutions and start and finish dates?
12. Could you list five awards and certificates that the company received for sustainable consumption and production during the last five years, from which institutions they were received, and when?
13. Could you list five projects that the company undertook on CSR during the last five years, the partner institutions and start and finish dates?
14. Could you list five awards and certificates that the company received for CSR during the last five years, which institutions awarded them and when?
15. Does the company carry out LCA? (No / Yes, in-house / Yes, with a consultant company)
16. Does the company hold ISO14000? If so, when was it issued?

17. Which of the below strategies does the company employ? (more than one can be selected)

Selection of low impact materials

- Eliminating materials with sensitive origin
- Selecting materials low in embodied energy and water
- Eliminating toxic materials
- Using recycled materials
- Using recycled and recyclable materials
- Using biodegradable materials

Material use

- Optimising the total weight
- Reducing the number of different materials being used
- Snapping different materials mechanically or geometrically instead of bonding

Packaging

- Reducing and reconsidering the packaging material used according to environmental concerns

Producing and manufacturing

- Reducing the material, energy and water used in manufacturing
- Recovering and reusing the resources or using renewable energy resources
- Reducing the outputs of pollution and waste

Distribution and transportation

- Reducing the transportation distances by reorganizing logistics
- Using less polluting transportation modes (e.g., from truck to rail)
- Improving transportation load efficiencies
- Reducing the weight of the product and packaging

Impact in use

- Reducing the resources consumed by the product during use (e.g., electricity, water, paper, batteries)
- Using renewable energy when possible (e.g., solar energy panels)
- Promoting most efficient use of the product to the users

Improve the social and economic benefits of manufacturing

- Choosing the best social and ethical conditions in production and distribution to add to social and economic development

Extending initial product life-time

- Making more durable and reliable products
- Reducing the “fashion” aspect of products to avoid obsolescence
- Making products, which get more valuable as they get older
- Conceptualising the products as a combination of “long-life” and “short life” components (e.g., removable head for shaving razors)

End of life systems

- Making easily-disassembled products
- Making easily-reused products
- Making easily-remanufactured products
- Making modular products
- Making products that can be easily collected for reuse or recycling

Meet user needs with a different product or service

- Designing products and services, which together fulfil user needs

Developing a hybrid product

- Combining functions of separate products into one product

Exploiting new technological opportunities

- Exploiting new technologies for complete product innovation

18. Please rate the below factors as drivers for your sustainable consumption and production activities (least to most)

- Reach new customers
- Increase exports
- Product quality improvement
- Saving costs
- Boost brand value and reputation
- Product innovation
- Brand differentiation
- New opportunities for value creation

19. Please rate the below factors as benefits that the company gained from sustainable consumption and production activities (least to most) (List at Question no 19)
20. Please rate the below factors that the company encountered as barriers
- Doubts about the environmental benefit of the option suggested
 - The company does not feel responsible for realising the option
 - Only becomes relevant if supported by environmental legislation
 - Only becomes relevant if supported by market demands
 - Creates a commercial disadvantage for our company
 - Creates a conflict with actual functional product requirements
 - Not a challenging technological innovation opportunity
 - At the moment there is no proper alternative
 - New investments in redesigning the product in question are fruitless
 - Lack of sufficient time to realise the option
 - Lack of sufficient knowledge to realise the option
21. Please rate the below support instruments that the company needs the most
- Equity support
 - Research and development
 - Demonstration and commercialization
 - Education and training
 - Networks and partnerships
 - Information services
 - Provision of infrastructure
 - Regulations and standards
 - Public procurement and demand support
 - Technology Transfer
22. From which institution does the company plan to receive the support listed above?

Appendix B : Questionnaire II (Chapter 6)

1. When was the organization established?
2. Which one of the following describes the nature of the institution? (Public / Private / NGO / Social Enterprise)
3. Which one of the following is the target group? (Start-ups / SMEs / LEs / Government and NGOs)
4. Do the companies pay for the services that the organization provides? (Companies don't pay, we provide free services / Companies pay partially / Companies pay)
5. What is the funding source of the organization?
6. Please specify the number of employees and the number of employees who interact with the companies or the service-receivers.
7. Please specify the number of the employees who have an educational or professional background in design.
8. Please specify the type of organization. (Innovation and business development agency / University and research center / Chamber of commerce and business association / Incubator and science park / Cluster organization / Private consultant)
9. Which of the following fields is the main focus of the organization? (Business / Design / Innovation / Sustainability / Technology)
10. Which type of innovation is aimed during the support process of the organization? (Technological- / Product- / Process- / Organizational- / Marketing- / Design- / Eco- / Social innovation)
11. Please rate the services that the organization provides mostly (Workshops / Consultancies / Conferences / Educational programs / Incubation programs / Governmental projects / EU projects)
12. Please rate the support instruments that the organization provides mostly (Financing / Networking and cooperation / Awareness raising / Internationalization / Technology transfer / Knowledge transfer / Identifying potentials and needs / Management support / Creation of specific skills)

Appendix C : Interview Questions (Chapter 6)

1. To what extent does the organization provide sustainability-specific support services? What are the specific challenges?
2. How would the above ratings of support services and instruments change when the focus of the support is sustainability?
3. To what extent does the organization provide support for sustainability-driven companies? What are the specific challenges?
4. Does the organization provide specific sustainability-related strategies and tools during the support processes? What are the specific challenges when applying these approaches and tools?
5. Do you recall any cases when the approaches and tools or knowledge of sustainability were inadequate?
6. Does the organization provide product-design services? If yes, what is the main focus, new product development, re-design, eco-design or product-service-system design?
7. Do you collaborate with design consultants (design agencies, universities, research institutes etc.) during the support processes? If yes, how is this collaboration formulated, is it in the form of matchmaking with the companies and design consultants or do you also get involved in the process as in co-design?
8. Do you provide support to design consultancy firms? If yes, what are their specific needs?
9. Could you give a successful example, which describes the services of the organization the best, in general and regarding sustainability?
10. What are the specific policies, such as national design policy, eco-design and sustainability policies, which influenced the services and approaches that the organization provides the most? (to get some information about the dependency of the intermediary upon macro-level factors)
11. How are the support tools and methods of the organization developed, what are the most important factors that shaped the support approach of the organization?

Appendix D : Interview Guide (Chapter 7)

1. Which intermediary roles did the university / department / scientist undertake and through which means?
2. How did the intermediary roles start and evolve in time?
3. Who are the stakeholders with whom you have collaborated?
4. To what extent did the projects include SCP and DfS domains and how did they relate to each other?
5. Which strategies did you develop in time to raise the impact created, based on your experience?
6. Which strategies did you decide to repeat and which to stop?
7. Do the intermediary roles match or conflict with education and research aims and how?
8. Which opportunities did you determine in the field concerning SCP and DfS, which need to be addressed by your or other institutions?
9. What are the institutional / regional / legal barriers you came across?
10. To what extent and through which means did project results continue to diffuse after the project finished?
11. To what extent did the partners intermediaries in the projects, if involved, still continue to follow the process that the university initiated?
12. Did the projects that you have conducted influence the university where you work and how?

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