METU JFA 2023/2
(40:2) *79-97*

DOI: 10.4305/METU.JFA.2023.2.4

ROLES OF INDUSTRIAL DESIGNERS IN INNOVATION-BASED COMPANIES: THE CASE OF ODTÜ TEKNOKENT

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Received: 27.11.2022; **Final Text:** 01.11.2023

Keywords: Industrial design; science and technology parks; university-industry collaboration; innovation; design process.

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INTRODUCTION

Science and Technology Parks (STPs) have emerged in line with the idea of creating a physical atmosphere to bring academia and industry together to support knowledge transfer between universities, companies located in the park, and the market (Henriques, Sobreiro and Kimura, 2018). The objectives of STPs are: (1) providing infrastructure in terms of technical, spacious, administrative, and financial support for the development of innovation-based companies (2) creating sustainable interactions between universities and industry for transforming technology into products and services that will meet the needs of the society, and (3) increasing the competitiveness among businesses and knowledge-based institutions (Henriques, Sobreiro and Kimura, 2018; Kılıç and Ayvaz, 2011). For those aims, STPs facilitate the knowledge transfer between universities, research and development institutions, and companies; they play an essential role in economic growth and regional development by supporting the creation of companies based on innovation (Henriques, Sobreiro and Kimura, 2018; Díez-Vial and Montoro-Sánchez, 2016).

A company is defined as an innovation-based company if it engages in innovation activities to develop novel or improved products or processes (OECD/Eurostat 2018, 2005). Innovation-based companies have a strong emphasis on developing innovative solutions to meet the changing needs of their customers. Innovation is mainly associated with a novel idea, product, system or service with social, economic, and environmental impacts in actual use context.

The Oslo Manual categorizes innovation into two main types: product innovation and business process innovation. Product innovation refers to innovations that significantly change or improve companies' products or services that meet users' changing needs and preferences. It involves the development of new ideas, designs, and features that enhance the performance, usability, and user experience of a product or service.

Business process innovation identifies a novel or improved business process for significantly different and available business functions from previous business processes (OECD/Eurostat 2018). Product innovation differs from business process innovation by focusing on developing new or improved physical and digital products or services. Product innovation can be related to business process innovation as each innovation type can coincide by affecting each other (Galindo-Rueda and Millot, 2015). For example, developing a new product may require changes in the production process or creating a new business model to support its production and distribution. Therefore, companies may need to consider all types of innovation to achieve successful product innovation (Tidd and Bessant, 2018).

According to the Oslo Manual, designers play a crucial role in product innovation as they are responsible for "generating ideas and concepts for new products or product features, and designing the shape, form, usability, and user experience of products" (OECD/Eurostat 2018, p. 85). The manual emphasises that designers are essential in innovation by understanding user needs and preferences and translating them into design solutions that meet functional and emotional requirements. Thus, understanding the roles of industrial designers in product innovation is essential for creating a shared understanding of the expectations from the employees while also providing effective working conditions in an interdisciplinary environment in STPs.

DESIGN IN INNOVATION

In a competitive environment in business, companies emphasise innovation and the development of new products and services to distinguish themselves. Design has started to be mentioned more often because of the set of actions driving innovation (Luo, Olechowski and Magee, 2014). Thus, companies acknowledge that design can add value by bringing innovation to organizations (Press and Cooper, 2003). Even innovation is a term driving business differentiation, and design is the core of innovation; they complement each other, working together to drive a successful business (Lockwood, 2010a; Press and Cooper, 2003). Er, Er, and Manzakoğlu (2010) state that design is more comprehensive than innovation. While product innovation interests a technical advancement in a specific field, the design involves making differences in the current knowledge. Within this assessment, good design is one of the ways for companies to improve their competitiveness (Er, Er, and Manzakoğlu, 2010). According to Wrigley and Bucolo (2011), design-based innovation refers to a set of methods in which designers consider user needs, business needs, and technology demands cohesively and interactively during the design process. Brown and Katz (2011, p. 81) propose design thinking as a methodology that connects innovation activities with a user-centred approach through three innovation spaces: inspiration, ideation, and implementation. They describe "inspiration" as the problem or opportunity that motivates the search for solutions, "ideation" as the process of generating, developing, and testing ideas, and "implementation" as the path that leads from the project room to the market. This path is closely related to the design process. Design thinking is a process that can be used to drive product innovation by placing the user at the centre of the design process. It involves a process of empathising with users, defining their needs and expectations, developing potential solutions, prototyping and testing those

solutions, and iterating until the final product is developed (Brown, 2008; Norman, 2013). By design thinking, companies can create functional and efficient products that meet users' needs.

Design as a means of driving innovation is a user-centred and creative activity that transforms concepts and knowledge into valuable ideas and implementations, enhancing efficiency in production and contributing to strategic decision-making (Galindo-Rueda and Millot, 2015). Design is considered a problem-solving activity that starts with exploring problems and the gaps in user experience, discovering new ideas, and developing solutions for production or execution (D'Ippolito, 2014; Cross, 2011). Design thinking is primarily a process that helps discover unmet needs, create new solutions, solve wicked problems and enable business transformation (Lockwood, 2010b). It involves understanding users' needs, expectations and experiences, and using this insight to create products and services that meet their needs in novel and creative ways.

Design thinking can contribute to innovation and, accordingly, a better insight into its values and effects on companies' innovation capabilities (Soyupak and Bağlı, 2020; Carlgren, Elmquist and Rauth, 2014). Innovation-based companies often employ design thinking as a means of driving innovation. By using design thinking, companies can create products, services, and experiences that meet the changing needs of their customers. Innovation-based companies that employ design thinking also tend to have a strong culture of collaboration and experimentation (Brown and Katz, 2011).

Even STPs and innovative-based companies in Türkiye are relatively new compared to the practices of developed countries. However, they are expected to contribute significantly to Türkiye's technology capacity (Cansız, 2019). Türkiye has begun to gain an international competitive advantage by creating a policy structure that is based on innovation and design. Yet, the state has not provided direct support for design even though it is recognized as one of the most crucial aspects of innovation (Çalgüner, 2010). Thus, studies on the contribution of design to innovation also support policy development that puts design in focus in Türkiye.

METHODOLOGY

The paper aims to understand the competencies and experiences of industrial designers while performing their duties in ODTÜ TEKNOKENT, Ankara, to support an effective collaborative working environment for companies seeking design and innovation. The main research questions of the study are:

- What are the roles of industrial designers working in STPs in product innovation?
- What are the drives and challenges for industrial designers in design processes for innovation?

This study started with a systematic literature review on STPs, university-industry collaboration, innovation, and designers' competencies and roles. Affinity diagrams are generated on Miro boards to reveal the relations and patterns among discussions in the literature. This process helped the researcher develop and structure the field study. Semi-structured interviews were conducted during the field study with 15 industrial design graduates working in 14 companies in ODTÜ TEKNOKENT. Most

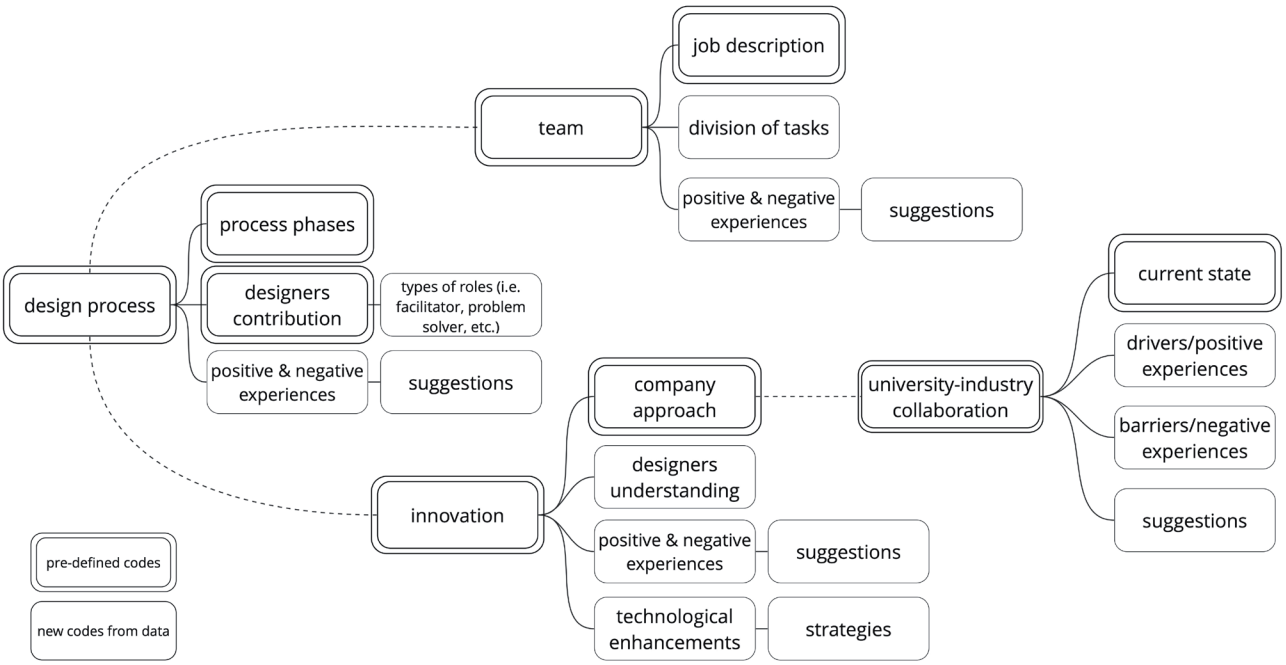

Figure 1. Codes and sub-codes retrieved from the data (prepared by the author)

innovation-based enterprises in Technoparks in Türkiye operate in Ankara and Istanbul (Cansız, 2019). ODTÜ TEKNOKENT is the first and one of the internationally recognised STPs in Türkiye (Çalgüner, 2010), and selected as the most successful STP six times in a row by the Ministry of Industry and Technology of Türkiye (Varol, 2018).

The interviews started with warming-up questions to get to know the participant and the company. The first set of questions concerned the work environment, including teamwork, job descriptions, and experiences. The second set of questions inquired about their companies' attitudes towards innovation and the project processes; to understand their roles and contributions. The third set is related to the university-industry collaboration, its form, drivers, and effects on project phases. Interviews were held remotely using Skype or Zoom since the meeting schedule coincided with the COVID-19 pandemic. The interviews were conducted individually, each lasting an average of one hour, and were recorded with the participants' consent. The recordings were transcribed verbatim, and content analysis was performed using MAXQDA2020 software.

Thematic coding was used to segment and categorize the data for analysis (Saldaña, 2013). Prior to initiating the coding process, a template related to the research questions was prepared. The transcriptions were coded accordingly. Subsequently, new codes that emerged from the data were added (Figure 1). Reflections and interpretations were then recorded in a notebook to interpret the data by sorting and developing ideas and establishing connections between insights and the existing literature.

FINDINGS

The findings of this study are structured to cover teamwork, innovation, and design process. The following sections first present the job descriptions of designers, communication, and collaboration within the team. Following then, it continues with the understanding of companies' innovation approach and university-industry collaboration. Finally, the contribution of designers to design processes for innovation is presented.

Job Descriptions of Industrial Designers in STPs

The participants in this study are employed in companies that span from physical product design to digital product and service design. The majority identified their job titles as industrial designers, while others referred to themselves as 3D artists, UX/UI designers, or researchers (Table 1). Some participants preferred this because they thought functional titles better describe themselves than professional ones. There is a consistent increase in the employment of industrial designers in the UX field in Türkiye (Kaygan, Ilhan and Oygür, 2020). Nine participants stated that they were involved in the projects' UX/UI design processes, and six others included those terms in their job titles.

As the roles of designers evolved from addressing simple problems to tackling complex ones, the need to work collaboratively with teams of dedicated colleagues who share the same passions and commitments arose, rather than working individually (Cross, 2011). Of the 15 participants, eight work with engineers from various fields, six work in interdisciplinary teams, and only one works with a small team of designers.

The participants take on various roles in teams. Their job descriptions include design research, UX/UI design, business development, content creation, idea generation, etc. Those are determined by a senior employee in a top-down approach or meetings discussing the experiences and competencies of team members. Although the second type of approach is more commonly preferred, it has some limitations, such as resulting in unclear, translucent, and invisible tasks in the team. Team members' roles may intertwine because a design process involves teamwork that cuts across various disciplines.

> "We experience confusion in task sharing. Is this something I should do right now? To what extent should I do it? It can get a little confusing... After the process is completed, my contribution is also uncertain." P4, industrial designer, biomedical products

> "Usually, we should set the boundaries in the process. They (managers) know what designers do but may not know exactly where engineers should start and where designers should stop… After a while, people at work may lose the distinction between industrial design and mechanical engineering." P11, industrial designer, robotics and industrial machines

The perceived roles of industrial designers differ according to different managers within the company. Managers from different backgrounds recognize the content of industrial design differently (Valencia, Person and Snelders, 2013). Differences in expectations from designers and unclear borders of tasks have a negative impact on collaboration within the team and hinder the visibility of designers' efforts in design processes.

Communication and Collaboration in Teams

As teamwork is a social process, communication is critical in design activity (Cross, 2011). Better communication among team members is indispensable for developing better products, services, and business models in innovation-based companies.

A high level of education and openness to collaboration are two promising factors to ensure the success of entrepreneurs' innovation and clustering approach (Cansız, 2019). Since ODTÜ TEKNOKENT is located close to the university, most employees are new graduates from the same university

Code	Company Profile	Job Title	Employees in the Team (excluding the participant)
P1	Interactive technologies	3D artist	2 software engineers
P2	User experience and research	UX researcher	1 CEO 1 manager 1 UX researcher 1 graphic designer
P3	Biomedical products	Industrial designer	2 software engineers 15 biologists and chemists (external members for feedback and tests)
P4	Biomedical products	Industrial designer	4 engineers (diverse disciplines)
P5	Interactive technologies	Industrial designer	1 software engineer 1 computer engineer 1 graphic designer 1 industrial designer
P6	Digital products for online platforms	UX researcher	1 UX team lead 1 interior designer 1 industrial designer
P7	Biomedical products	Industrial designer (co-founder)	1 software engineer 1 hardware engineer 2 industrial designers
P8	Cybersecurity	UX designer	1 team lead 1 product manager 2 designers 2 backend developers 2 frontend developers
P9	Positioning and geographical information systems	Industrial designer (co-founder)	1 designer 1 economics 1 software engineer 2 electronics engineers
P10	Software development in the defence industry	UX/UI designer	1project manager 2 computer engineers 1 electronics engineer
P11	Robotics and industrial machines	Industrial designer	1 product and planning manager 1 industrial designer 1 graphic designer 1 technical drawing artist 1 mechanical engineer
P12	Digital products for online platforms	UX researcher	1 team leader 1 designer 4 developers 1 UX researcher
P13	Biomedical products	Industrial designer (co-founder)	1 computer engineer 1 mechanical engineer 1 industrial designer 1 supervisor from a university
P14	Software products for mobile and smart devices	UX/UI designer	1 manager 1 industrial designer 5 developers
P15	Design consultancy	Industrial designer	5 industrial designers

Table 1. List of participants

who are highly motivated to learn new things. It enables employees to communicate and collaborate more efficiently.

> "Frankly, I have a lot of positive experiences. Our ages are very close, so we have very similar thoughts. We get along very well. Fortunately, I feel fortunate in this regard." P2, UX researcher, user experience and research

> "The biggest benefit of working in technopolis is to work with young and excited people…you can do something together. So, it brings good friendships too." P8, UX designer, cybersecurity

Effective communication is vital for improving the team experience in exchanging ideas, receiving constructive feedback, and improving skills.. As most participants work with other disciplines, they can exchange knowledge and learn from one another. They support one another and complement the shortcomings during teamwork.

> "We generally go through a brainstorming process in the projects. Where everyone from different disciplines comes together... There is an open office there. So, we get the opinion of people who are more experienced than us and close to our field of work. It usually goes well." P9, Industrial designer (co-founder)

Based on the study, collaboration within the team in STPs enables increased motivation in the team, creates a learning environment through sharing knowledge and skills, reflects different opinions, broadens the perspective of other disciplines, and decreases the workload in a team through sharing tasks and responsibilities. Despite the advantages of an interdisciplinary team environment, communication and collaboration are problematic in defining and dividing tasks. The rooted role distribution in the projects can have a negative impact on individual knowledge and skill development, blocking knowledge transfer, as each team member is strictly confined to an assigned task.

> "Since we already know who is doing what here, we have finished that information flow. We seem to be missing a bit there. It's like everyone is doing their own job." P1, 3D artist

Conversely, a lack of design awareness (i.e., designers' roles and contributions) among non-designers and a lack of teamwork awareness (i.e., shared purpose, openness, valuing diversity, and approach to decisions) can impact communication and collaboration. The participants highlighted the difficulty of communicating with administrative and production levels, especially while conveying the contribution of industrial design to the projects.

> "Since we have always worked with designers [in the university] before, we had no experience of what people might see us as. The reactions of different disciplines were new to me. It is complicated to explain the contribution of industrial designers to people who are especially on the administrative, production and project management sides." P11, industrial designer, robotics and industrial machines

Beyond these factors, individual actions in a team, such as individual efforts in a busy schedule, holding individual meetings for task assignments, reactions like panic or singling out someone, challenges in negotiating ideas, and reaching conclusions, are primary examples of a lack of teamwork awareness.

> "If a person works too individually and takes flexible working hours often, it becomes difficult to be a team. Especially if she/he is a key person in the project and all other tasks depend on her/his…Also, not everyone

> can stay calm enough when we run the business. 'I am very depressed. It probably won't finish.' conversations like this can be around. In this case, a person who gets very demoralised can put the whole team in a challenging situation." P5, industrial designer, interactive technologies

> "Sharing information is important. Everyone sometimes concentrates on work because of the task intensity… things must be caught up. In a short time, everyone is intensely focused on their work. And we may not be aware of each other's work outside." P15, industrial designer, design consultancy

The findings highlight that effective communication and social interactions are crucial in design activities within innovation-based companies. Collaboration, education, and proximity to universities enhance communication and collaboration among team members, facilitating the exchange of ideas and constructive feedback for skill improvement. However, challenges arise in defining and dividing tasks, and there is a lack of design and teamwork awareness among team members. Individual actions and difficulties in negotiating ideas can also impede teamwork.

Industrial Designers' Understanding of Their Companies' Innovation Approach

This study explored the companies' innovation approach from the participants' perspective. Most participants believe that their companies are receptive to new ideas and innovation. Their innovation approach revolves around exploring the possible implications of technology in design and potential usage of existing technology in a new product category.

> "In VR/AR, there are spaces open to innovation; it is a new technology. We don't have an example here [in the company]. We constantly think about what we can do and how to use the knowledge we have received from previous experiences." P1, 3D artist, interactive technologies

On the other hand, the participants in biomedical products mentioned the COVID-19 pandemic's effect on innovation in healthcare. At the onset of the pandemic, numerous efforts mainly focused on health-related issues. Some companies explored the possible implications of existing technology in healthcare products.

> "For Covid-19, permanent damage occurs in the lungs of people who have had this disease. ... This is similar symptoms to the disease we are currently focusing on…We realized that, with the adjustments in the design, we can turn this [current product] into a project not only for this disease but also for patients who continue to follow up at home after COVID-19." P13 industrial designer (co-founder), biomedical products

Participants generally associate their companies' innovation approach with new digital or physical product design solutions and integration of technologies into the design. Thus, it is critical to explore the role of design and the contribution of designers in product innovation, more broadly, including all phases of design processes.

University-Industry Collaboration

The geographic proximity of companies to the university is one of the most critical advantages of STPs for knowledge exchange. Even though the proximity makes the diffusion between the company and the university easier, it does not have to create knowledge transfer automatically; formal and informal interactions are required to increase companies' innovative capacity (Díez-Vial and Montoro-Sánchez, 2016).

Most participants emphasised that formal and informal interactions for collaboration depend on personal relationships. The *personal formal relationship* includes hiring internships and graduate students from the university, student involvement in industry projects, and using university facilities (Ankrah and Al-Tabbaa, 2015). Recruiting intern industrial design students was found to be the most frequently mentioned type of collaboration under this category. Additionally, some participants stated that their companies support industrial design students' graduation projects and attend their final juries and exhibitions.

> "Because we are at [university campus], we can reach students. Like interns or graduates to come and work. We attend graduation exhibitions. We enjoy the advantage of being close to the university." P7, industrial designer (co-founder), biomedical products

As the infrastructure of facilities requires investment, the same participant suggested using university facilities (e.g., usability labs) rather than direct consultancy from the university.

> "We have not worked with any professor from [university] so far. I think infrastructural support from academia will be more tangible than human resource support. To say, 'We will do a usability study, the school also has the opportunity, let's do this together in the university" is more efficient." P7, industrial designer (co-founder), biomedical products

The *personal informal relationship* includes individual consultancy and personal contact with university staff (Ankrah and Al-Tabbaa, 2015). Based on the findings, the companies have collaborated with academia on projects they feel less competent, especially in technical topics. This form of collaboration usually occurs in the early stages of the design and development process; in some cases, the companies consult in different project phases. They consult an academician, usually outside of the industrial design discipline, to gain further knowledge about a particular topic. The consultancy is not involved in the design phases directly.

> "We have a project about education and digital storytelling. There are academics known by [the manager] in the faculty of education. We try to involve them; we try to get ideas from them. We do not hesitate to go and ask where we see ourselves as less competent." P1, 3D artist, interactive technologies

> "We actually have a serious exchange of information with the academy. For example, we had to work with many historians and archaeologists during the [name] Exhibition. After all, it is not an area in which we are competent. Of course, we read things, but we need to consult academicians." P5, industrial designer, interactive technologies

While collaboration is recognised as one of the potentials of STP for enhancing the innovation capacity of companies, universities are not the most consulted knowledge source for innovation activities in Türkiye (Kiper, 2010). A few participants mentioned that they have no type of collaboration with the university. This finding is not enough to say there is no collaboration in the projects. However, even if there is, the findings show that those industrial designers are not involved in the knowledge transfer cycle during collaboration.

The findings show that university-industry collaboration includes hiring interns and graduate students, involving students in industry projects, and utilizing university facilities. Other interactions involve individual consultancy and personal contact with university staff. Companies often collaborate with academia in areas where they feel less competent, typically

during the early stages of design and development. However, the extent to which these university-industry collaborations impact companies' innovation capacity requires further exploration.

Designers' Contribution to Innovation

As mentioned in Section 2, design thinking has become increasingly crucial for innovation-based companies. Therefore, it is appropriate to consider the roles of industrial designers in innovation alongside their roles in the design process. In the analysis phase, the core activities of design thinking—inspiration, ideation, and implementation (as defined by Brown and Katz, 2011)—are regarded as early stages, idea generation, and finalization within the design process.

Industrial Designers in the Early Phases

The early phases of the design and development process cover research and analysis, including all the activities related to defining problems, exploring the design context, conducting design research to gather external information (i.e., standards, technology, emerging trends), and acquiring user knowledge (i.e., user needs, experiences, preferences). All these activities serve as an inspirational source for the subsequent phases of design. Based on the findings, industrial designers acquire knowledge from external information and users, to provide a background for the idea generation phase. This knowledge is analysed and synthesized to define the problem and develop a new idea that adds value to the user experience. The product should be related to the user, as innovation happens when a new idea is commercialized or used for the benefit of people. The participants see their primary contribution to innovation as incorporating users in the design and development process. They develop design considerations in line with the user requirements.

> "Even if a software developer develops a program, there is a design part of it; a person still uses it. The designer predicts how the user will use it, what she/he will think or how she/he will act and defines the considerations for those." P5, industrial designer, interactive technologies

Although the participants define innovation as the possible implications of technology and the potential usage of existing technology in a new idea, they agree that technology should be aligned with user knowledge. As technological advancements spread, the touchpoints of user interaction with the product have increased, and digitalization has significantly impacted user experiences. This opens up a new context for industrial designers to explore novel problem definitions in user experience.

> "With new technologies, more security protection features come out…Every new area means a new context for designers. It means new problems and user habits, such as the user's adoption, acceptance, etc. That always brings us into the user's life." P8, UX designer, cybersecurity

As technology and trends become obsolete, industrial designers need to keep pace with them to explore the potential applications for innovation and interpret their potential implications on social life. For example, COVID-19 has significantly impacted people's lifestyles, leading to increased time spend at home. It catalyses digitalization and alters the dynamics in many sectors, including online shopping and digital application software, offering various opportunities for innovation.

> "Well... In this [COVID-19] period, even shopping habits are open to innovation as we spend time at home. The execution of the online shopping

> experience requires innovation. We need something new." P2, UX researcher, user experience and research

> "Everyone was locked in their homes and started to spend too much time with TVs during the pandemic. Thus, certain companies updated their applications. A development made by a company in a different part of the world affects you because the user wants it. You also have to follow-up." P14, UX/UI designer, software products for mobile and smart devices

The findings highlighted that industrial designers contribute significantly to the early stages of the design and development process in product innovation by creating value for user experience through the collection of external information and user insights to generate ideas. Participants believe that giving due consideration to users in the design process is crucial for innovation.

Technological advancements and digitalization have significantly impacted user experiences, leading to new problem definitions in design. Industrial designers need to stay updated on technology and trends to explore innovative applications and understand their implications on social life.

Industrial Designers in the Idea Generation Phase

Idea generation plays a critical role in innovation as the ideation phase incorporates generating ideas and choosing opportunities among many (Girotra, Terwiesch and Ulrich, 2010). Findings show that output from preceding phases feed into the ideation phase of the design and development process, guiding design decisions for further improvements. The participants use the knowledge from early design and development phases to support idea generation.

> "We must support an idea with user research…Does it add value if we do something [the idea] like that? My team has been such an example recently. There was huge user feedback on a project which required long-term improvement. After the research and supporting findings, that feature was added to that product. And the product sales increased by 30%." P12 UX researcher, digital products for online platforms

During this phase, designers define their roles in innovation primarily as system thinkers, value adders, problem definers, and solvers. They mainly examine design proposals from an inclusive systems perspective.

> "With the improvements in technology, more variables on the user side come into play. We need to be system thinkers. And we are more like problem definers and solvers. Because once you define the problem, it is already solved." P8, UX designer, cybersecurity

Designers must evaluate market and user needs, costs, and resources during the design and development process. It is crucial to define valid problems with system thinking, before solving them. Findings show that the participants rely on the knowledge acquired from earlier design phases to generate ideas. User research is crucial in supporting and validating these ideas, ensuring they add value to the user experience.

Industrial Designers in the Finalization Phase

The implementation stage of design thinking refers to the finalization of the design and development process. Based on the findings, the industrial designers come to the fore with their facilitator roles because of their intense communication with other actors in the projects during the finalization phase. The participants identified themselves as key contributors in facilitating the communication and knowledge transfer

among team members, customers, or investors to build a shared understanding of ideas. This facilitator role emerges through two skills: one involves mediating and facilitating processes and relationships using social skills (Moreira, 2018), and the other entails communicating between functional areas through visualization skills (i.e., design communication) (Paik et al., 2019; Valencia, Person and Snelders, 2013).

> "I see myself between the product and the technical team in innovation, at the point of transferring, collecting, and turning the information into the product. Other than that, if I have to, I must find a way to convince the investor?" P11, industrial designer, robotics and industrial machines

> "While presenting the final screen, no one tells you 'What a well-coded application' but 'What a well-designed application". Since people only see the graphic user interface. I know that developers also make it live. I can't ignore this." P14, UX/UI designer, software products for mobile and smart devices

To facilitate the communication among actors, one of the most potent tools at their disposal is design communication, including techniques such as sketching, digital drawing, 3D modelling, physical modelling, documentation and presentation. With the improvements in design communication tools, they have become more accessible and widespread. This situation has increased the visibility of design. Participants believe that these delivery methods facilitate communication with other disciplines and stakeholders. However, it has also increased the expectations from managers and clients for the industrial designers, thereby creating additional pressure on them.

> "Designers are constantly expected to present ideas beautifully. I started to feel the pressure a lot in my last work. Really! They notify me in the morning and request a project presentation in the evening like I am a machine. These technological developments [in tools] caused the design to come to the forefront, but also to be seen as simple." P13 industrial designer (co-founder), biomedical products

During the finalization phase of design thinking, industrial designers play a vital facilitator role, engaging in intense communication with various project actors to establish a shared understanding of ideas. This role arises from their ability to mediate and communicate effectively through social and design communication skills.

DISCUSSION

This paper adopts the perspective of industrial designers and seeks to understand their contributions to innovation in STP companies through their work experiences and design and development processes. Their contributions to innovation were explored by correlating their roles with the design and development processes. Subsequently, teamwork dynamics during projects and collaboration with the university, identified determinants of innovation, were investigated by understanding potentials and limitations in the work environment.

Contribution of Industrial Designers

The contribution of industrial designers to product innovation is aligned with the roles in design and development processes. In the early phase of the project, industrial designers understand and identify users' needs, preferences and use context, and propose possible implications of technological advancements. They function as system thinkers, value

adders, and problem-solvers in the idea generation phase, transferring information from the early stages to develop new ideas and concepts. For the finalization phase, industrial designers use communication and presentation skills to facilitate communication and knowledge exchange among project team members and/or customers. The communication skills of designers are indispensable in facilitator roles throughout the process. While these roles are concentrated at certain phases, they are transitive at each stage due to the iterative nature of the design and development process.

On the other hand, integrating design thinking into innovation can be challenging as designers' role has changed over time. The borders of defining design in terms of problem-solving, product development, and innovation have become fuzzier (Marxt and Hacklin, 2005). The visibility of designers' contribution to innovation supports the development of policies on design (Hernandez et al., 2021; Galindo-Rueda and Millot, 2015). Thus, determining the role of the industrial designers in innovation will support the inclusion of design thinking when developing the policies, establishing a more effective collaboration in interdisciplinary working environments, and setting more explicit expectations for designers.

Teamwork

Collaboration can be achieved through effective communication to transparently share ideas and decisions. From the industrial designer's perspective, clear job descriptions and task distributions in teamwork, coupled with increased design and teamwork awareness, ensure that project processes are carried out more efficiently. Companies gain a user-centred perspective and improve their approach to projects with a growing awareness of design and design thinking (Soyupak and Bağlı, 2020). The lack of information on design and user-centred approaches within companies can cause the process to be incomplete or erroneous, such as difficulty moving beyond fixed ideas and requiring periodic revisions (Pala Ercan, 2020). This situation can be mitigated by increasing design awareness in multidisciplinary working environments. In this direction, creating an effective workspace and strengthening communication within the team will provide more room for innovation, enabling companies to develop new methods for a collaborative work environment.

University-Industry Collaboration

Based on the findings of the study, university-industry collaboration is limited to formal and informal personal relationships such as hiring internships and graduate students from the university, supporting industrial design students' graduation projects, individual consultancies with university staff, etc. STPs need to plan and provide both configuration-oriented components, which refer to the available physical infrastructure, facilities, and resources, and the process-oriented components, which refer to the active, hands-on support such as mentoring, networking, etc., to increase the collaboration capacity of STP companies (Albahari et al., 2019).

Studies on STP research mainly focus on technological and economic dimensions rather than the social ones (Cansız, 2019). However, we are facing environmental, social, and economic issues in the context of sustainable goals (UN, 2015). It is valuable to rethink new collaboration models with the university, including social, economic, and environmental issues. Promoting transdisciplinary collaboration between academia and

industry fosters holistic solutions to address sustainability challenges. (Trencher et al., 2017). It is recommended to cultivate a culture of collaboration and trust, establish joint research projects, and encourage collaborative efforts to enhance university-industry collaboration (Zhou, Sawang, and Yang, 2016; Etzkowitz and Leydesdorff, 2000).

Science and technology parks offer physical spaces for collaboration, access to specialized resources, and the opportunity to build networks and partnerships among universities, industry partners, and government agencies. Gülmez and Sağtaş (2016) define gatekeepers as people bridging between organizations (i.e., company, institution, and technoparks) to contribute to innovation activities and increase the absorption capacity of companies by facilitating the interactions among the companies and transferring knowledge and information. The characteristics of gatekeepers match those of industrial designers, as both possesses analytical thinking, innovation, and effective communication skills. Design is pivotal in shaping companies' innovation strategies through problem definition, creative thinking, and enhancing the decision-making process (Calabretta et al., 2013). Thus, involving industrial designers in the knowledge transfer cycle in collaboration with institutions positively impacts the implementation of innovation.

CONCLUSION

This study has explored the contributions of industrial designers to innovation in science and technology parks (STP), emphasizing their role in product innovation, teamwork, and university-industry collaboration. The findings have provided valuable insights into the work experiences of industrial designers, their involvement in understanding user needs, proposing innovative solutions, and facilitating effective communication within multidisciplinary teams. The study has underscored the importance of teamwork and collaboration in achieving successful innovation outcomes, highlighting the need for clear job descriptions, increased design and teamwork awareness, and improved communication within project teams. It offers a distinctive perspective in exploring the role of industrial designers in innovation within phases of design process. Therefore, it highlights that design thinking combines designers' cognition and working processes with a user-centred approach to innovation. It presents a holistic perspective that ensures clarity in interdisciplinary knowledge transfer, and task allocation in work settings.

Moreover, the study has shed light on the state of university-industry collaboration in STPs, revealing that existing collaborations primarily rely on personal relationships and limited interactions. To fully harness the potential of university-industry collaboration, it is crucial to establish more structured and comprehensive partnerships beyond personal connections. This can be achieved by fostering a culture of collaboration and trust, initiating joint research projects, and encouraging collaboration. Science and technology parks provide valuable resources and networking opportunities, serving as physical spaces for collaboration and facilitating partnerships, thus fostering a more interconnected and innovative ecosystem. By broadening the scope of university-industry collaborations, STPs can effectively contribute to addressing sustainability goals and other complex societal issues.

Overall, STP companies can enhance their innovation capabilities and make valuable contributions to sustainable development by recognizing and leveraging the contributions of industrial designers, cultivating a collaborative work environment, and establishing meaningful partnerships with universities. Acknowledging the crucial role of design in innovation fosters policy development that foregrounds design and innovation.

LIMITATIONS AND FUTURE RESEARCH

This study was conducted with a limited number of participants from Türkiye, which provided in-depth and rich data about the phenomenon. Thus, it reflects findings from a particular culture. Another limitation was the online data collection phase via video calls due to COVID-19 pandemic conditions. Future research could be enriched by observing industrial designers within their professional work environments. It also limited data collection to industrial designers; further research could gather data from a more diverse set of actors.

ACKNOWLEDGEMENTS

The author would like to thank to the participants in the study who explicitly shared their experiences and opinions. This research was supported by Middle East Technical University Scientific Research Projects Coordination Units [project code: AGEP-203-2019-10099].

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Alındı: 27.11.2022; **Son Metin:** 01.11.2023

Anahtar Sözcükler: Endüstriyel tasarım; bilim ve teknoloji parkları; üniversite-sanayi işbirliği; inovasyon; tasarım süreci

İNOVASYONA DAYALI ŞİRKETLERDE ENDÜSTRİYEL TASARIMCILARIN ROLLERİ: ODTÜ TEKNOKENT ÖRNEĞİ

Bilim ve Teknoloji Parkları, sanayi ve akademinin teknoloji transferi ve inovasyona odaklandığı platformlardır. Bu nedenle, endüstriyel tasarımcıların teknoparklardaki rollerini anlamak, endüstriyel tasarımcılardan ortak beklentilerin anlaşılması ve disiplinler arası ekiplerde etkili çalışma ortamlarının sağlanması için gereklidir. Bu çalışmaya, bağlamı anlamak ve alan çalışmasına temel oluşturmak için endüstriyel tasarım, inovasyon ve teknoparklar üzerine bir literatür taramasıyla başlanmıştır. Alan çalışmasında, ODTÜ TEKNOKENT Ankara'da çalışan endüstriyel tasarımcıların yetkinliklerini anlamak, onların inovasyon alanında tasarım konusundaki anlayışlarını, çalışma ortamındaki etmen ve sınırlılıklarını keşfetmek amaçlanmaktadır. Bu amaçla farklı firmalarda çalışan endüstriyel tasarım mezunları ile yarı yapılandırılmış görüşmeler yapılmıştır. Bu çalışmanın sonuçları, endüstriyel tasarımcıların inovasyona katkılarını, takım çalışması deneyimlerini ve üniversite ile işbirliği tiplerini ortaya koymaktadır. Çalışma, inovasyona dayalı şirketlerde tasarımı disiplinler arası ekiplere daha iyi entegre etme, endüstriyel tasarımcılardan daha net beklentiler belirleme ve endüstriyel tasarımı içeren politikaları destekleme konusunda rehberlik edecektir.

ROLES OF INDUSTRIAL DESIGNERS IN INNOVATION-BASED COMPANIES: THE CASE OF ODTÜ TEKNOKENT

Science and Technology Parks (STPs) are platforms where industry and academia focus on innovation and technology transfer. Thus, understanding industrial designers' roles in STPs is essential for a shared understanding of the expectations of industrial designers and for providing effective working environments in interdisciplinary teams. This study starts with a literature review on industrial design, innovation, and STPs, to understand the context and also provide a basis for the field study. The field study aims to understand the competencies of industrial designers

working in ODTÜ TEKNOKENT, Ankara, and explore their understanding of design in innovation, drivers and challenges in the work environment. To this end, semi-structured interviews were conducted with industrial design graduates working in different companies. The results of this study present the contribution of industrial designers to innovation, their experiences of teamwork, and collaboration types with the university. The study will guide innovation-based companies to integrate design in interdisciplinary teams better, set more explicit expectations from industrial designers, and support policies including industrial design.

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