



Considering Industrial Design in The Context of Communication: The Concept of Design Communication

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Abstract

The design process, essentially a problem-solving activity, is deeply intertwined with communication. In this process, designers share ideas and information not only with themselves but also with external parties through various media. Communication is defined as "the process of sending information using a medium," and it serves as a pivotal intersection between the fields of design and communication. One crucial element in this design communication process is the environment. The environment acts as a physical mediator, facilitating the loading and transmission of messages that can stimulate the senses. Different environmental factors, such as the method, process, and perception, influence the formation of the designer's original idea and the overall functioning of the design process. While the literature frequently addresses the concept of "Communication Design," the specific concept of "Design Communication" itself has not received adequate examination. Furthermore, its framework within the context of industrial design discipline remains incompletely defined. As part of this study's scope, an analysis of various definitions of design communication in the literature has been conducted, leading to the identification of five distinct contexts through which the concept is approached and its framework established within the realm of industrial design discipline.

1. INTRODUCTION

The field of design encompasses a wide range of disciplines, spanning from 3D objects to graphic communication forms and from architectural structures to entire urban environments. While each design field may require different areas of expertise, they all share fundamental concepts and processes. At its core, design is the activity of creating purposeful solutions. This process of solution creation involves designers sharing their ideas and knowledge with themselves and with external parties through various media. As part of this iterative process, designers internalize what they observe and then externalize their thoughts to others [1]. The act of externalization is crucial since it allows internal representations to become accessible to others and enables the formation of a shared mental model of the design object. Norman [2] characterizes this design process as a "real communication process" and asserts that good design is tantamount to good communication. The ability to effectively communicate ideas, both within the design team and with stakeholders, is vital for successful design outcomes. In conclusion, design encompasses diverse fields with distinct specializations, but they all share the essential process of creating purposeful solutions. Effective communication plays a pivotal role in this process, as designers share their ideas and externalize their thoughts to bring about well-designed outcomes.

With its general definition, communication is the process of sending information using a medium. In the design process, in order to create a purposeful solution and translate design ideas into practice, effective communication of these ideas is essential—they need to be expressed through a medium. Consequently, design and communication actions are inherently interconnected by nature [3]. These relationships between the concepts of design and communication have led to the emergence of the term "design communication" in the design literature.

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Considering the industrial design literature as a design field, it is evident that while the concept of "Communication Design" is frequently addressed, the concept of "Design communication" has not received sufficient examination, and its framework within the context of industrial design discipline remains undefined. In this study, the industrial design process, regarded as a specialized design activity, is viewed as a communicative process. This approach introduces an interdisciplinary perspective, merging with the communication discipline. The aim of this research is to establish a framework by analyzing and associating various definitions of design communication in the literature, thereby revealing consistencies and differences. In other words, the study intends to conduct a detailed exploration of this phenomenon.

2. DEFINITION OF COMMUNICATION

Communication is the process of transmitting information using a medium. It encompasses both verbal and nonverbal forms and is dependent on human needs and activities. In other words, communication actions, whether verbal or nonverbal, occur based on the needs that necessitate these actions, and individuals choose and perform activities to fulfill these needs. Communication is a vital condition for carrying out biological, intellectual, and social activities, as well as meeting various needs. Therefore, the reasons for communication encompass all kinds of needs for the biological and social survival of human beings.

In communication research, two fundamental approaches are observed: the process approach and the meaning approach [4]. The process approach views communication as the "transmission of messages." It delves into how senders and receivers encode and decode information, how transmitters utilize communication channels and tools, and it primarily focuses on communication actions. On the other hand, the meaning approach sees communication as "the production and exchange of meanings." It delves into how messages interact in creating meanings and emphasizes communication products.

2.1 Elements of Communication

Almost all common explanations of communication, either explicitly or implicitly, treat communication as a process that begins with the sender and ends with the receiver's reception (and effect) [5], [6]. In the literature, numerous communication models exist. One of the most important communication models used in communication research is Lasswell's [7] communication model. According to this model, to define communication, the following questions need to be answered: Who is the source? What is the message? Through which media is it transmitted? To whom is it addressed (recipient)? With what effect? In Lasswell's model and other common models, the basic elements of the communication process include:

- Sender: The one who outputs, releases, or transmits the signal or message.
- Code: The complete set of possible signals and contexts.
- Signal: The behavior (or the form and structure of the word or behavior) inferred by the sender.
- Message: The message can be an expression of thought, request, feeling, wish, command, or attitude.
- Channel: The path that the signal travels.
- Media: The entity that carries, delivers, or transmits the signal or message.
- Noise: Background activity in the channel that distorts the signal.
- Receiver: The one who responds to the signal/message and whose behavior is desired to be changed by the signal/message.
- Feedback: The receiver's response to the signal/message.

3. DESIGN COMMUNICATION

3.1 Definition of Design

Design, in its most basic sense, is defined as a goal-oriented solution creation activity [8]. In other words, design is the process of transforming existing physical environments or situations in line with design decisions. Norman [2] describes this process as "a real communication process" and equates good design

with effective communication. The field of design is vast, encompassing a wide range of disciplines, from 3D objects to graphic communication forms, and from architectural structures to entire urban environments. While each design field requires different expertise, they share fundamental concepts and processes. These common features include the requirement for creativity, the need for repetition, a focus on continuous improvement, and a dedication to serving human needs. In summary, design is a creative human endeavour and an industry that generates economic value by addressing and meeting various human needs.

3.2 Industrial Design

Industrial product design is a research field that emerged after the industrial revolution and has developed its own educational infrastructure, methods, terminology, and content over time. It has proven to be a "discipline" capable of producing and developing new knowledge [9]. While the basic context of the industrial design discipline was initially limited to industrial products designed as tools for specific purposes and produced with machine technology, the scope of this definition has expanded with social developments over time. The product development process typically involves collaboration between disciplines such as design, marketing, and engineering. Throughout history, this collaboration and the role of the designer within it have undergone various changes. Previously, the industrial designer was primarily viewed as the person responsible for shaping the product's outer appearance and dealing with its shell and aesthetic qualities. This role was often limited to the final stages of the product development process. As time passed, aesthetics remained a central aspect of product design, but designers began addressing other critical factors such as functionality, ergonomics, usability, technology, material selection, and environmental issues. The concept of "designer thinking" emerged as an approach that moved design beyond merely focusing on the aesthetic object. Instead, it advocates for offering creative solutions to various problems. In this way, industrial design evolved into a more holistic and problem-solving-oriented discipline.

Design thinking refers to the designer's internalization of what they observe and their ability to externalize their thoughts to others [1]. By externalizing internal representations, designers can create a shared mental model of the design object, making it accessible to others. They utilize various design tools to explore, describe, and communicate ideas independently of the context. This approach considers design as a thought system rather than just an object and advocates finding design-oriented solutions to events and situations. According to Norman [2], design thinking involves focusing on identifying the main problem first, rather than just addressing the stated problem. Once the problem is identified, designers evaluate numerous potential solutions rather than settling on an immediate fix. This process is known as designer thinking. The thinking process of a designer is depicted in the "double diamond" model introduced by the Design Council in 2004 (Figure 1). This model portrays two diamonds representing the process of exploring the subject more broadly or in-depth (divergent thinking) and then applying focused action (convergent thinking).

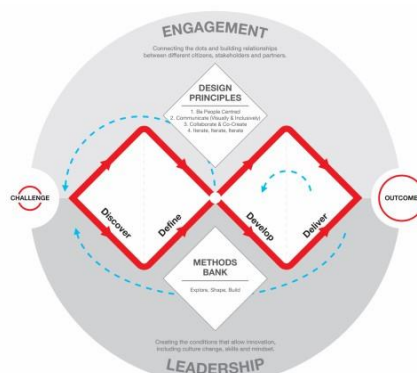


Figure 1. Double Diamond Model

3.3 Design as a Communication

In the design literature, studies by researchers such as Eco [10], Nelson [11], Koenig [12] appear as the earliest examples of the approach that views design as communication. The common feature of these early studies is their emphasis on the communicative potential of products. The communicative perspective of design products also remains the subject of subsequent studies [13], [14], [4], [15], [16], [17]. The communication potential of products is discussed in various ways in the research literature, and these different perspectives can be categorized in five ways [18]:

1. The product is seen as using a language that consumers read.
2. The product is considered to be part of a sign system in which consumers form meaning.
3. The product is accepted as a means of persuasion or discussion.
4. The product is seen as a component of social interaction.
5. The product is considered as a message or medium in the sender-receiver process.

To frame their ideas about communication, many scholars have developed schematic models that represent the relationship between the message as intended and the message as interpreted. Maser [19] established a basic designer-product-user structure and then characterized the factors that influence the creation and interpretation of the product.

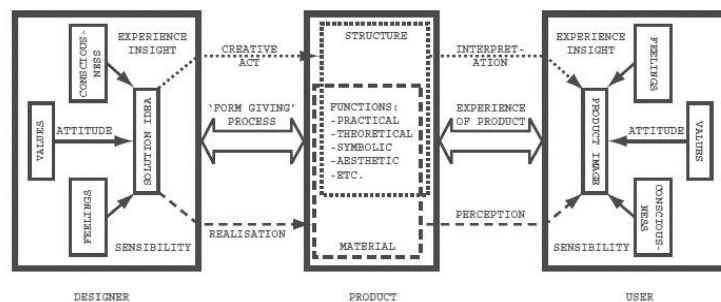


Figure 2. Maser's Model

Krippendorff and Butter [13] adopted a similar structure. They also emphasized the feedback that designers received from their users and users' manipulation of both the product and its context.

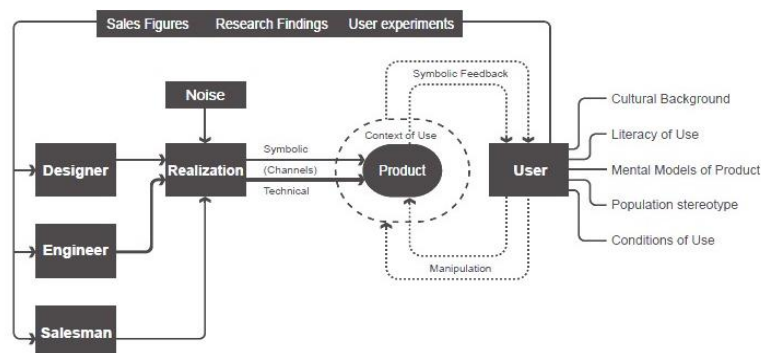


Figure 3. Krippendorff and Butter's Model

While these models represent design as communication, they focus on the communicative potential of products but make no reference to the communication models that preceded them. Monō [15] on the other hand, evolved Shannon and Weaver's communication model [20] into a design-specific representation, taking into account factors such as manufacturing quality and competition in the market.

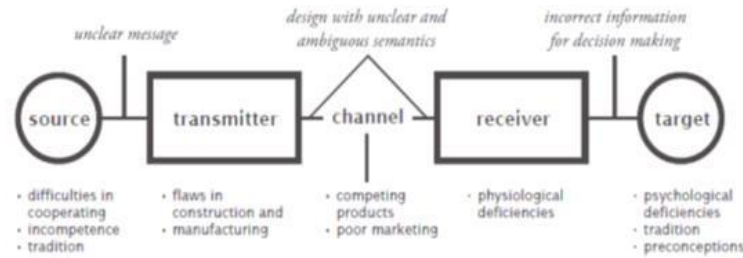


Figure 4. Mōno's Model

In the literature, critics of these models are grouped under two headings. First, they state that the meaning is included in the messages rather than being constructed by people in the models, and secondly, they state that the source of the message has authority over the meaning of that message [18]. It is possible to summarize these views as the meaning is not contained in the communication medium and the interpretation of the "recipient" may differ from the one conceived by the "source".

In the design literature, another approach that sees design as communication is associated with the concept of "representation". The word representation can generally be explained with concepts such as description, expression, re-presentation, similarity, equivalent, substitution, substitution. Representation in design provides the designer's communication with himself and others. "Design representation" has been explored and scoped in a number of studies [21], [22], [23], [24], [25]: how representation is created, used for design in design environments, and the use of design modes in creating products. This scope allows to understand its relations with design thinking [26].

Goldschmidt [24], primarily discusses two situations of representation: internal representations that manifest in the mind of the designer and are executed internally, and external representations formed by transferring the thoughts from the mind to other environments. In the context of design, external and internal representations are interpreted as sketches and mental images. Internal representations are described as mental images or the "essence of cognition" [24]. Although external representations may not be identical, they reflect the internal representations. Design communication also pertains to the process of transforming these internal representations into external representations. This process involves translating ideas and other information through various media. In essence, the designer follows a path that they envision, leading to the end result by developing their foresight through representational environments. In other words, the environment serves as a feedback tool for the designer and influences the development style of the final design [27].

In the world of design, another approach that sees design as communication is associated with the concept of "Media." Media are agents that require mental operations, procedures, techniques, and representations to transform concepts into forms. These mental operations are parts of design cognition, defined as human abilities or intelligence, that organize design knowledge and problem structures to create artifacts. When using different media, different representations and cognitive processes are used [26]. The nature of the "new" in relation to new media and new technology concepts is constantly changing. New technologies in the context of design are often defined by creating new environments for designing products [28].

Changes in theory and practice have been revealed in the context of the transformation of design, process, and representation relations, especially in the discourses that have intensified since the 1990s. These changes in theory and practice seem to focus on the use of computer technologies that create a new design environment [28], [29], [30], [31], [32] [33], [34]. The use of computer technologies in design processes has led to the development of various distributed design environments, and the utilization of new communication channels has increased. The figure illustrates the conditions of communication between multiple people in a distributed design environment, including cognition, transference, and representation [35].

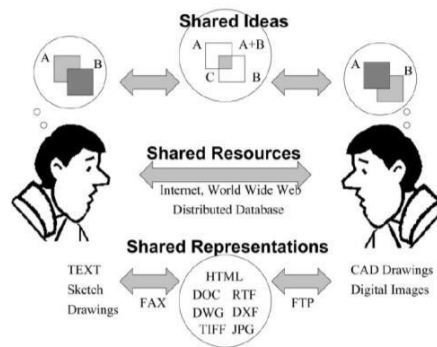


Figure 5. Chiu's Model

With the use of computers in design processes, understanding how people interact with the environment in the process has become critical, and the discussion focuses on three topics: Process and communication environment, design organization, and information flow. In this context, Oxman [36] describes the forms of interaction transformed by the participation of the digital environment created by computers in design in four ways:

1. Interaction with non-digital representation: Direct interaction of the designer with the representation of the object designed using tools such as sketches, drawings, and models.
2. Interaction with the digital structure: The interaction of the designer with the sketch, drawing, or model created in the digital environment.
3. Interaction with digital representation: It is the interaction of the designer with the digital structure created by the generating mechanisms within the framework of defined rules and relations.
4. Interaction with the digital environment that creates the digital representation: It is the interaction of the designer with the mechanism that creates the digital design.

Chiu [37] highlights the important conditions for design communication in a computer environment as follows:

1. Three types of communication should be considered, including human, data, and network.
2. There are different levels of communication in terms of individual, group, and project.
3. Conditions for participation and coordination among individual members of a design team are critical to communication and representations, and design task dependency defines data dependency and information flow.
4. Communication usually occurs between the smallest number of people in the design organization.
5. Common goals are shared by all participants, and the design communication process is cyclical until the goals are achieved."

Interaction refers to another approach that design communication is associated with in the design literature. The situations in which designers interact differ in a wide variety of ways. These different situations create different types of communication needs, influencing how designers behave and what they need for their collaborative activities. Eckert and Stacey [38] identified six dimensions for designers' communication situations: mode of communication, mode of task, subject matter expertise, tool, organization, and representation of knowledge. Eckert and Stacey [38] identified 3 interaction scenarios in line with the 6 dimensions that designers defined for communication situations: handover, joint designing and interface negotiation.

Collaborative design activities deal with the communication and sharing of design knowledge, whether computer-aided or not. The effects of computer-aided processes go beyond data models, where the focus is on the exchange of information between computer programs, and instead, it focuses on developing an understanding of how human designers communicate through computers [34]. Collaboration in the design process includes organization, communication, and decision making, and these concepts are related as follows [35]:

1. Media are available for communication.
2. Communication is established for decision making in design.
3. Decision making is applied to exploring design possibilities or solving design problems.
4. Technology can facilitate the effectiveness of communication and decision-making.,

Williams and Cowdroy [39] observed and analyzed both formal and informal design meetings of a Hongkong design firm over a twelve-month period and found that team designers used a wide variety of communication strategies to reach a common understanding among members:

1. Technical Language: Use of technically domain-specific language for an item or procedure to be used in the project
2. Analogy: Use of project-specific analogies related to using samples from the specific project the team is working on
3. Gestures: The use of hand gestures. These gestures are predominantly used to depict a number of design-related aspects: Size, Function / mechanism, relationship to other components, shape.
4. Graphics-Sketching: Use of graphics or freehand drawing (2D/3D drawings and sectional drawings). It is commonly used to show shape, articulation, and situational change.
5. Existing graphics: Use of graphic forms consisting of technical or production drawings and photographs
6. Actual Objects: The use of the main object under discussion for technical information transfer or design discussion to illustrate the issues under consideration.

Verbal Strategies	Visual Strategies
1. Technical Language	3. Gesture
2. Analogy	4. Graphics – Sketching
<ul style="list-style-type: none"> • Project Specific • Domain Specific • External to Domain 	5. Existing Graphics
	6. Actual Objects

Figure 6. Williams and Cowdroy's Model

Minneman [40], Bucciarelli [41] and Henderson [42] studied large-scale engineering design processes as participant observers. These studies imply that complex designs are largely developed through social discussion and negotiation processes. In other words, it can be said that design emerges through a negotiation process among the participants, where information is actively communicated and made sense of, rather than passively transmitted through an organization. However, this view ignores the role of a solo designer communicating with him/herself – sketching, modeling, etc.

Persson and Warell [43] presented a model that explains the incremental gains for the collaborative design work of designers and engineers. Based on empirical findings and communication theory, the model distinguishes between four modes of interdisciplinary contact and the degree of contact's existence. The modes are one-way communication, mutual communication, interaction, and cooperation. According to this model, one-way communication is a prerequisite for effectively communicating with other people; that is, we must be able to export and transfer data. This requires a common language that both parties understand. In mutual communication, the sender receives feedback on whether the information has been understood. This requires a common language and the goal of building a shared understanding of the problem/task. Interaction includes processes in which groups and individuals mutually influence each other through their actions. The result of interaction is that work and actions are influenced by the actions and messages of other team members. On the other hand, cooperation means working together with others for mutual benefit. A willingness to share knowledge and learn from others is the decisive key to successful collaboration.

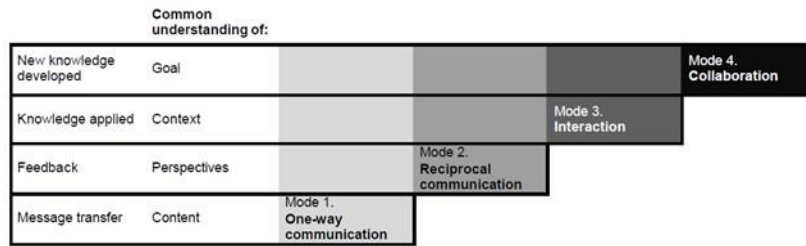


Figure 7. Persson and Warell's Model

In the literature, there are also approaches that deal with the concept of design communication in a more general context. In these studies, a general definition of design communication is provided, and its characteristics are revealed [44], [45], [46]. The Industrial Design Institute (IDI) defines design communication as the translation of ideas and other information through various formats and media, and divides it into three categories [44]:

1. **Verbal communication:** Oral communication focuses on the spoken word, intonation, language, enunciation, and speaking rate. It is often part of an overall communication experience, which may include other factors, including non-verbal communication. Examples of verbal communication include user interviews, business meetings and presentations, collaborative design interviews, general business communications, reviews, and written communications (emails, documents, notes, presentations, etc.), as well as verbal social media communications.
2. **Nonverbal communication:** Nonverbal communication is the process of conveying messages between people through visual cues. Examples of nonverbal communication include body language movements, touch, personal space (proxemics) in cultural interactions, paralinguistics (emphasis, tone, etc.), physical appearance, smell, and non-verbal social media communication.
3. **Visual Communication:** Visual communication is defined by the transfer of ideas and information in forms that can be read or studied. Examples of visual communication include visual storytelling, sketching, rendering (computer or manual), graphic design programs (such as Photoshop, Illustrator, Rhino, etc.), photography, graphic design (infographics), visual aids (images, posters, etc.), and visual social media communication, as well as technical communication.

Maier et al. [45] systematically searched various literature sources and produced a list of 120 recommendations for potential design communication. These factors are classified under 4 categories as information, individual, team and organization:

1. **Information:** Information sharing to improve communication
2. **Individual:** Direction and production context
3. **Team:** Configure collaboration
4. **Organization:** Effective functioning

Clarkson and Eckert [46] expressed the characteristics of communication that they define as an important part of any design process:

1. It can happen between different people and groups, e.g., between different designers, between departments within a company, between project teams, or between the company, supplier, and end user, etc.
2. It has different aspects, e.g., top-down (manager to designer), bottom-up, or peer-to-peer.
3. Communication can be formal or informal.
4. It can happen at the same time - synchronously - or at different times - asynchronously.
5. Information transferred can be in many different formats, e.g., verbal, written, or visual.

4. DISCUSSION AND CONCLUSIONS

Within the scope of the study, various definitions of design communication in the literature were analyzed. The outputs of the analysis conducted on the concept of "design communication" in the design literature are as follows:

- Although it is a concept that started to be discussed in the 70s, it is seen that with the use of computer technologies in design in the 90s, it has been the subject of many researches, and the current framework of the concept was drawn during these years.
- Looking at the historical development of the concept, it is evident that the way it is handled differs depending on the context it is associated with. These contexts are: product, representation, medium, interaction, and general (Table 1). Studies dealing with the product context focus on the creation and interpretation of the "meaning" generated by the products. In the context of representation, studies emphasize "tools" as the providers of communication in design. Studies related to the environment focus on the use of "technology" in design, which influences the form of communication. Research in the context of interaction concentrates on the organization and information flow between stakeholders in different design tasks. Finally, studies in the general context focus on the comprehensive definition and characteristics of the concept.
- The researchers who discussed the concept in the context of interaction focused on the "collaborative design" approach and conducted field studies on design teams and interdisciplinary design projects in companies. In these studies, it is also observed that the scope of design projects is an important factor in terms of communication.
- Studies that deal with the concept in the context of representation have focused on design tools as external representations.
- Studies that deal with the concept in the context of the environment have focused on the technology concepts that create new media in design. It is observed that the studies in this period centered around the concept of "design in the computer environment" with the widespread use of computer technologies. These environments are called digital and virtual.
- When we look at the literature in general, it is seen that most of it focuses on interpersonal communication during the design process. However, the concept of design communication includes not only interpersonal communication but also the designer's communication with themselves during the idea development process. In this context, it can be said that the communication of the designer with themselves remains in the background/neglected in the literature.

Table 1. Contexts of the Concept of Design Communication

CONTEXT	
PRODUCT	<ul style="list-style-type: none"> • Products have communicative potential. • The product uses a language that consumers read and is considered part of a sign system in which consumers create meaning. • The product is accepted as a means of persuasion or discussion and is seen as a component of social interaction. • The product is accepted as a message in the sender-receiver process.
REPRESENTATION	<ul style="list-style-type: none"> • Design communication refers to the process of transforming internal representations into external representations. This process consists of the translation of ideas and information through the medium. It is divided into three as verbal, non-verbal and visual. • Representation basically has 2 states: Internal representations that appear in the mind of the designer and carried out here, and external representations formed by transferring the thought in the mind to other environments.
MEDIA	<ul style="list-style-type: none"> • Different representations and cognitive processes are used when using different media. • New technologies in the design context are often defined by the way they create a new environment for designing products. • The use of computer technologies in design processes has created various distributed design environments, and the use of new communication channels has increased. • In the design communication within the computer environment, three types of communication, including human, data, and network, should be considered. Additionally, there are different levels of communication, such as individual, group, and project-based communication.
INTERACTION	<ul style="list-style-type: none"> • The different situations in which designers interact create various types of communication needs, influencing how designers behave and what they require for collaborative design activities. • Communication is the coordination of behavior, thus influencing and enabling collaboration in product development networks. • Design communication is central to design development in the process. The effectiveness of design communication becomes critical in sharing design information, making decisions, and coordinating design tasks. • There are four modes of interdisciplinary contact in design communication: one-way communication, mutual communication, interaction, and collaboration.
GENERAL	<ul style="list-style-type: none"> • Design communication consists of translating ideas and other information through various formats and media. • Communication is an essential part of any design process. It can take place between different people and groups. It has different aspects, and the information transmitted can be in various formats. The communication can be synchronous or asynchronous, formal, and informal. • Design communication can be classified under 4 headings as information, individual, team and organization. • There are six dimensions for designers' communication situations: mode of communication, mode of task, subject expertise, tool expertise, organization, and representation of knowledge.

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