# Interdisciplinarity: Umberto Eco's Semiotics Approach in Architectural Design

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# Interdisciplinarity: Umberto Eco's Semiotics Approach in Architectural Design

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**ABSTRACT**
Architecture is a multidisciplinary field, with or without intention, architecture absorbs knowledge from other fields of discipline to become a part that enriches itself. If knowledge is centered on signs and meanings, then Eco's semiotic theory which is based on communication and signification becomes interesting to be verified as a method of transferring concepts/propositions from other disciplines. This research is a theoretical qualitative research with case studies which include: (1) Analysis to examine the relationship between the components of the structure of the Elementary Communication Model as a coding system descriptively for interdisciplinary purposes; (2) Verification of Modes of Sign Production as a concept transfer method through case studies of "The Gherkin Tower" work of Norman Foster and "Church of the Light" work of Tadao Ando. This study concludes that the difference in the scope of each discipline area lies in the continuum, so it is necessary to add a "Converter" component to the Channel component of the Elementary Communicational Model structure, and Modes of Sign of Production as a converter method.

***Keywords:*** *Interdisciplinarity, Concepts, Communication, Semiotics, Converter, Sign Production*

## 1. INTRODUCTION

Architecture is a combination of several knowledge or called *multidiscipline* [1]. Because the richness of architecture arises and aligns with the development of other disciplines, in the working of design, architects interact, adapt, absorb and adopt specific part of other knowledge as part of architecture.

It should be understood that the difference between *multidisciplinary* and *interdisciplinary* lies in the barrier that limits the area of knowledge itself. Although multidisciplinary emphasizes studying several disciplines simultaneously, the boundaries of each discipline persist. While interdisciplinary concerns the transfer of methods from one discipline to another [2].

The heterogeneity of knowledge raises the question, how can the concept of knowledge be transferred as an interdisciplinary process into architectural design?

Knowledge itself is based on concepts and propositions. Submission of concepts and propositions requires language (a communication tool), but because concepts/propositions have a broader scope than language can convey, they need to be linked with semiotics. Semiotics is a field of study related to *signs* and/or *meaning* [3].

Although there are various semiotic theories, this research uses Umberto Eco's semiotic theory approach, which offers a sign production method model based on communication and signification systems. The production of signs corresponds to the designer's work to produce designs (physical expressions), and the primary communication system is in line with interdisciplinary goals. Thus, this study aims to verify the "Modes of Sign Production" method as an interdisciplinary method.

## 2. UMBERTO ECO'S SEMIOTICS THEORY

Eco calls knowledge as an encyclopedia or an extensive library, space where books are interconnected in intertextual links and possible paradigms of meaning that can be used to produce new signs. Encyclopedias are sources of semiotic rules, spaces in which knowledge shows its rules of function and establishes the conditions for interpretation and production of signs. Knowledge appears in the form of signs and/or codes, where transmission is bonded by cultural conventions as a result of communication activities [4].

### *2.1. Signification and Communication*

Elementary Communicational Structure in Umberto Eco's view includes eight components in a sign function. The eight components are: *source-transmitter-signal-channel-signal-receiver-message-destination*.

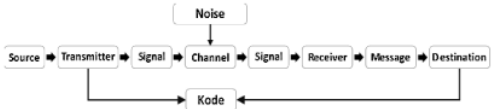



**Figure 1** Elementary Structure of Communication Model [4, p.33]

Eco gave an example of a code system in the electrical system apparatus to communicate the water level from the reservoir to signify the four color codes of the lights with different meanings (danger level to low water level). An apparatus is a sign-functioning or expression (physical material) that emits content in a message [4]. The code is the interpretative key that governs the sign-function, consisting of the correlation of the two sides of the sign: expression and content [5].

Socio-cultural factors can be a problem between the sender and the receiver, to make a communicative text. The sender of the message must estimate that the message code used can be understood by the receiver, so that in the end the sign undergoes a process of signification, namely meaning.

Messages are text: webs of various messages depending on various codes, sometimes related to various expressive substances with content, so the above model can be written as follows [4]:

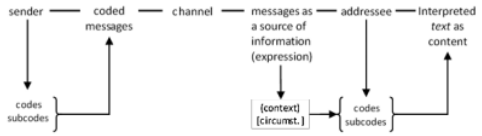



**Figure 2** Interplay between codes and messages in Communication model [4, p.141]

The code has many possible options depending on contextual interpretation and circumstances. When the receiver fails to isolate the sender's codes or fails to replace the codes with his subcodes, the message will be received as noise.

### *2.2. Modes of Sign Production*

Modes of Sign Production is the physical labour of building a machine programmed to produce signs or "expressions" objects, requiring a well-established motivation to prove that there is a constant physical relationship between agent and result (between content to expression & type to token). While there are other machines to attach certain content to each expression and the final result is decided by convention.

The table below lists the processes required to produce an "expression" (sign-functioning, message, or text) that ranges from *Recognition* of the object or event, *Ostension* (pointing or selecting), *Replica* (replicating units that can be combined), to *Invention* of previously non-existent or unencoded expressions.

**Table 1** A Typology of Modes of Sign Production

| PHYSICAL LABOUR required to produce expressions | RECOGNITION | | | OSTENSION | | | REPLICA | | | | | INVENTION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE/TOKEN RATIO<br>Ratio difficilis<br>⇕<br>Ratio facilis | IMPRINTS | SYMPTOMS | CLUES | EXAMPLES | SAMPLES | FICTIVE SAMPLES | VECTORS | STYLIZATIONS | COMBINATIONAL UNITS | PSEUDO-COMBINATIONAL UNITS | PROGRAMMED STIMULI | CONGRUENCES<br>PROJECTIONS<br>GRAPHS | TRANSFORMATIONS |
| CONTINUUM to be shaped | HETEROMATERIAL (MOTIVATED) | | | HOMOMATERIAL | | | HETEROMATERIAL (ARBITRARILY SELECTED) | | | | | | | |
| Mode and rate of articulation | Pre-establish (coded and over coded) GRAMMATICAL UNITS (according to different modes of pertinence) | | | | | | | | | | | Proposed undercoded TEXTS | | |

(Source: A Theory of Semiotics [4, p. 218])

This way of sign production relates signs to actual objects or events, a continuum with possible physical causality functions as their contents, where physical causes act as sign producers, and as a process of forming a continuum of expression. The four cases and their various operations consist of [4]:

1. *Recognition* of existing objects or events as signs (objects/events are seen as expressions of specific content) through *imprints, symptoms* and *clues*. The existence of one's theory and experience will facilitate the stability of this stage.
2. *Ostension* is a general abstraction by pointing to an object or event for the purpose of definition or description [6], as an expression of the class where the object or event belongs (looking for expressive features), through *examples, samples,* or *fictive samples*.
3. *Replica* generates expression elements for signification purposes (tokens), including *fictive samples, vectors, stylizations, combinational units, pseudo combinational units,* and *programmed stimuli*.
4. *Invention* produces a new way of organizing (content type) by selecting a new material continuum (unencoded or undercoded expressions). At this point,

we "define the mode of production in which something has been changed or has not yet been defined." Since there is no previous convention to correlate expression elements with the content selected from the above process, in order to be accepted, token producers can perform expression-token and content-type mappings.

*Stylizations* are certain 'iconic' expressions of a convention in which the expressions are not recognizable to the content-model, but have similarities to expression types that are not so strict as to allow for free variation [4].
*Programmed stimuli* and *pseudo-combinational units* are sets of "non-semiotic elements intended to elicit an immediate response in the receiver." According to the painter Kandinskij's theory, a certain colour leads to a certain stimulus [4].

## 3. METHODS

The methods used are a qualitative analysis of theory and case studies to verify *The Elementary Structure of Communication* and *Theory of Sign Production* to transform concepts from other disciplines into architectural design. The details are as follows:

1. Transfering the concept of knowledge into the concept of architectural design descriptively, to examine the relationship between components of the structure of the Elementary Communication Model.
2. Verification of Modes of Sign Production as a concept transfer method through case studies of “The Gherkin Tower” work of Norman Foster and “Church of Light” work of Tadao Ando.

## 4. RESULT AND DISCUSSION

The working relationship of sign production for interdisciplinary purposes can be understood as a relationship of expression and content. The content that one expression emits, can be passed on to produce another expression, which emits another content, and so on. Or in other words, the content of the first signification can be the expression of the next signification. The continuous linear signification process can be described as follows:

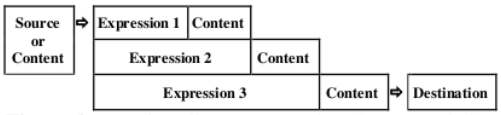



**Figure 3** Interdisciplinary Expression-Content relation linear flow (Source: adapted from Eco [4])

### *4.1. Field of Interdisciplinary Cooperation*

If in Figure 2, the sender and receiver relationship is a message and code relationship, while the code itself refers to the model in Figure 1, then the interdisciplinary cooperative relationship can be described as follows:

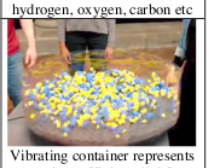

**Figure 4** Scheme of interdisciplinary direct conversion of tokens and channels (Source: Author’s analysis, 2021)

An essential component in a sign-function is the signal and channel; the receiver (in this case, the architecture) performs the equivalence from token to token. The signal is is a token-functive based on relationships of *token* and *type* with the same source (sender's knowledge proposition) as the element that has the power of signification.
*Token* is defined as a concrete expression, both spoken and written, which is seen as an example of something else. For Peirce, a sign in its singular occurrence is a token and a sign as a general rule is *type* [4].
The continuum can be chosen arbitrarily to deliver the tokens to the receiver. The receiver needs to understand the tokens received and convert them into tokens according to their own discipline. Generally, each discipline has a different raw material from other disciplines, so that the signal sent to the other party will experience a token and channel (continuum) transition.

Table 2 below shows the transformation of one of the science concepts from the story in the simulation film “How was this biological machine created?” [7]. A concept is coded using a simulation of a pentagon-shaped plastic chip being shaken with a vibrating container in this film. The simulation is then projected into a simulative architectural design to transfer the concept.
This process shows the equivalence of token to token, from source to receiver, according to a replica procedure called by Eco as a result of *ratio facilis* mapping. This is the act of correlating tokens to types exactly and can be estimated by the code concerned to determine content [4]. This is the result of *similitude transformation*.
A transformation is a biunivocal correspondence between a point in the expression space and a point in the virtual space of the content model. There are two types of transformations, namely: *Similitude Transformation*

(similitude geometry) mapping based on similar properties in congruent or equivalent relationships; and *Topological Transformation* (isomorphic geometry) mapping that is toposensitive like the relationship diagram with space [4].

**Table 2** Simulation of Concept Transformation

| **Source**<br>**Creating Block of Life** | | **Film (science simulation)**<br>**Sender Expression Plane** | | **Architecture**<br>**Receiver Expression Plane** | | **Message (Content)** | **Destination** |
|---|---|---|---|---|---|---|---|
| **Signal** |  <br>Magnetic pentagons represent hydrogen, oxygen, carbon etc | **Continuum:** Energy phenomenon.<br>Simulation of electric sparks to mimic lightning effect on primordial soup | **Token:** Magnetic pentagon plastic<br>**Type:** Affinity | **Token:** Man & Woman<br>**Type:** Affinity | **Continuum:** Activities and interaction in a limited space | • How a group is created?<br>• Concept of possible union<br>• Concept programming<br>• Other interpretation | Architectural design concept |
| **Channel** |  <br>Vibrating container represents a container of Primordial Soup | | **Channel:** Vibrating container machine | **Channel:** Limited space or area | | | |
| **Information (physical or non physical):** distributable source (code) properties | | | **Code – Sign Function** | | | **Message=Content:** Accepted codes | |
| | | | **Extra code:** Yellow and blue color | **Extra code:** Not required | | | |

(Source: Author's analysis, 2021)

The simulation between these concepts is then described in the components as an Elementary Communicational Structure as follows:

**Table 3** Concept transformation applied in Elementary Communicational Model

| Component | Interdisciplinary category |
|---|---|
| **Source** | Information on the theory of the gases methane, hydrogen and ammonia (H, O, C, ancient soup, & lightning) that make up the engine of life |
| **Transmitter** | Simulation in scene 4 of the movie "What are we"; code or subcode that will be sent by related people from other disciplines |
| **Signal** | Pentagon magnetic pieces and their combination |
| **Channel** | **Vibrating Container ⇔ Limited space or area** |
| **Signal** | Male-female, child-adult, or other units of similar interest, selected according to the design context |
| **Receiver** | Everyone involved, code or subcode |
| **Message** | The concept of formation due to affinity, that allowed by space and time |
| **Destination** | A generative concept of possible integration, or diversion for other purposes such as design |

(Source: Author's analysis, 2021)

If the simulation in the film is seen as a simulation of a collaborative process to produce code, then the simulation is an expression that requires channels with different materials (see channel components from the table above). Therefore, this process requires a "converter" element, which functions to select, transfer or assign such materials. The converter's function is similar to *translators*, or people who are experienced and master both channel areas. The converter is a switching circuit system on the channel to adjust the continuum from the sender to the receiver continuum.

The sender can freely use an intermediary continuum (props and others) which can be switched by the receiver (the designer), so that the receiver can choose the right continuum in the field of his discipline.

The transfer function can occur after a token/text has been produced, in the form of a message ready to be transferred for another purpose, such as a chain message. However, the converter function emphasizes a direct transfer between token to token, code to code or sub-code to sub-code. Because the converter function may or may not be required, the converter is only a component part that is inserted in the channel itself. The channel to be expressed is the channel in the receiver-expression field. Furthermore, the components of the primary communication structure or Eco Code system are modified into "*transmitter, signal, channel-converter, signal, message* and *destination,*" described by the following scheme:

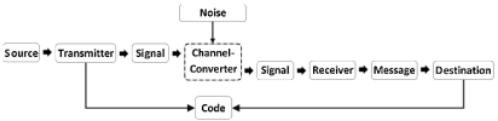



**Figure 5** Converter is a component added in Channel (Source: Author's Analysis, 2021)

In many cases of the design process, the architect needs another continuum medium before the coding can be completed. Architects do sketches, make installations, experiments, and so on to search for a new continuum that has not been imagined. Here it is understood that the architect needs to do simulations. Simulation becomes a temporary sign-function, part of the way in the sender-

expression plane, where something can be transformed into a different form of receiver-expression plane.

### *4.2. Modes of Sign Production in Architectural Design*

Modes of Sign Production is basically a method of replicating the phenomenon of objects or events, referred to as a sign-function production method. This method can be used to transfer differences in the scope of different scientific disciplines, especially for architectural design which is always related to signs or texts. The more complex a text, the more complex the relationship between expression and content.

The case studies below are examples of an architectural work with a cluster of simple expression units, but represents the complexity of two states of knowledge contents: (1) *The Gherkin Tower work* of Norman Foster, where the relationship of expression and content is affected more by *ratio facilis*, while (2) *Church of the Light* work by Tadao Ando, contains the *ratio difficilis* procedure in producing the sign.

Replica is formed by a type and token comparison. In addition to ratio facilis, *ratio difficilis* occurs when the suitability of a token-expression to the content-type does not exist or has not existed yet, the expression is motivated by the content. Example: a replica of the expression of a finger pointing to an exact-content; or expressions in the form of textual clusters to convey uncertain portions of contents or nebula-content [4].

#### *4.2.1. The Gherkin Tower*

The Gherkin Tower is located in London (2003), designed by Norman Foster is one of the architectural works that mimics organism, so it is seen as a biomimetic architecture. Design of Gherkin Tower are units of expression of the result of the *imprints* operation in the case of *Recognition*. It identifies the shape and structural strength of the Venus flower basket sponge *(Euplectella aspergillum)* that lives in the deep sea. This proposition has been investigated in the theory of Radiolarians, which is about the way organisms develop their structures in response to a motion to strengthen the organisms themselves or by reducing the material that inhibits them [8].

In the *Ostension* case, *fictive samples* of Venus flower basket sponge's exoskeleton and round shape, which provide stiffness and disperse the forces from strong current, can be mimicked into architecture. In the *Replica* case, the properties of the sponge are replicated through a *stylization* operation into a diagrid steel structure in the building envelope; and *vectorial* operations that mimic a curved shape, so that the building can withstand wind pressure by blowing air up through the cutaway floor openings.

In the case of *Invention*, the message evoked by this building expressively explains the meaning/content of the Venus flower. Here Norman Foster managed to create a new code of biomimicry architecture. If codes are acceptable as cultural convention, these code are seen as type or icon that can be used as a token for other sign production cases [4].

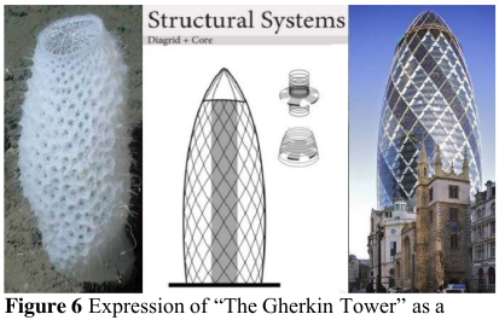



**Figure 6** Expression of "The Gherkin Tower" as a replica of a fictive sample of the Venus flower basket sponge [9]

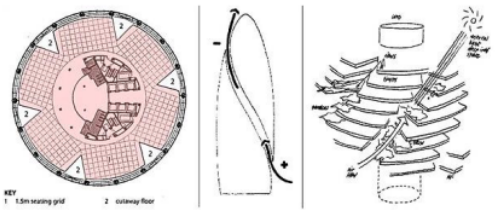


**Figure 7** Air movement through the Cutaway Floor [9]

The replica that uses *fictive samples* to imitate coded and intrinsically produced acts into the form of buildings is a case model of how "Biomimicry Architecture" works. This case is more of a metonymy than a metaphor.

The difference between *Metonymy* and *Metaphor* depend on the axe of syntagm and paradigm. Metonymy represent procedures of substitution by contiguity, while Metaphor represent procedures of substitution by similarity [12].

#### *4.2.2. Church of the Light*

Church of the Light, located in Ibaraki, Osaka, Japan (1989), is one of Tadao Ando's signature architectural works. This church embraces Ando's philosophical framework between nature and architecture [10].

Viewed from the way of sign production, these church expression units are clusters of expressions consisting of a number of conventional symbols as a result of the *clues* operation in the Recognition case, such as: the cross represents the Christianity icon and hope which is represented by the light of the sun rising in the morning as a new beginning. These icons are ready to use as tokens for replication.

Several ways of operation in this *Replica* case simultaneously include: (1) the rectangular shape of the building mass that takes the axis to the east is a *vector* (an architectural type like a pointing finger), to direct the people towards the wall with a cross-shaped hole; (2) the cross shape is an *extra code*; (3) exposed concrete wall that is void of all traditional Christian ornaments is a *stylization*

operation (wall material is Tadao Ando's style); (4) the operation of *programmed stimuli* conveys a nebula-content unit to present light as a conventional hope or icon of an abstract figure of God.
Programmed stimuli is a mode of operation which is also an *Invention* case (see Figure 2). In this case, Tadao Ando produced new codes by allowing the east façade to pour light into the space throughout early morning and into the day, which has dematerializing effect on the interior concrete walls, transforming the dark volume into an illuminated box [10].

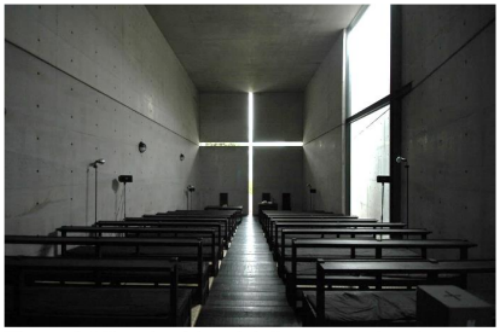


**Figure 8** "Church of the Light" an expression that stimulates undefined object [11]

In contrast to The Gherkin Tower, this building design expression in line with *vectorial* operations and *programmed stimuli* to point out an undefined content-unit or nebula, is a *ratio difficilis* suitability, where an expression is motivated by content. An icon is a metaphor by substituting an undefined object with light.

### *4.3. Reflection*

This research is based on the interplay between codes and messages as in Figure 2, as an act of communication between field of discipline A and field of discipline B, producing the need for a converter, so that a transformation can take place briefly from token to token (token production). A converter can be analogous to the role of a translator or architect, but can be more complex in the form of a method or machine. The converter can be a new subject to be investigated further.
While the case study shows the implementation of "Modes of Sign Production" as a method that is able to convert content fields or concepts from other fields of discipline into architecture, hence Modes of Sign Production is a converter method.

## 5. CONCLUSION

The conclusions of the analysis are as follows:
1. The difference between each discipline lies in the material of the continuum or channel.
2. The interdisciplinary process into the architecture requires a *converter* component, which acts to select the appropriate material for a message or content (concept), so that it can carry out the replica process from token to token, code to code or subcode to subcode.
3. By using Modes of Sign Production as a converter method, there can be changes in form while maintaining a concept/proposition content. This is because a replica procedure allows the use of other materials as long as the content/message to be conveyed remains the same.
4. Case studies of The Gherkin Tower and Church of the Light show that the Modes of Sign Production method can accommodate heterogeneity and complexity of knowledge. It can express a content based on *ratio facilis* or *ratio difficilis*.

Architects as receivers can freely choose and form their continuum, thus producing various architectural works according to the chosen continuum and how an architect replicates and expresses the building. The choice of material for a continuum is arbitrary, opening up vast opportunities for the development of architectural science through the invention of new codes.

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# Interdisciplinarity: Umberto Eco's Semiotics Approach in Architectural Design

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