



TEXAS TECH UNIVERSITY™

Department of Industrial Manufacturing
& System Engineering

IE5320

SYSTEMS THEORY

Final - Systems Exercise

ISOMORPHISM

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Abstract: Isomorphism is an essential part of the system theory that promotes knowledge and understanding among different groups. An isomorphic system is a knowledge of how one system works. Successfully modeling that system's structural information to another system assists decision-makers in making critical choices about a system's potential future balance and operation. This paper explains isomorphism by drawing parallels between organizational structures and living organisms.

Introduction: Isomorphism is a formal mapping between complex structures that include equal parts. The word "isomorphism" originates from ancient Greek, where "isos" suggests "equal" and "morphe" means "shape" ("Isomorphism," 2010). Simple working models of the two systems can be seen in the context of living organisms and an organizational structure, as shown below (Figure 1).

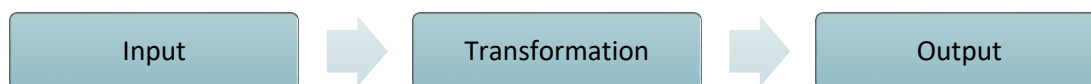


Figure 1: Simple model of living organisms and an organizational structure.

Both systems use a similar working model. The input is loaded into the system, the transformation is done in the system, and the output is generated. This idea is explained further in this paper.

Analysis of Isomorphism in living organisms: The human body is an open system because of its interaction with its surroundings. An open isomorphism system in the human body can be seen with input, transformation (throughput), and output. Such interactions occur in energy transfer, material transfer, and, in this case, stimulus and response, where stimulus enters, and the system generates a response (Allport, 1960). The human body takes in oxygen (O_2) as an input. The inner transformation would be the breathing process. Oxygen is brought into the lungs through the larynx and oxygenated by the blood. Finally, the human body breathes out carbon dioxide (CO_2), an output from the input and respiratory process, as shown in Figure 2 below. The stimulus and response of the human body show a similar structure. When a hand comes into contact with a hot surface, the human body sends messages to the nerves, which interpret the stimuli and react to the heat by immediately withdrawing the hand through muscular motions. In this case, the input is placing the hand over the fire. The stimulus transformation is the nervous system registering the heat. The output responds to the heat by taking the hand off of the fire. Figure 3

depicts an isomorphic structure that is consistent with the model structure.

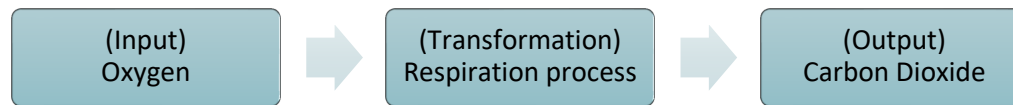


Figure 2: Respiratory process structure

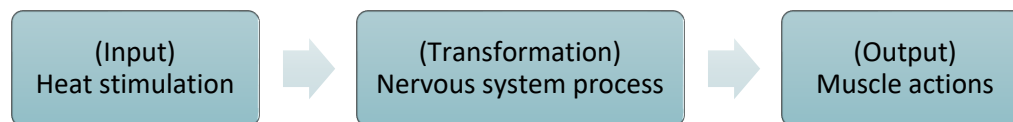


Figure 3: Heat Stimulus-Response Structure

Analysis of Isomorphism in an organizational structure: In terms of strategic, goods, and service features, a company in a specific industry is impacted by its potential clients and competitors, effectively making it an open system. Competition, pricing changes, changes in consumer demand, societal expectations, innovation, and other factors all play a role. Organizations primarily function in the input-transformation-output phase. A developed product that can attract customers is required for a company to function correctly. Raw material/unfinished products will be used as input. The transformation will be the company's activities to achieve the correct refined product that can compete better than other competitors' products and meet consumer demand. These actions rely on product design, development, manufacturing, quality, and supply chain to create the desired product. Consequently, the business will have a unique product that stands out and offers it an advantage in the market. Figure 4 illustrates the flow of input, transformation, and output.



Figure 4: Product Input-Output in an organizational structure

Structural similarities may also be seen in an organization's reaction to a stimulus. Various elements can act as stimuli to prompt certain behaviors in the organization. Essentially, those

components serve as input. The information is then processed and changed into an output related to the desired change. Adaptation is a typical process for organizations triggered by competition, crisis, and prospects. There have been several instances of well-established corporations diversifying their product lines due to the rise of new product prospects, which is the stimulus. The transformation is the company seeing the opportunity and choosing to and taking initiatives to diversify their current product line. The output is creating new items. The phenomenon is shown graphically in Figure 5.



Figure 5: Stimulus-Response in an organizational structure

The present Covid-19 outbreak is an example of an organizational stimulus-response; the globe is seeing a shortage of personal protective equipment (PPE). As China is perhaps the only PPE seller, including domestic and global markets, its industrial output is low. In this scenario, various producers step in to compensate for present shortages. Consequently, companies like Peugeot, Tesla Motors, and other companies manufacture ventilators and coordinate with PPE vendors by modifying current processes to create needed goods (Xu, Elomri, Kerbache, and Omri, 2020). So, in an organization's reaction to a stimulus, Tesla and other manufacturers followed a similar process of one organization to another, be it the result of simulation or independent development under similar constraints, which defines Isomorphism (Bertalanffy, 1968).

Conclusion: According to system theory, identical patterns of system functioning are commonly seen. The system's viewpoint may provide abilities for recognizing these patterns, finding connections, getting to the root of an issue, and eventually resolving it. This analysis shows one of the system's isomorphism concepts using the human body and organizational structures. Both systems are open because they may be influenced by outside forces and follow a similar working pattern of input transformed to generate an output. Stimulus-response models addressed the human body and the process of bringing a new product into an organization. The Isomorphic system is formed when all models in different systems are given the same input components.

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