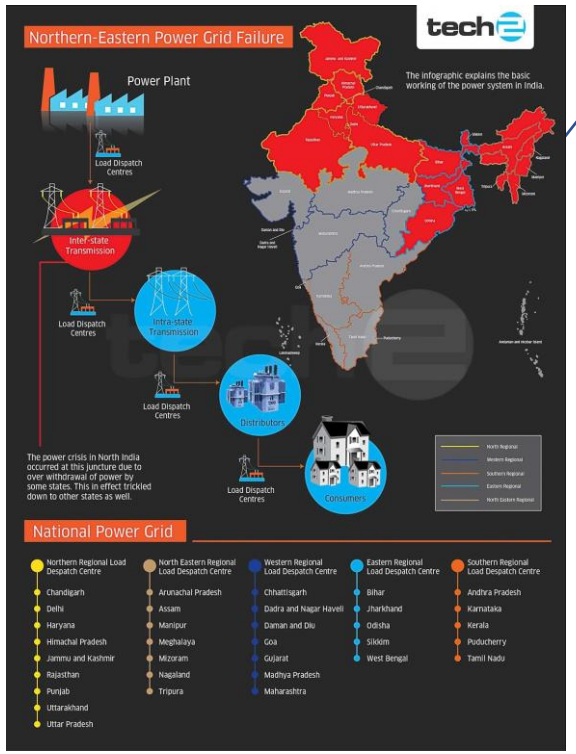
Conceptualizing a system

Class 3, 7th Jan 2019

Kavita Vemuri

For driverless cars to ply on Indian roads, the **system** has to change



Northern Grid power failure, July 30 2012

Certain states in the northern region overdrew power

- possible reasons for overdrawing power is the deficient rainfall, which meant increased use of electric pumps to withdraw water for farming in these agricultural states

- The generation plants, the power grids and the sub-stations have to work in tandem.

An overload results in system failure

Why the railways suffer on an average 100 accidents a year

Over 700,000 people work on safety-related operations at the country's largest employer, according to Indian Railways' response to a Parliament question. A small slip by one of them, or a single flaw in the 66,030km track criss-crossing the country can affect one or more of 10,773 locomotives, 63,046 coaches and 245,000 wagons , jeopardizing the 23 million passengers and three million tonnes of freight that the network carries everyday.

Indian Railways has divided its 66,030km of track into 1,219 sections and out of these 492 are running at 100% capacity, in some cases more. Most accidents occur on these over-capacity routes

EXAMPLES

- Engineering: https://www.youtube.com/watch?v=8lFLV6yApsI
- Human engineering marvel: https://www.youtube.com/watch?v=-K-QIwXoGHE
- Human engineered systems: https://www.youtube.com/watch?v=5pn8qAKL0V4

How to Characterize a System?

- Attributes – The term *attributes* classifies *functional* or *physical* features of a system. Examples include gender; unit cost; nationality, state, and city of residence; type of sport; organizational position manager; and fixed wing aircraft versus rotor.
- Properties – The term, *properties*, refers to the *mass properties* of a system. Examples include composition; weight; density; and size such as length, width, or height.
- Characteristics – *Behavioral characteristics* examples include predictability and responsivity.

– *Physical characteristics* examples include equipment warm-up and stabilization profiles; equipment thermal signatures; aircraft radar cross sections; vehicle acceleration to cruise speed, handling, or stopping.

Class exercise – 20 minutes

- Take any system of your choice and

(a)list out at least 10 of its attributes.

(b) Pick 3 non-functional attributes and explain briefly why they are important to your system.

The difference is that **non-functional requirements/attributes describe how the system works**, while **functional requirements/attributes describe what the system should do**.

Examples:

non-functional: a laptop keyboard must not break under some X weight or pressure.

Functional: The external button of the keyboard should make electrical contact with the inner circuit when tapped.

Representation of a System

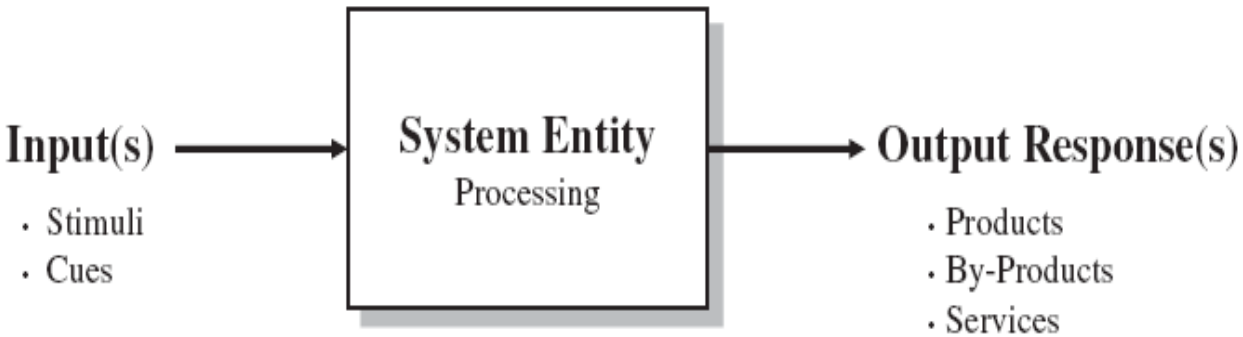


Figure 3.1 Basic System Entity Construct

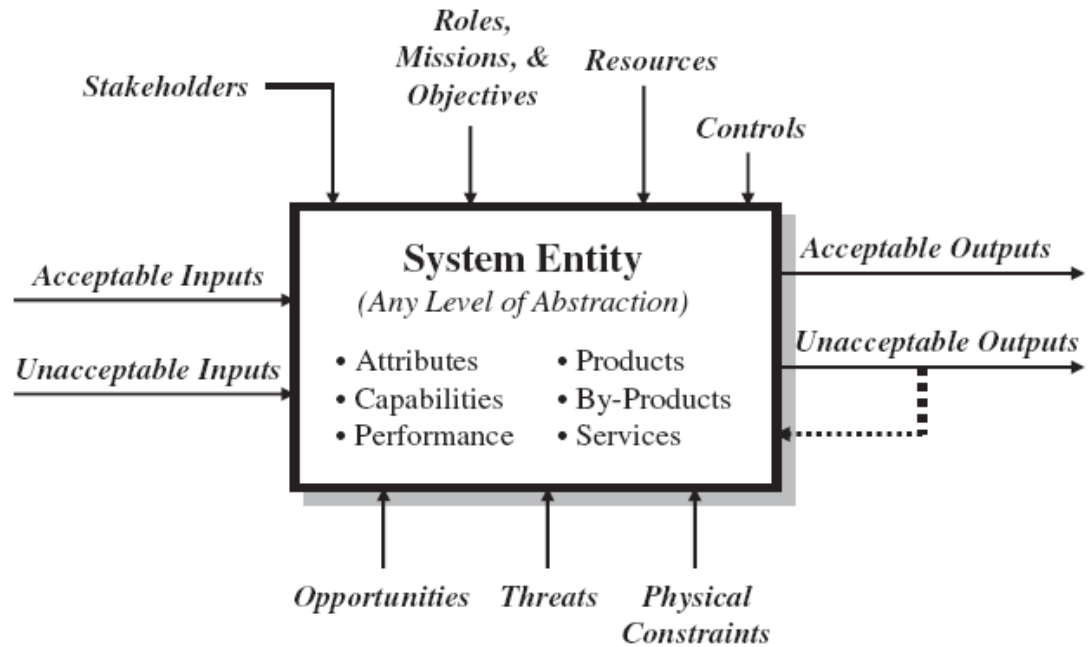


Figure 3.2 Analytical System Entity Construct

Definitions – attributes, properties and characteristics

- System Benefactors: Every system has at least one or more benefactors such as owners, administrators, operators, and maintainers, who benefit from its behavior, products, by-products, or services
- System life cycle: Every system, product, and service has a life cycle that depicts its level of maturity.
- System missions: Every system performs missions in fulfillment of its purpose to achieve outcome based performance objectives established by its owner and Users.

Definitions – attributes, properties and characteristics

- Mission goals and performance objectives: Each system and mission must be characterized by a set of goals and objectives, preferably documented. *Goals* and *objectives* provide the performance fundamental basis for resource expenditures by the system owner and shareholders based on a planned set of multifaceted accomplishments and an expected return on investment(ROI). Each goal must be supported by one or more specific objectives that are *quantifiable*, *measurable*, *testable*, and *verifiable*.
- System utility: Every system must provide a physical, psychological, sociological, financial, and economic *value-added utility* to its User. System utility includes ease of use,usefulness, etc.