Systems Thinking for Design

Session 6

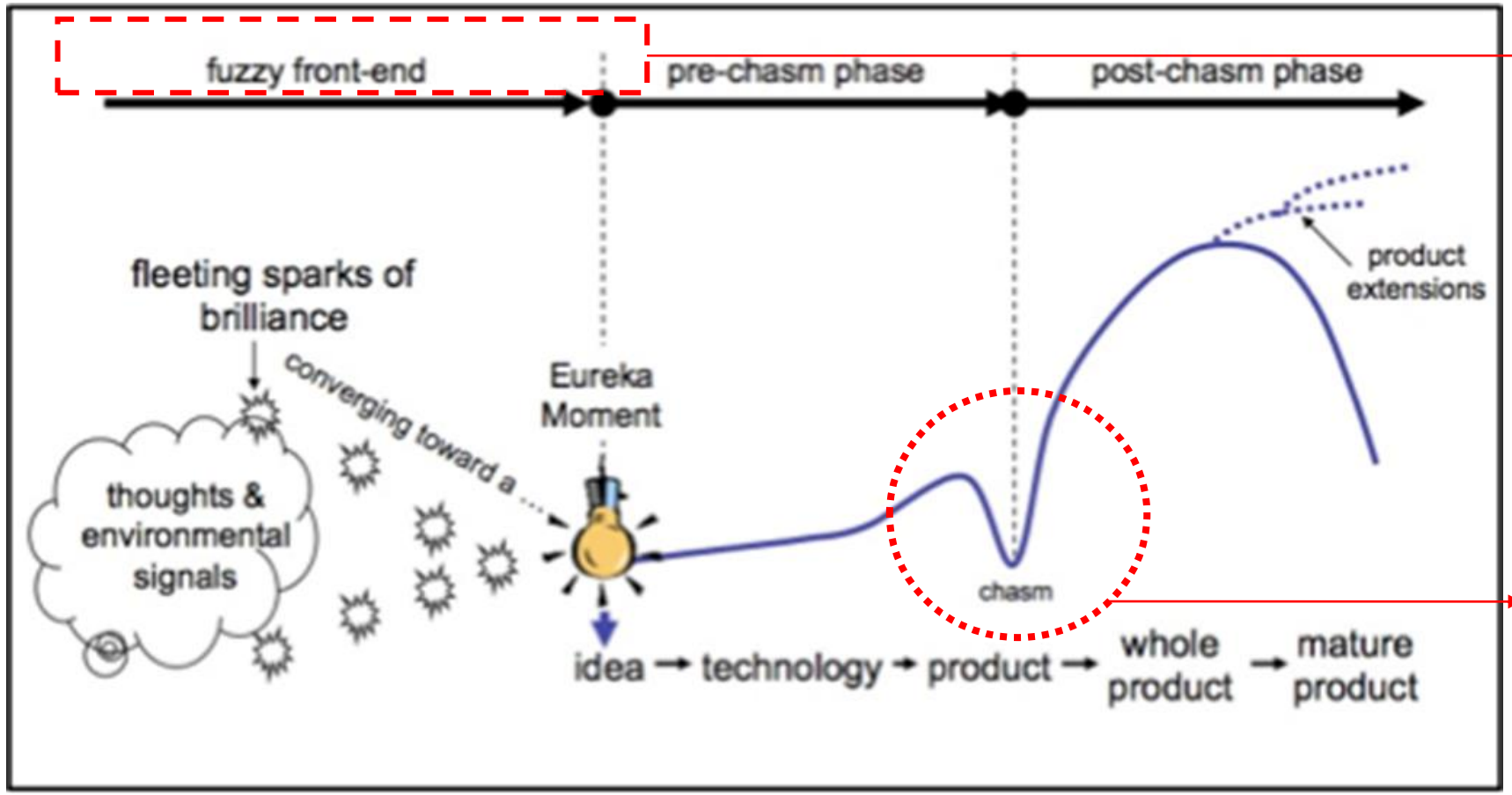
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY,
DESIGN AND MANUFACTURING,
KANCHEEPURAM

- Dr. Karthik Chandrasekaran

Session outline

- Moving from discovery to diagnosis
- Understanding the Context: Stakeholder Analysis

Recap of sessions so far (1/2)

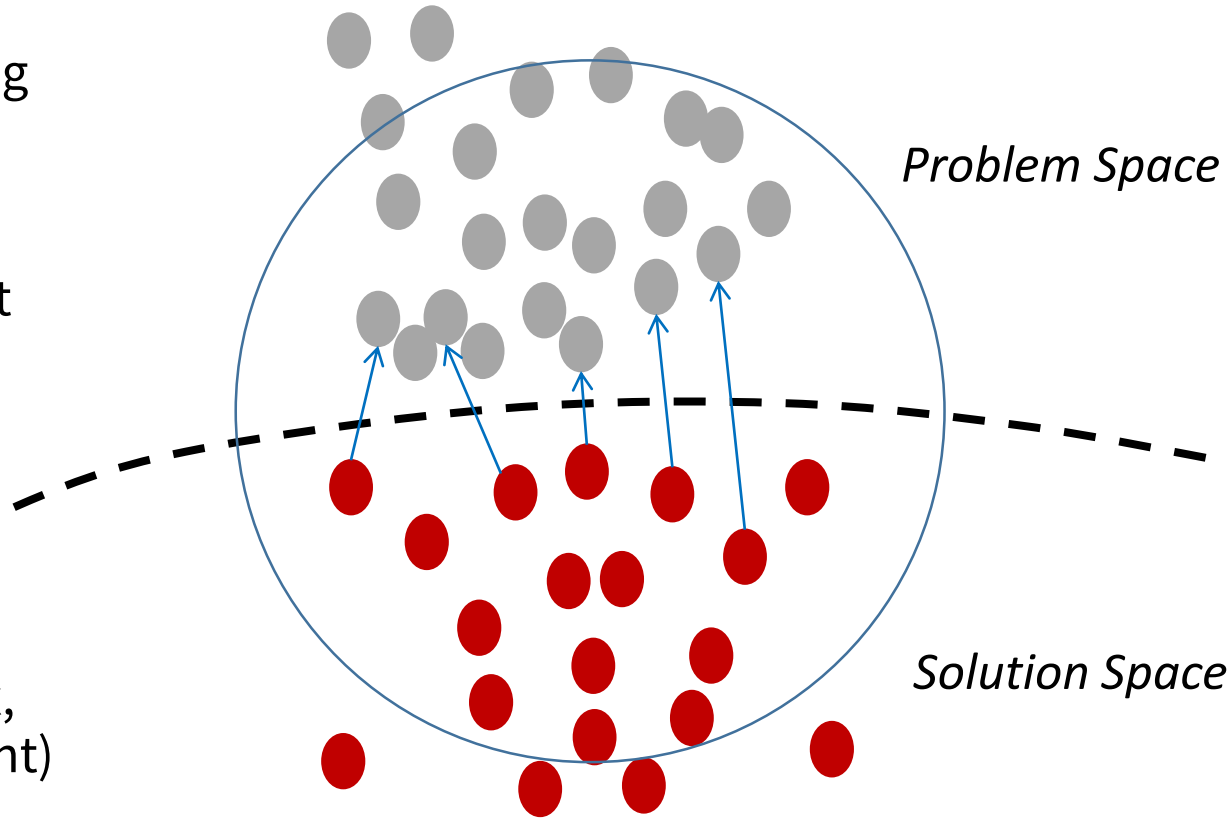


We, hopefully, learnt more about the fuzzy front-end of product innovation, and the importance of discovering or understanding a problem context

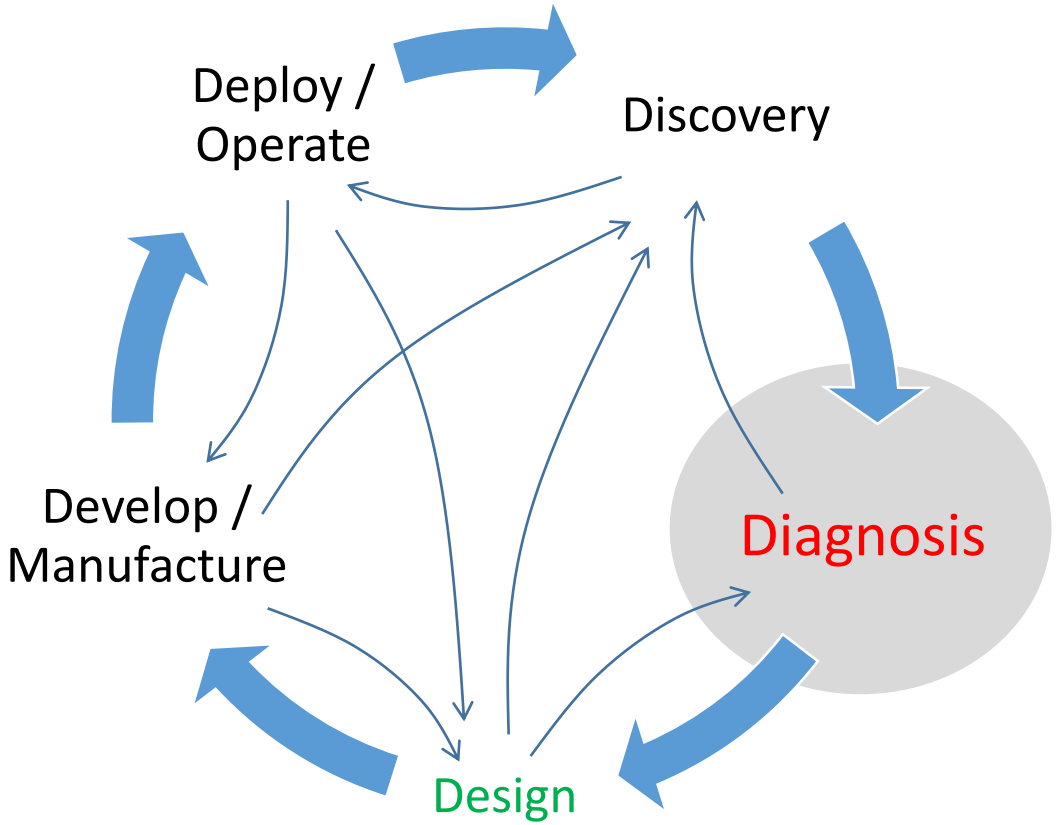
Incubators try to help startups deal with challenges in this stage

Recap of sessions so far (2/2)

- Understanding self, identifying an area of interest, seeking collaboration and negotiating problems of interest (1-3)
- Observing, listening & discovering more about the problem and its context (historical, social, economic, technological trends) in a non-judgmental way (4)
- Checking for completeness and summarizing problem understanding with Discovery Matrix, Basic Systems Principles (System, Environment) (5)



What next? Why another step before design?



- Aspects to probe in the discovery matrix
  - *What is the real system-of-interest?*
  - *What are its unique characteristics, context, constraints?*
  - *What are the high leverage parts-relations that can drive holistic change?*
  - *What is the likely purpose of the system?*
- Why do we do this?
  - It is only through a deeper understanding of the problem situation that you can define the problem in a creative way … in other words, frame the problem statement or “Design Challenge”


#CAPUCCINO
Protein Shake

Tea

non-coffee/tea

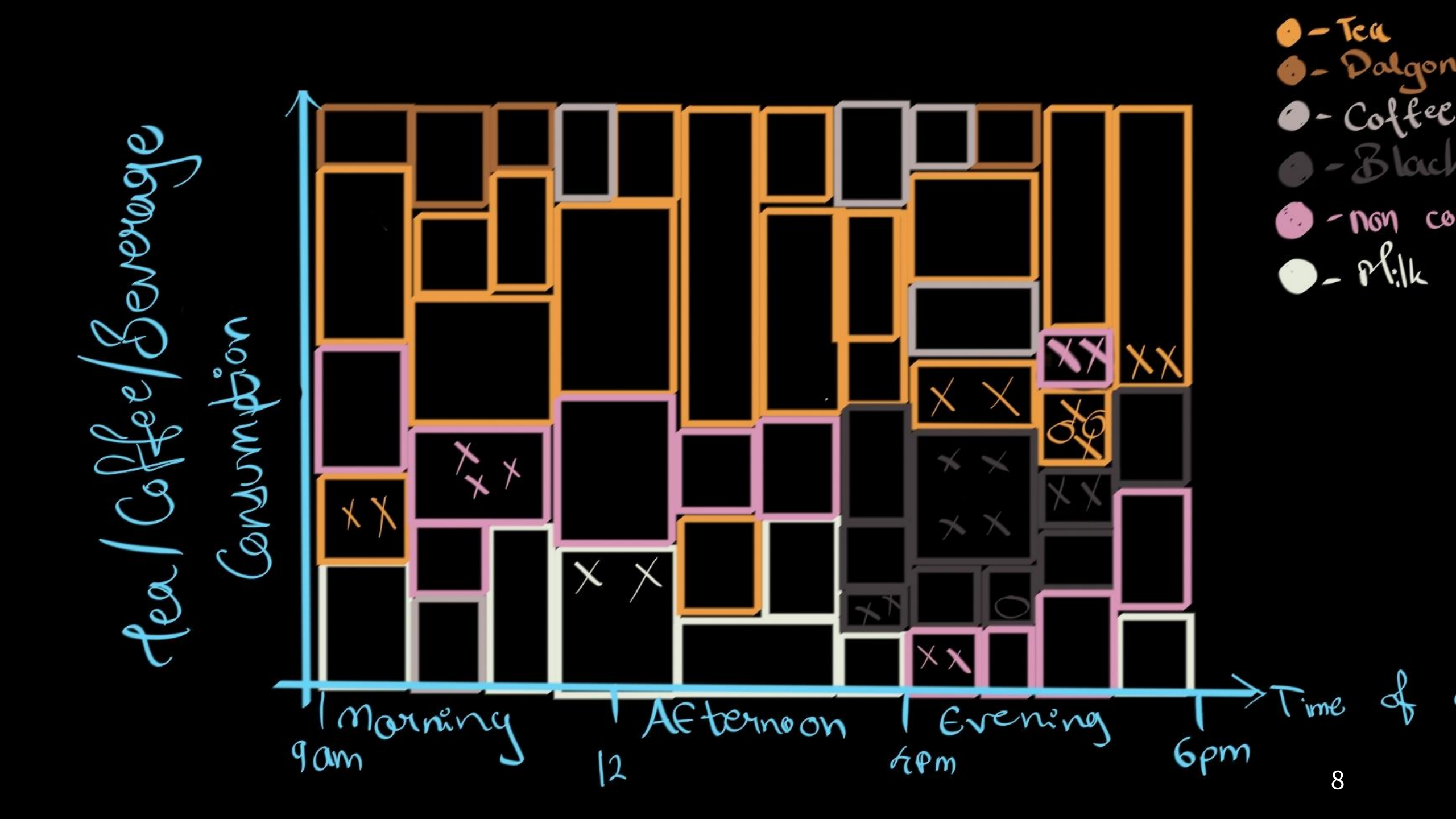
Coffee

XX= 2+ cups in one img

O = Snack

Black Tea

Milk


Tea / Coffee / Beverage Consumption
- Tea
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Morning
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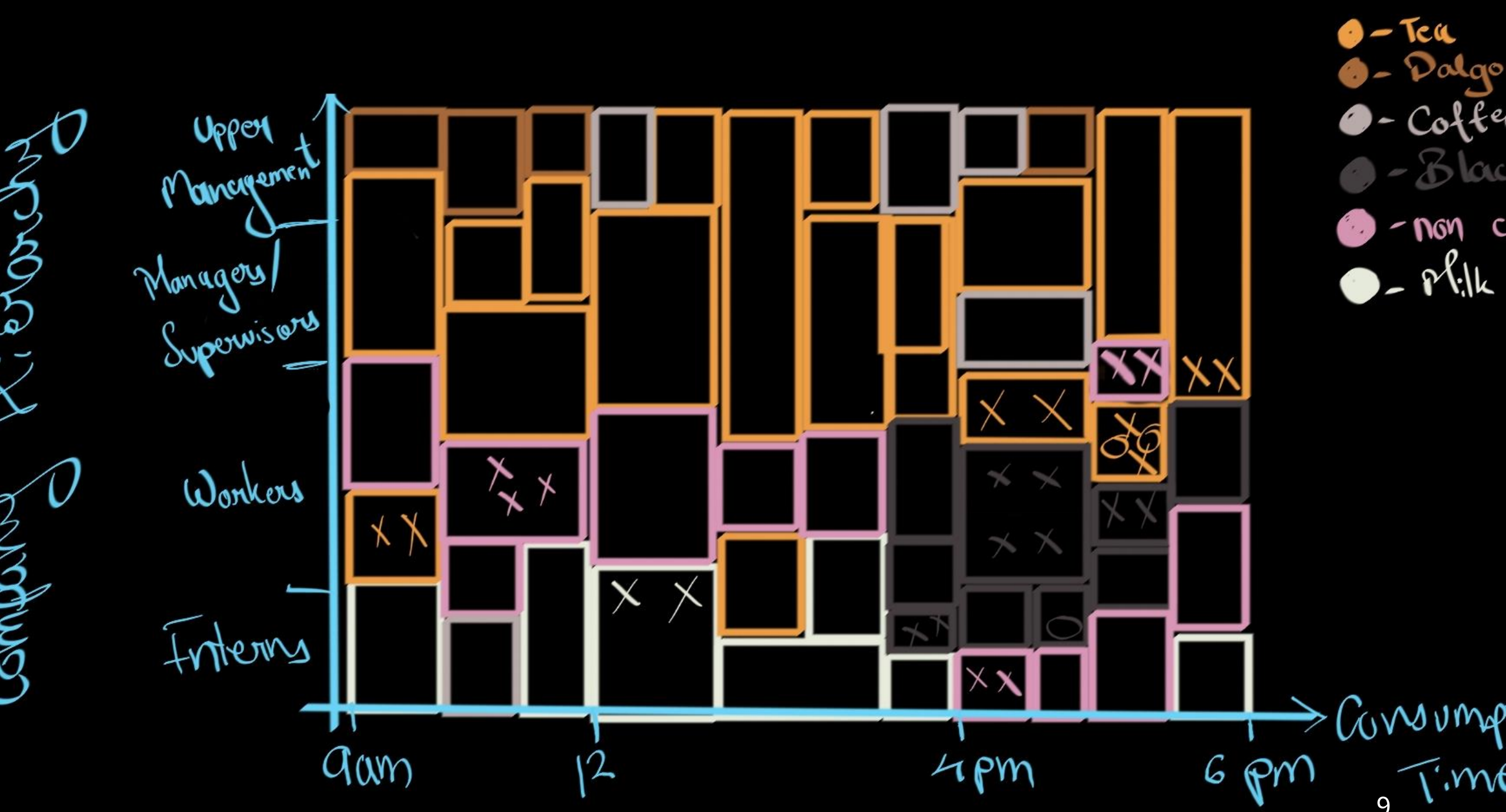
Upper Management
Managers/ Supervisors
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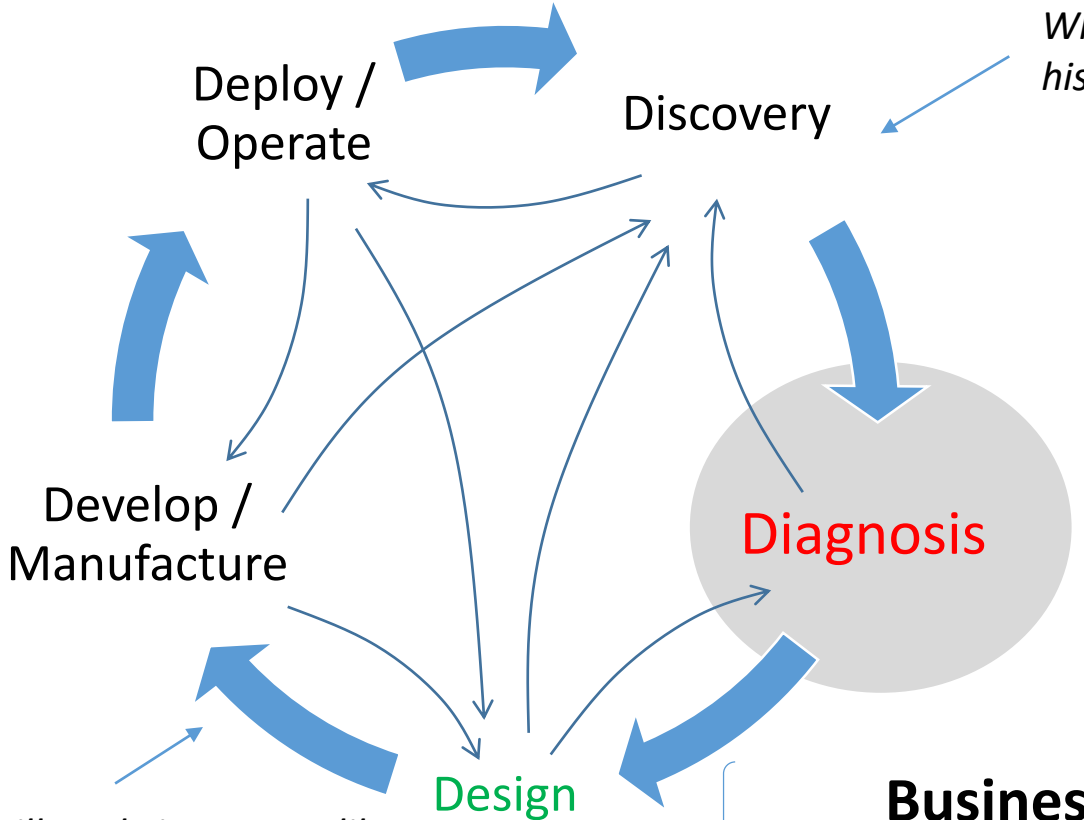
How do we do diagnosis?

- By analyzing the discovery matrix for patterns of relationships

- Using multiple methods such as
  - Stakeholder Analysis
  - Cybernetic (Feedback) Analysis
  - Network Analysis

How can we leverage other disciplines to improve problem solving?



What you studied in design history should be applied here

Matrices & Graph Theory

What you are studying in Engineering Economics should be applied here

What you will study in courses like Algorithms & Data Structures, DSP, Materials Science, Mechanics will help here

Business Case for a potentially innovative product, service or solution

Session outline

- Moving from discovery to diagnosis
- Understanding the Context: Stakeholder Analysis

Understanding the context

Complexity is the result of interactions among stakeholders

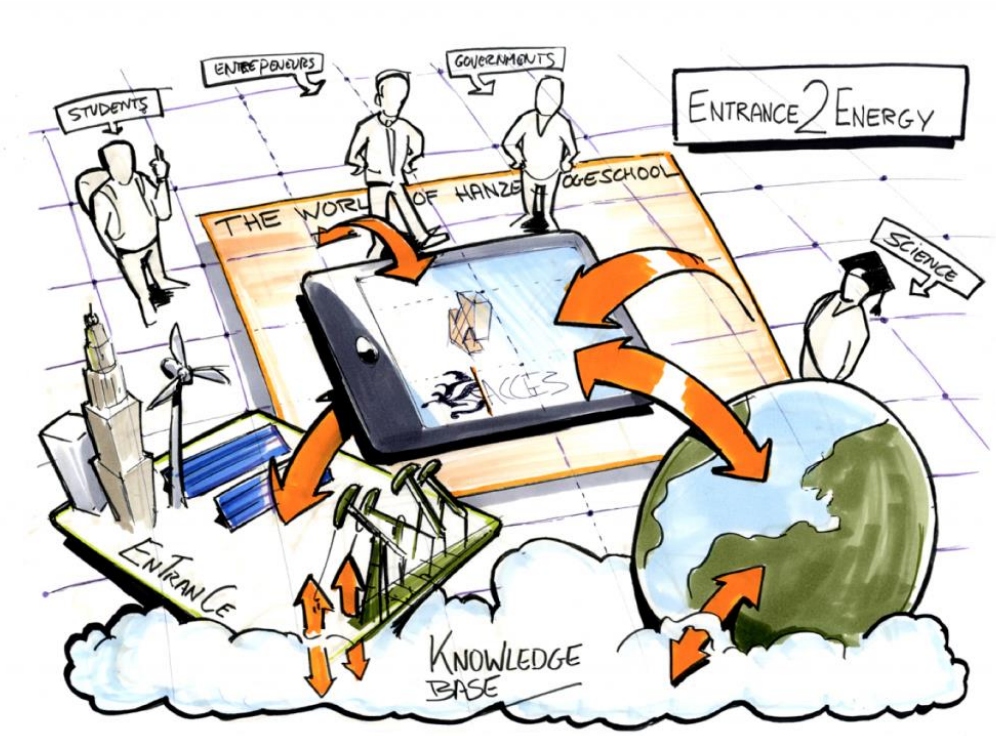
- Several interest groups can be present in a situation
- Customers views can be different from employees views
- Departmental objectives may only convey internal perceptions

Important to recognize the constraints in a situation

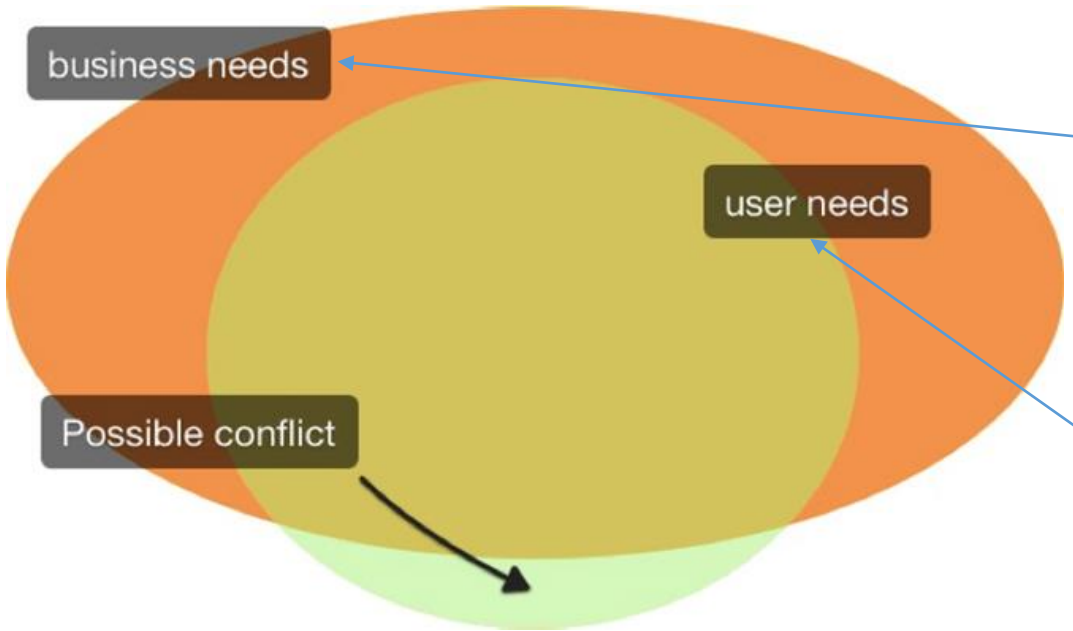
And distinguish between constraints and alterables (solution options)

Who is a Stakeholder?

- Individuals, groups or agencies who have a stake in the system-in-focus
  - Their needs have to be fulfilled by the system eithe by choice or by obligation
- Those who will be affected by the product or solution
  - They may or may not have a role in product / solution formulation
- Over time mismatches could emerge between organizational or departmental objectives and their stakeholders



What are the Needs of Stakeholders?



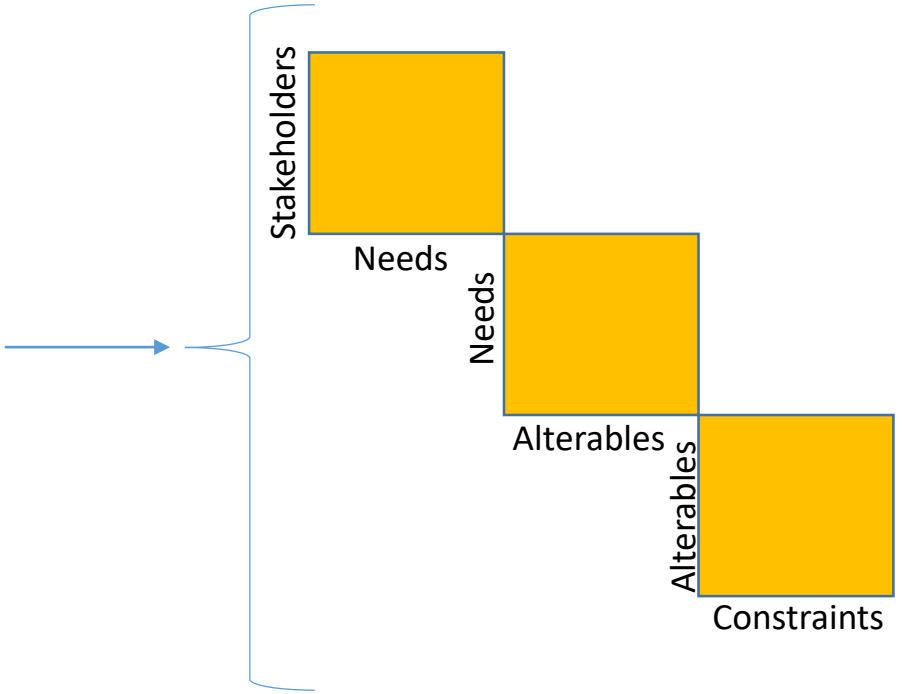
- NEED Refers to the requirements of stakeholders which are to be fulfilled by the system-in-focus
- Fundamental Needs
  - The fundamental reason why stakeholders are associated with a system
- Operational Needs
  - Related to existing responsibilities of departments
  - Operational needs arise due to changes in fundamental needs (of existing or new stakeholders)

Alterables and constraints

- Alterables
  - Parameters, events or processes that can be controlled or altered to fulfill the needs
  - Alterables are different from alternatives. One alterable can have multiple alternatives
- Constraints
  - Limitations imposed by factors that are not controllable by the system-in-focus
  - The time factor separates constraints from alterables

Using Stakeholder Analysis for Diagnosis

- Categorize the key elements (identified from problem description) into:
  - Stakeholders
  - Needs
  - Alterables
  - Constraints
- Refine the discovery matrix by exploring the four categories
  - S x N x A x C matrices
- Develop a list of system objectives by combining Needs, Alterables & Constraints
  - Ex: To “address a need” through “an alterable” … constraints define the extent of achievement



Exercise 6.1

- Classify elements in the discovery matrix by S,N,A,C. Identify missing stakeholders or needs or alterables or constraints

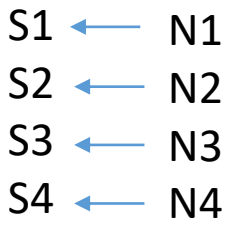
Stakeholders	Needs of stakeholders	Alterables for the system-in-focus	Constraints for the system-in-focus
S1. Customer	N1.1 Clean streets	A1. Improve collection	C1. Street size/layout
	N1.2. No health hazards		
	N1.3	A2. Local treatment	C2
S2	N2.1…		
S3.	N3.1…	A3. Spray disinfectant	C3. Limited resources
S4			
S5		A4	C4

Inferring from Stakeholder Analysis (1/3)

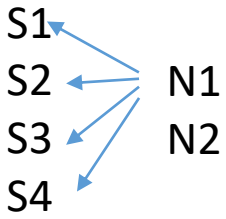
- Boundary Analysis: Does it provide clues about the system-of-interest?
  - What is the domain of interest?
  - What is the problem of interest?

- Stakeholders & Needs: Are they diverse, conflicting or concentrated and aligned? Which stakeholders are most critical and who can be ignored? Who is the customer?

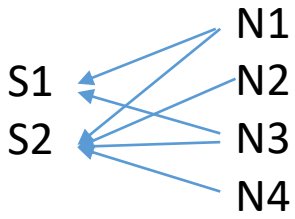
Diverse set of stakeholders & needs



Needs with high out-degree, Potential for conflict



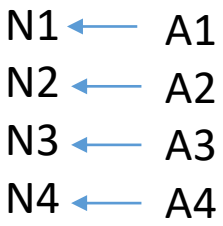
Stakeholders with high in-degree, Possibility of Alignment



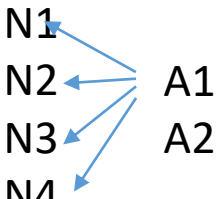
Inferring from Stakeholder Analysis (2/3)

- Alterables: Check the out-degree and in-degree of alterables

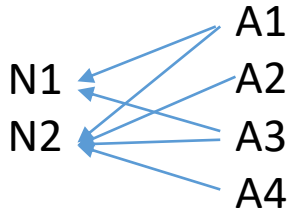
Diverse needs – rethink system boundary



Alterables with high out-degree, Advantageous



Needs with high in-degree, Multi-pronged approach, Dependencies



- Constraints: Do they point to unique aspects of the problem & limits to change?
  - Are constraints within the system or in the environment?
  - Identify those which have a high out-degree?
  - Check if they affect the high out-degree needs or high in-degree stakeholders?

Inferring from Stakeholder Analysis (3/3)

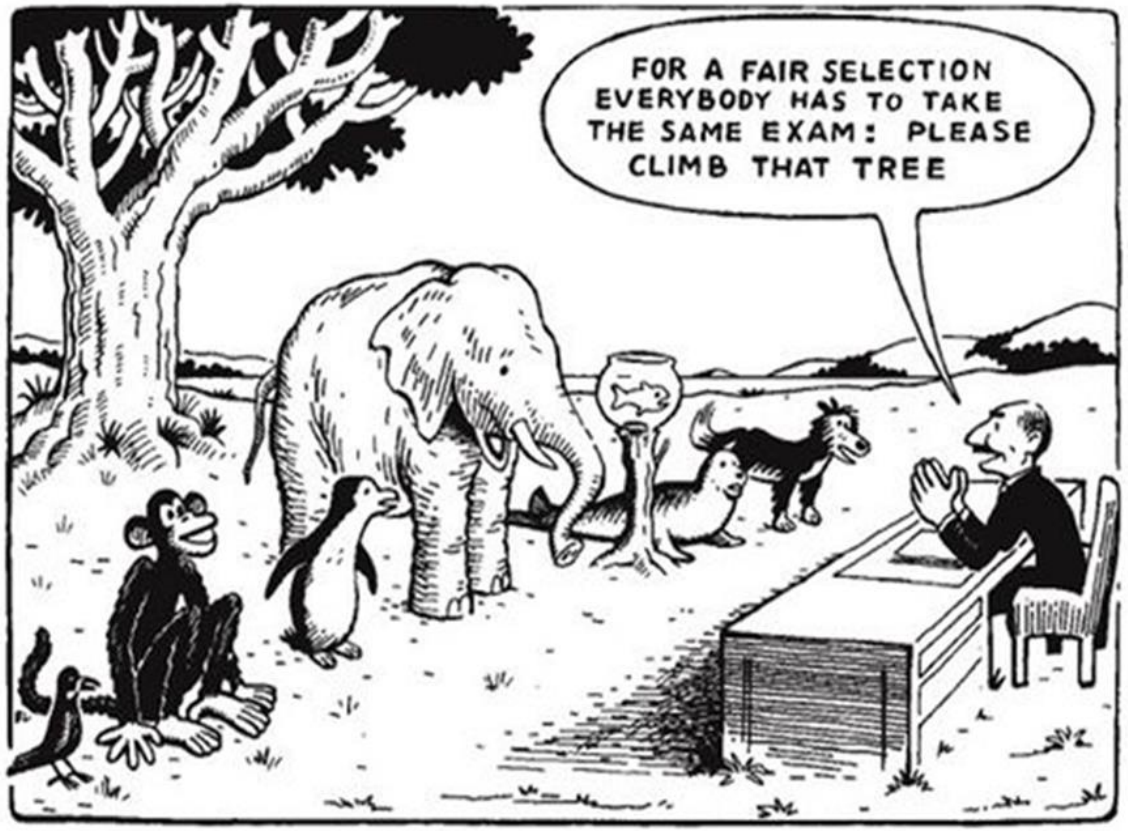
- Formulate objectives by combining needs, alterables and constraints
  - An objective is ***To "satisfy the need of a stakeholder" by "modifying an alterable" within "the given constraints".***

- Once all combinations are formed, refine and reduce the set of objectives (what the system should do) to about 20-25 most important ones

- Analyze the objective set to see if it provide clues about purpose of the system, its unique aspects and critical success factors

Exercise 6.2

- Derive inferences about your problem from the SNAC matrix



The problem solver or designer should overcome the tendency to use their constraints as an excuse to avoid understanding the unique characteristics of their clients

Interactions with stakeholders and more fine grained observations of their everyday work can help question the obvious and explore alternatives

Stakeholders & Needs of a naval refit unit

NHQ / Ship Staff

- Attention to maximum defects
- Quality and timely delivery of ships after refit
- Shore supply services (water, electricity, etc.) from dockyard
- Single point contact before, during and after refit

NHQ / WNC / ENC

- Timely delivery of ships with desired quality to maintain balance of force
- Minimum number of postponements
- Transparency in operations of dockyard

Planning & Production Control

- Standard defect lists or updated matrix units
- Draft Key Schedule for a particular refit
- Timely accessibility to information on resources available at Production Centers, Service & Support Centers and Dry Dock Facilities
- Timely and reliable feedback on shop floor status from Production and Service & Support Centers on each WI and material status

MSB

- Accurate requirements for materials and spares (quantity, specification) from Naval Dockyard
- Return of unused material
- Standardization of material and spares
- Consolidated and phased requests for material/spares

Controller of Defence Accounts (CDA)

- Transparency in operations
- Authentic information on manpower sanctions and actuals

Industrial / non-industrial workers, supervisory staff and civilian officers

- Due consideration for experience
- Higher responsibility and training for the same
- Respect from younger service officers
- Training for higher responsibilities – supervisory and managerial
- Healthy working conditions
- Skill Training
- Minimum off-loading of work

Alterables

- Materials planning (how much, from whom and when)
- Maintain database of past problems on refit and the material used.
- Maintain database on past delivery schedules from MSB and other suppliers for various types of material
- Computerization and networking of departments
- Channeling similar material requirements through a single source

- Resource allocation/utilization
- Recruiting younger people
- Training – multi-skill, managerial, computer
- Fresh talent – lower age group
- Higher position for civilian officers
- Relocation of people
- Facilities planning/grouping
- Trained manpower from training center

- On line inventory control with access to each shop floor
- Local purchase
- On-line access to ship movement plan
- Out sourcing vessel maintenance
- Computerized data base on casual workers
- Comprehensive personnel database
- Computer operators and resources
- User friendly system for different types of analysis

- Conduct training courses during lean periods
- Streamlined systems and procedures
- Simple impact analysis models
- Guidelines on contract work
- QA guidelines
- Mode of appraisal
- Budgets
- Cost accounting and reporting procedures
- On-line connectivity with stores

Constraints

- Lack of documentation on foreign equipment and material.
- Actual material requirements not known till the opening of equipment at dry dock
- Non standardized nature of equipment /defects.
- Materials procurement policy of NHQ (dependence on MSB)
- Lead time for the supply of material by MSB and other agencies

- NHQ policy – on class of ships, changes in priorities
- WNC policy
- Apprentice Act
- Frequent changes in officers placement
- Location in Mumbai (on costs, availability of people)
- Inconveniences to people (travel/health) and operational difficulties due to maximum load taken up in monsoon
- Dry dock facility

- SRO (Statutory Recruitment Order – criteria for recruitment)
- Shortage of skilled man power
- Selection of proper external agencies for maintenance
- Non-availability of spares and inventory status
- Complaint over verbal communication.
- Delay in availability of ship movement detail.
- Non-availability of vehicles

- Physical spread of dockyard for regular monitoring
- Untimely change in ship movements
- Availability of vessels
- Maintenance of vessels during heavy work load
- Limited supply of feed water
- Difficulty in maintaining casual labor details
- Some naval specifications are not in conformity with IS/BS specifications.
- Shortage of alternate sources of suppliers

Sample system Objectives & measures

ASD

- To abide by NHQ policy/priorities
  - No. of Deviations concerning departments, management, employees
- To improve flexibility in maintaining balance of force
  - No. of ships under refit class wise
- To minimize dependency on foreign agencies
  - No. of depending foreign agencies
  - % materials / spares / equipment procured from foreign agencies

DGM (PL/PP), COSM, PRMs

- To improve accuracy of key schedules taking into consideration actual work load
  - Percentage of deviation between actual and estimated
- To standardize defects list to ensure minimum deviation between planned and unplanned defects
  - % of defects standardized
- To minimize slippage in schedules by reducing lead time in organizing resources
  - Average lead time

DCY, CoY

- To assess information on ship requirements (fresh water, feed water, fuel requirements)
  - No. of deviations from actual requirements
- To improve dry dock utilization
  - % space unutilized
- To identify new technologies for shop floor equipment
  - No. of equipment identified for new technology
  - No of new technologies identified

Summary of stakeholder assessment

- The ranking of processes (in terms of objectives)
  - Planning & production
  - Human Resources
  - Yard Services
  - Materials
  - Quality Assurance
  - Information Systems
  - Costing and Auditing.
- About 60 percent of objectives were related to Planning, Production and HR processes indicating their criticality in overall improvement

Reflect on today's session and post your comments