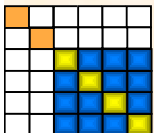


FROM STAKEHOLDERS TO FUNCTIONS

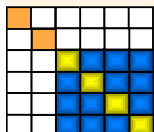
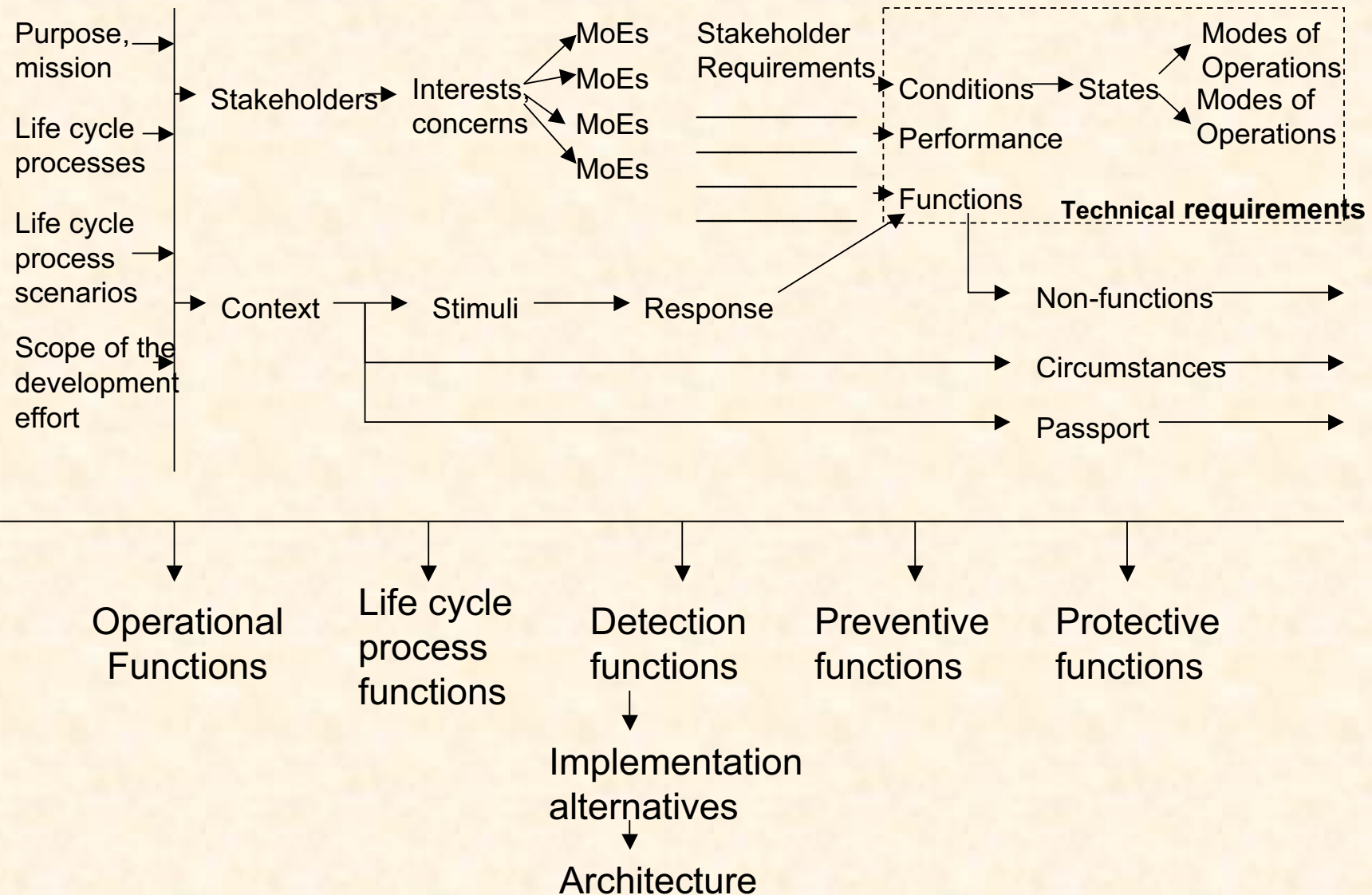
By

Geilson Loureiro, PhD

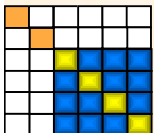
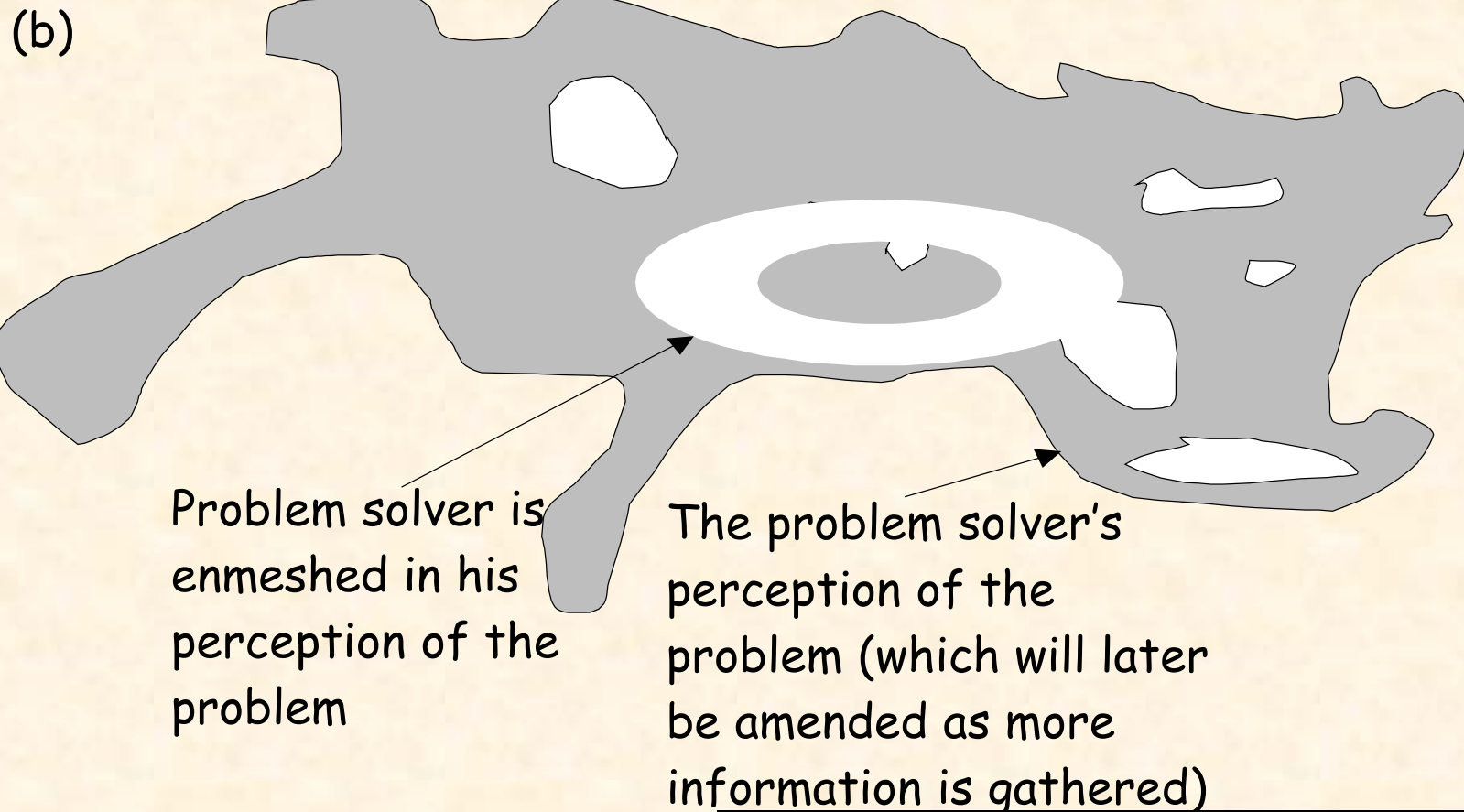
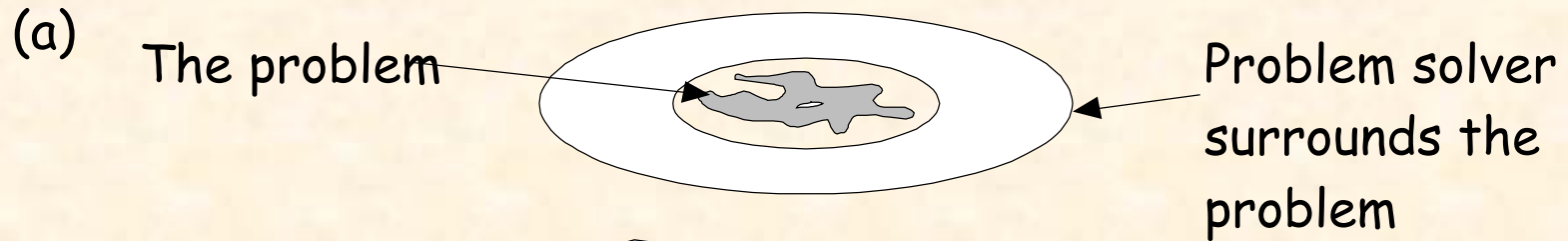
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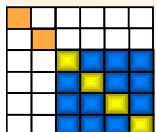
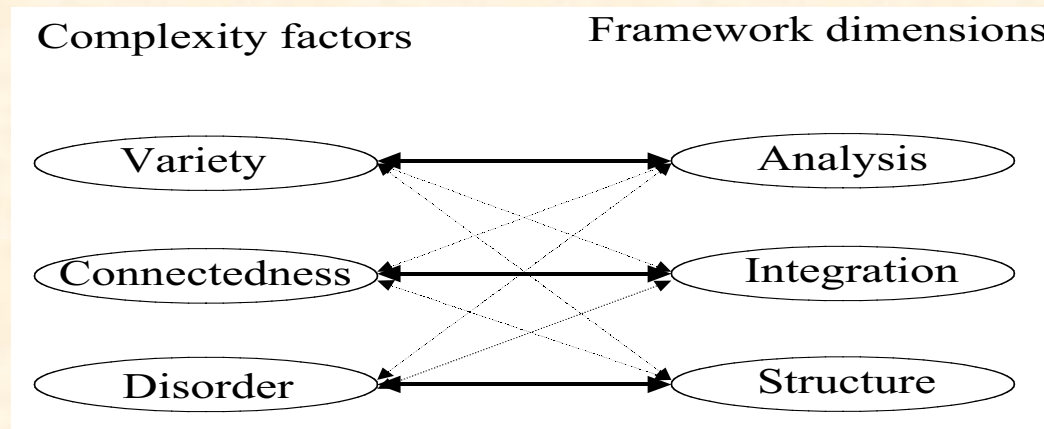
OVERVIEW



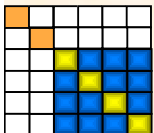
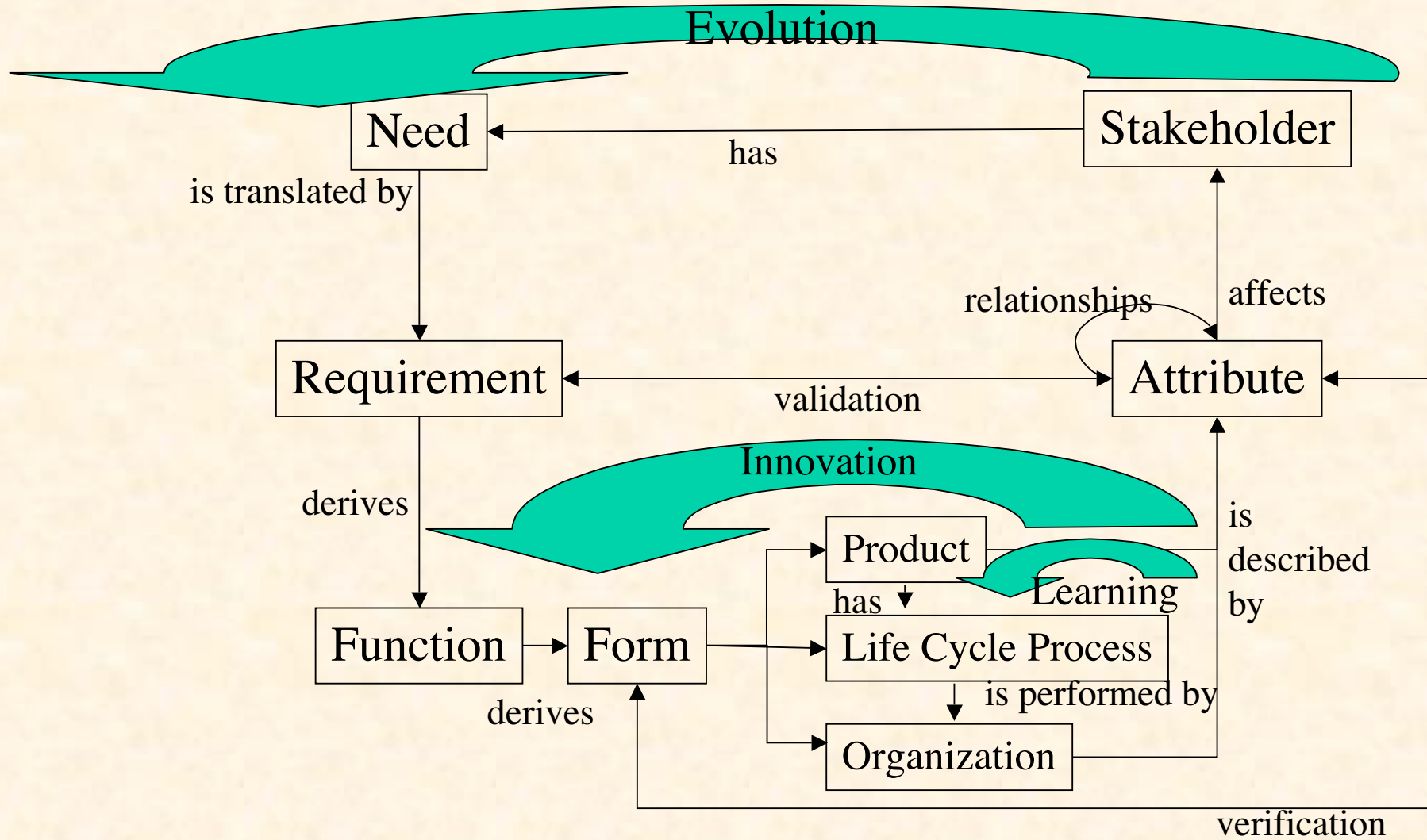
COMPLEXITY ESCALATES



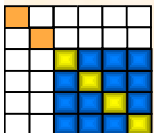
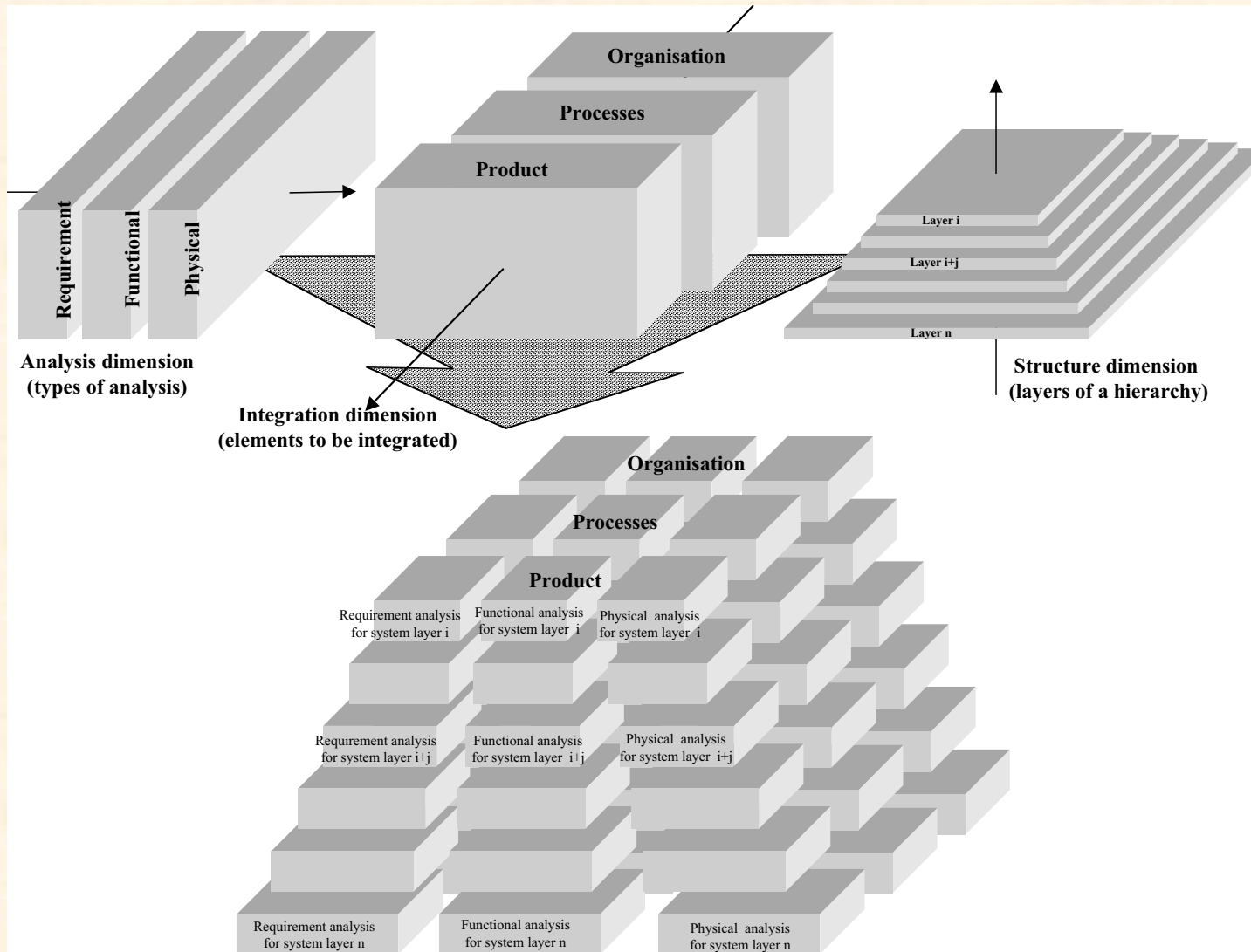
COMPLEXITY MANAGEMENT FACTORS AND DIMENSIONS



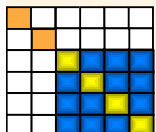
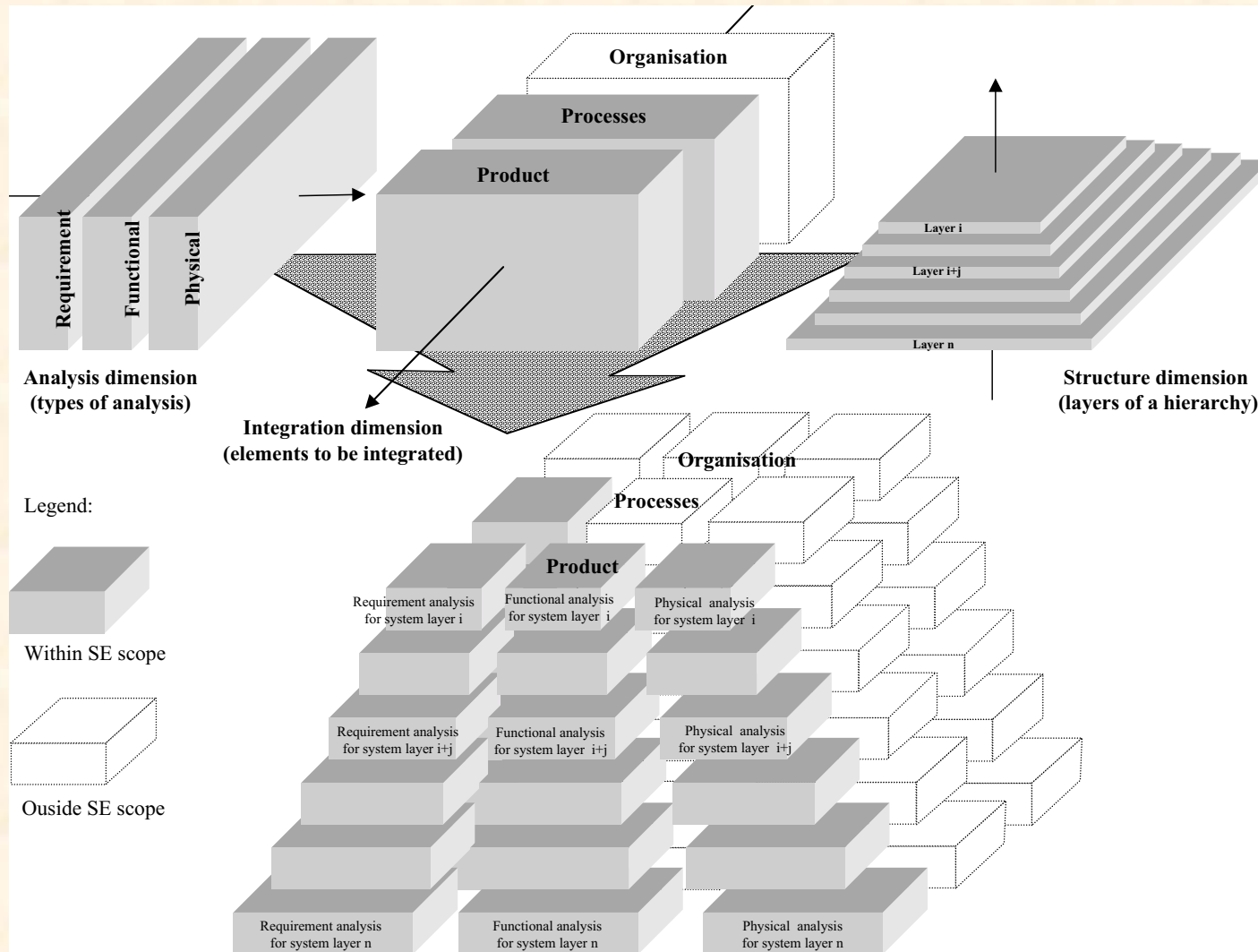
MODEL OF INTEGRATED DEVELOPMENT



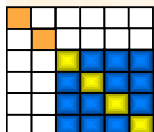
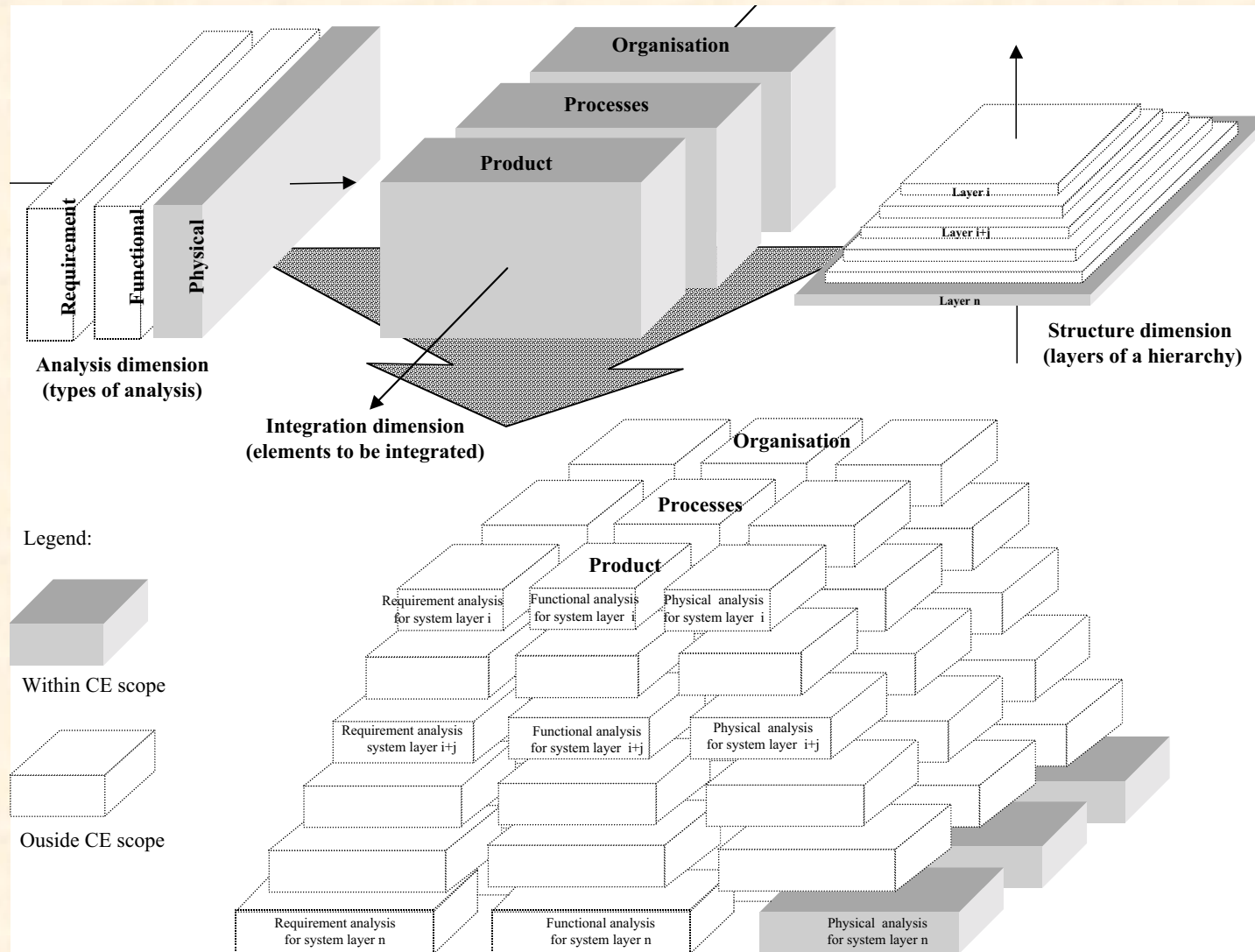
INTEGRATED DEVELOPMENT FRAMEWORK



SYSTEMS ENGINEERING



CONCURRENT ENGINEERING



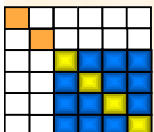
SYSTEM

Every system performs a purposeful action, called **function**.

The function is the objective or purpose of a system

The function of a system must be explicitly defined and understood so that system elements may provide the desired **output** for each given set of **inputs**.

Once defined, the objective or purpose makes it possible to establish a **measure of effectiveness** indicating how well the system performs.

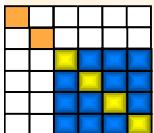


SYSTEM

Consists of a *group of interdependent items* that together are a functional unity

The *functional boundary* is what determines the definition of a system in a given application

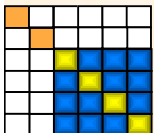
Systems are composed of *elements, attributes e relationships.*



SYSTEM:

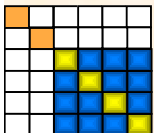
The elements are the operational parts of a system consisting of **input**, **process** and **output**.

Each element may assume a variety of **values** to describe the **state** of the system established by a control action and one or more constraints.



SYSTEMS ENGINEERING

IS AN INTER AND
MULTIDISCIPLINARY
COLLABORATIVE ENGINEERING
APPROACH FOR DERIVING,
EVOLVING AND VERIFYING A
SYSTEM-SOLUTION BALANCED
OVER ITS LIFE CYCLE AND THAT
SATISFIES STAKEHOLDER
EXPECTATIONS



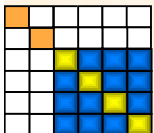
Stakeholder Analysis

Who are the stakeholders?

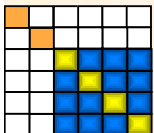
What are their stakes?

What are the opportunities and challenges of the stakeholder relationship?

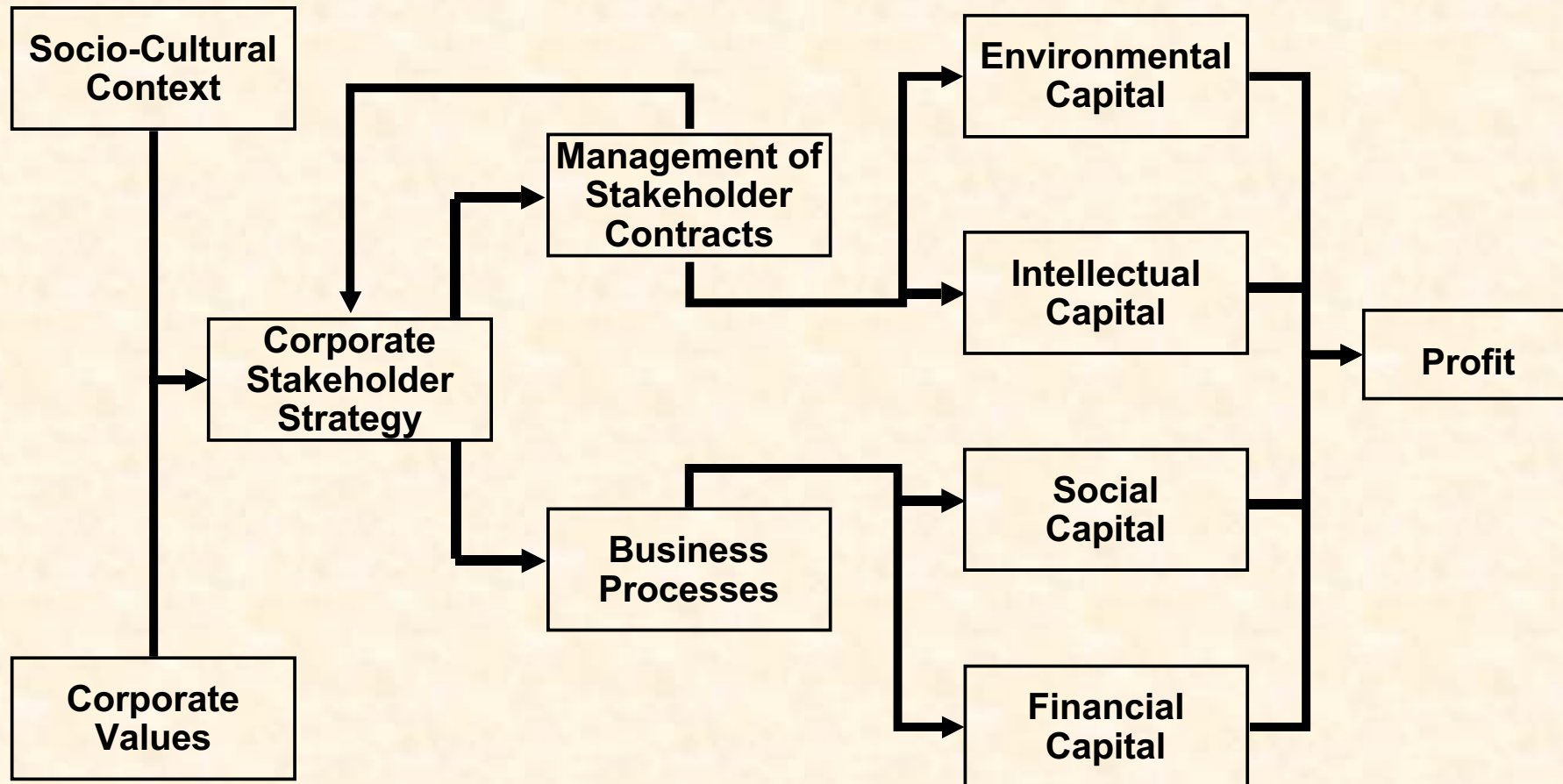
How to organize in order to face opportunities and challenges?



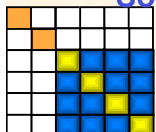
-
- Corporate organizations are:
 - a **network** involving **multiple participants** and **interests**, each of which may take **contributions** and receive **rewards** as a result of corporate **activity** [Donaldson, T. & Preston, L., leading stakeholder theorists]
 - Stakeholders are:
 - individuals or groups who
 - can affect or be affected by
 - a product over its life cycle or by [Ulrich & Eppinger, 1991]
 - the product life cycle process performing organization's activities [Svendsen, 1998]
 - Most common set of organization's stakeholders [Svendsen, 1998]:
 - investors
 - employees
 - customers
 - suppliers
 - communities



A MODEL OF STAKEHOLDER CORPORATION BEHAVIOUR



Source: Svendsen, A. *The stakeholder strategy*, Berret-Koehler Publishers, San Francisco, 1998. ISBN: 1-57675-047-7



REQUIREMENTS (EIA 632-1)

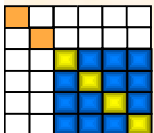
"Total set of considerations that govern:

What is to be accomplished;

How well it is to be accomplished;

Under what conditions it is to be accomplished;

Logical and physical characteristics of the system."



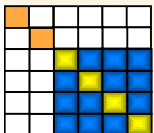
FUNCTIONAL REQUIREMENTS

actor + verb + object upon which function is applied

Behaviour

Effect

Action or service

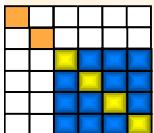


PERFORMANCE REQUIREMENTS

Measure of function fulfilment

How well, quantity, duration, frequency

Ranges or measure values applied to the function to be performed and, if appropriate, to the object acted upon by the function



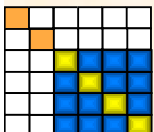
CONDITIONS

Under which conditions a function must be carried out to produce a given level of performance

Environment

Cause to start a function

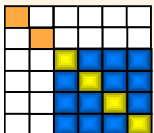
Cause to terminate a function



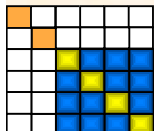
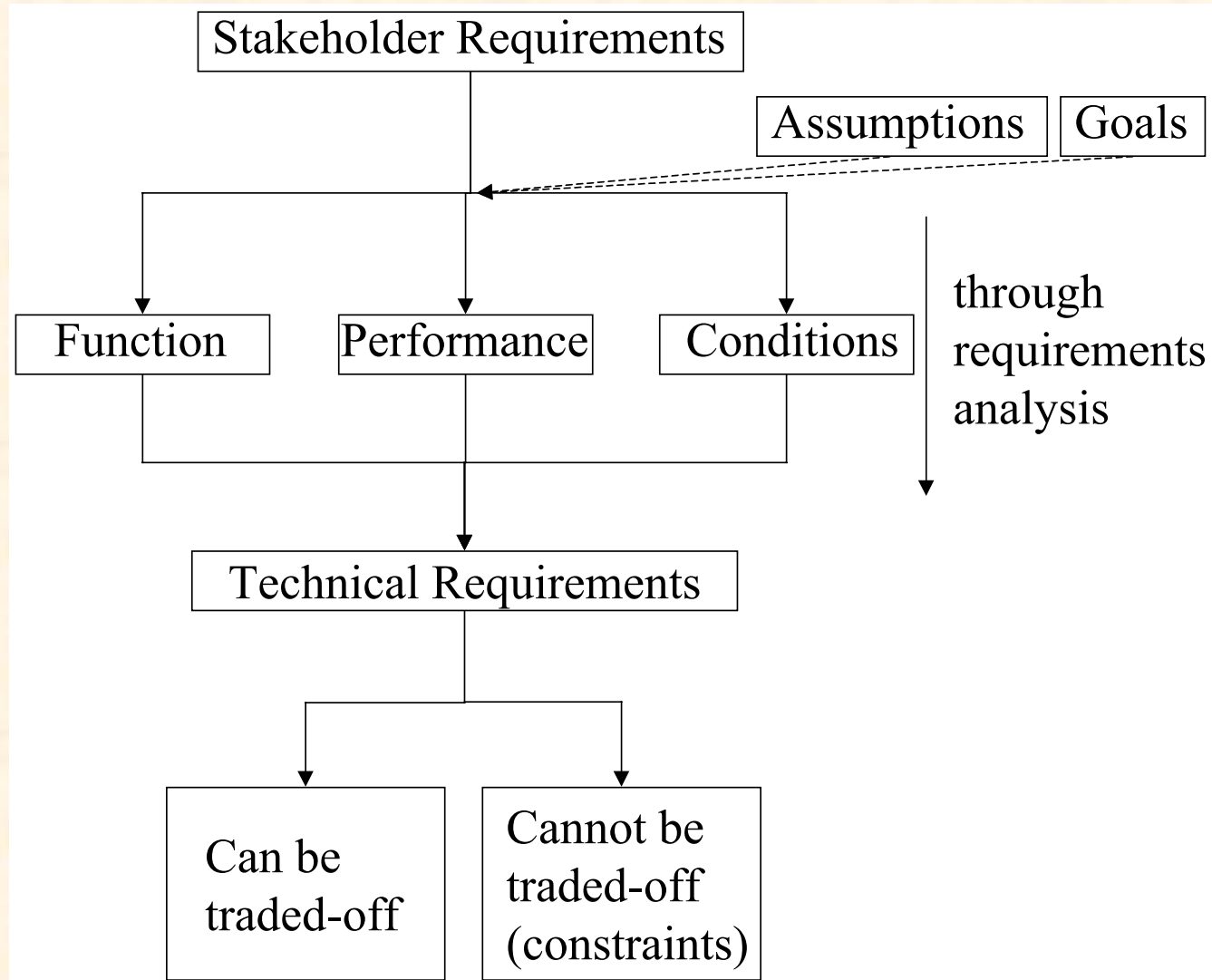
Interfaces

Logical and physical

External e internal



Requirements evolution



TYPES OF REQUIREMENTS (by Robert Halligan)

Estates and modes of operations

Functions

Performance

External interface

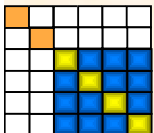
Environment

Resources

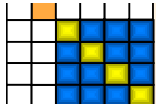
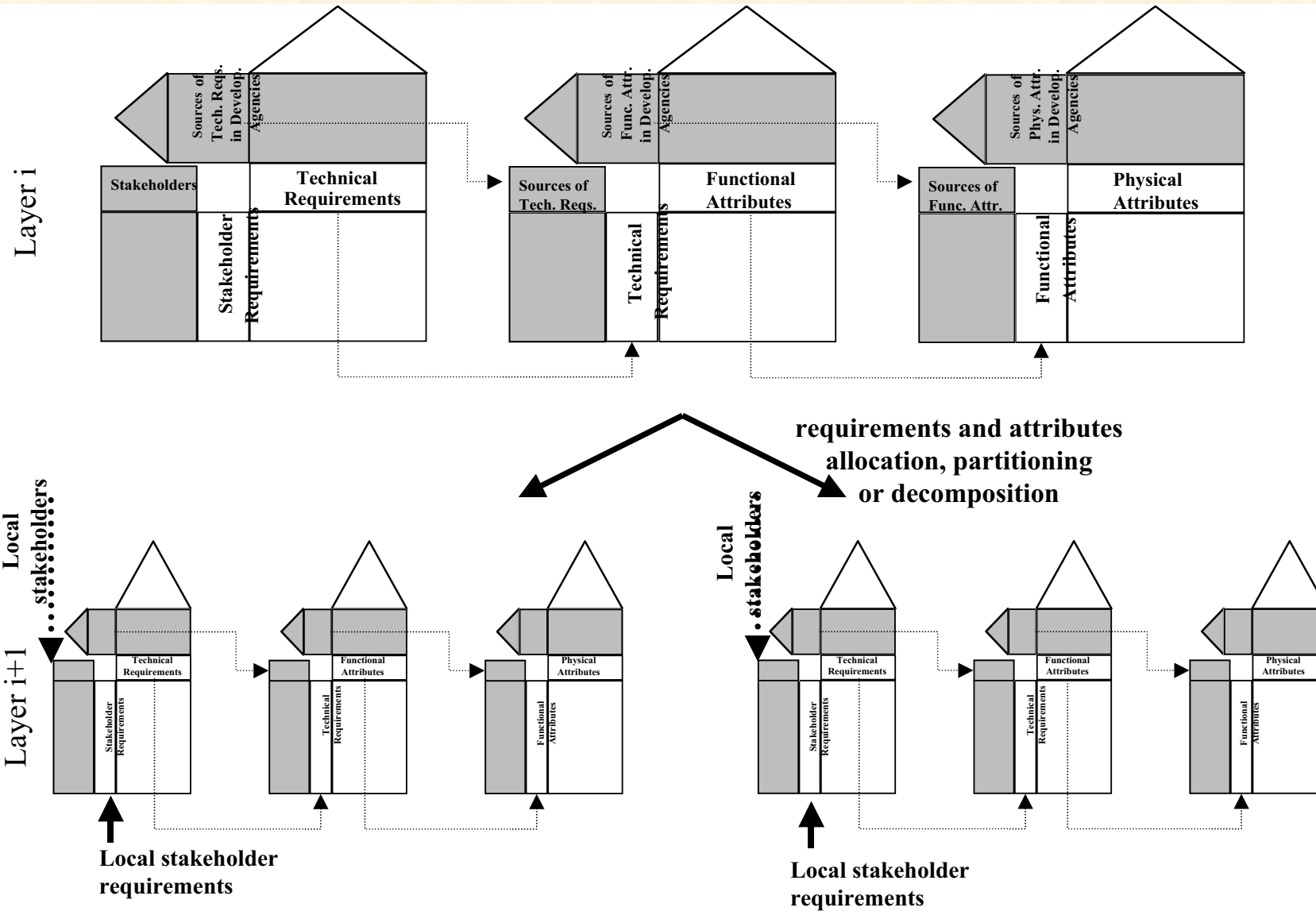
Physical properties

Other qualities

Project driven



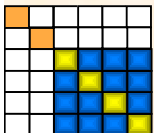
Allocation, partition e decomposition



Define end product mission/objective

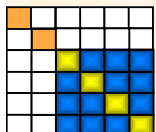
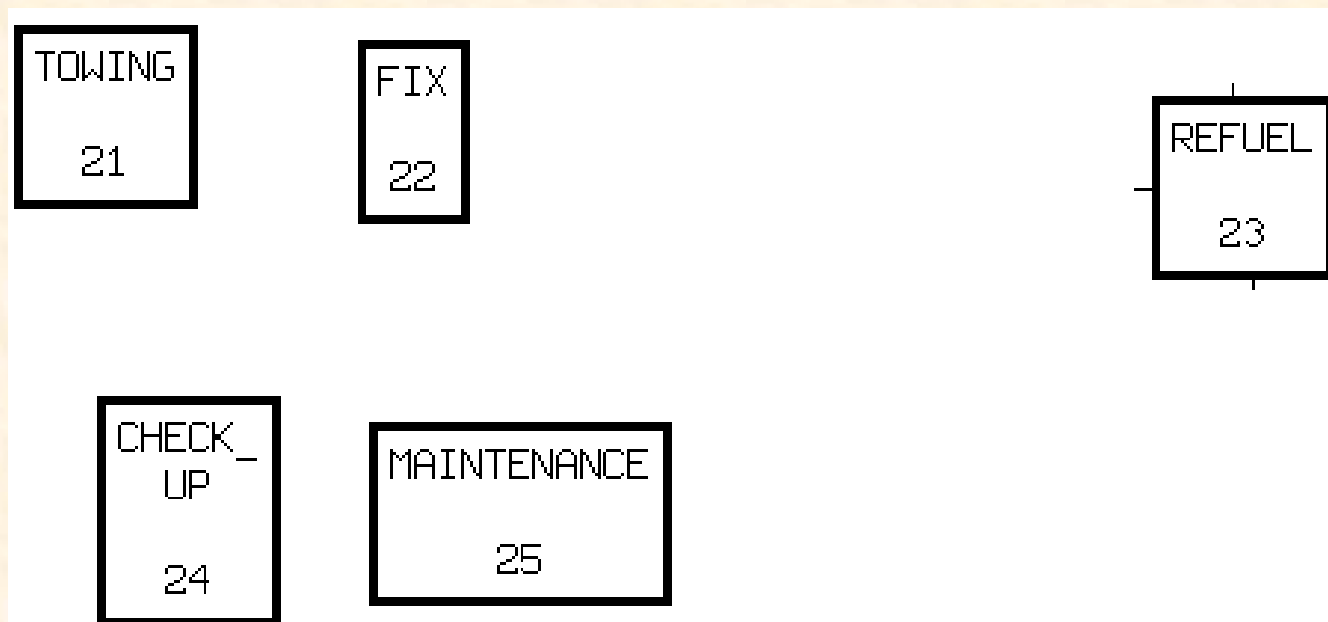
Transport private
riders on a road

1



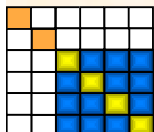
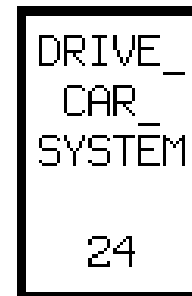
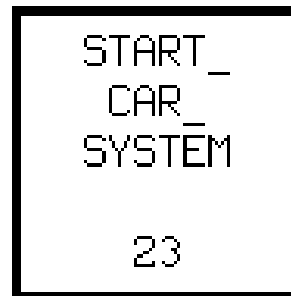
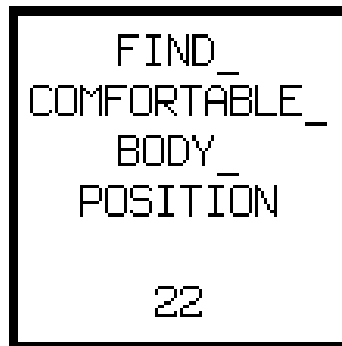
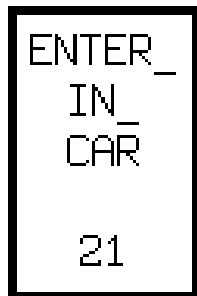
Analyze life cycle process scenarios

Possible functions embedded in the life cycle process term

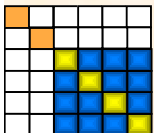
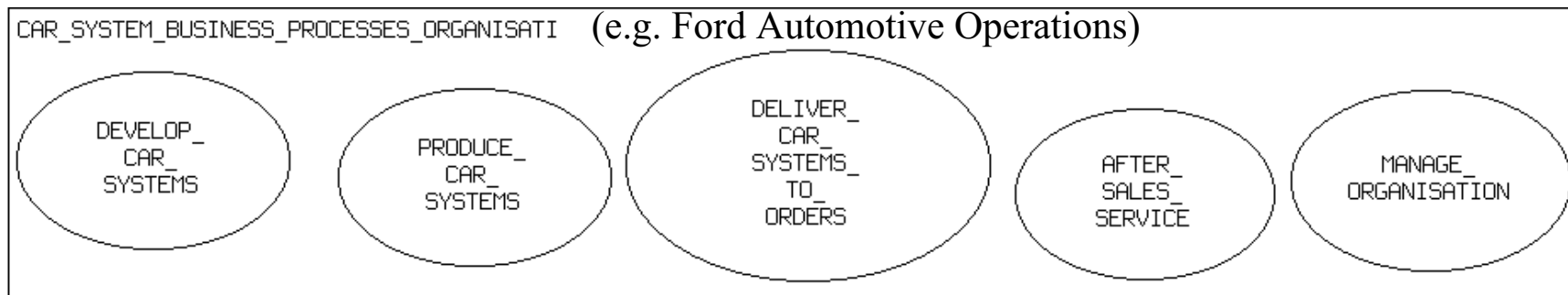


Analyze life cycle process scenarios

Defined sequence of activities that expands the life cycle process term



Identify life cycle process organizations

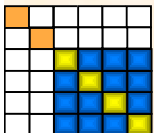


Identify stakeholders

Who are the people who directly interact with the product over its potential life cycle scenarios?

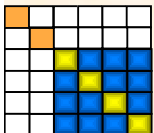
Who are the sources of inputs, destination of outputs, providers of mechanisms or mechanisms themselves and sources of control or control themselves?

Who are the people outside the organization who play a role in relation to the business?



Capture stakeholder requirements

interviews with stakeholders,
derivation from business requirements,
working in the stakeholder environment,
analogous or existing system,
change suggestions and problem reports,
innovation work,
stakeholder group meetings,
workshops,
studies or descriptive documents,
prototypes,
new technology,
questionnaires,
stakeholder modifications of existing systems .



Capture stakeholder requirements

legislation, patents, trade marks, registered designs and copyright;

reports, proceedings and reference books;

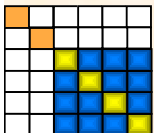
official and private representative bodies;

statistical data;

market data publications;

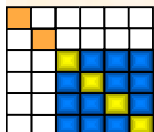
specialist libraries;

engineering science information.



Organize assumptions, goals and stakeholder requirements

Number	Text	Concern	Type	Compliance	Status	PPO	Constraint	Verifiability	
								T//D	Procedure
S003	Provides for personal comfort/convenience	Comfort	F	M	TBD	Prod	Y	D	R202
S003.001	Comfortable front seats	Comfort	P	M	TBD	Prod	Y	D	R202
S003.002	Driving position is fully adjustable	Comfort	F	D	TBD	Prod	N	D	R202
S003.002.001	Can personalise seat, head rest and arm rest position	Comfort	F	D	TBD	Prod	N	D	R202
S009.007.001	Starts quickly every time whether hot, cold or wet	Driveability	P	M	TBD	Prod	Y	T	R202
S009.007.002	Never stalls when cold or hot	Driveability	P	M	TBD	Prod	Y	T	R202
S009.007.003	Quick to idle and settle	Driveability	P	M	TBD	Prod	Y	T	R202
S009.007.004	Consistent start times	Driveability	P	M	TBD	Prod	Y	T	R202
S009.007.004	No overheating	Driveability	F	M	TBD	Prod	Y	T	R202
S012	Easy to service	Maintenability	P	M	TBD	Proc	Y	T	CETP
S020	Reuse resources from previous vehicle programs	Investment efficiency	F	D	TBD	Org	N	D	TBD

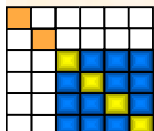
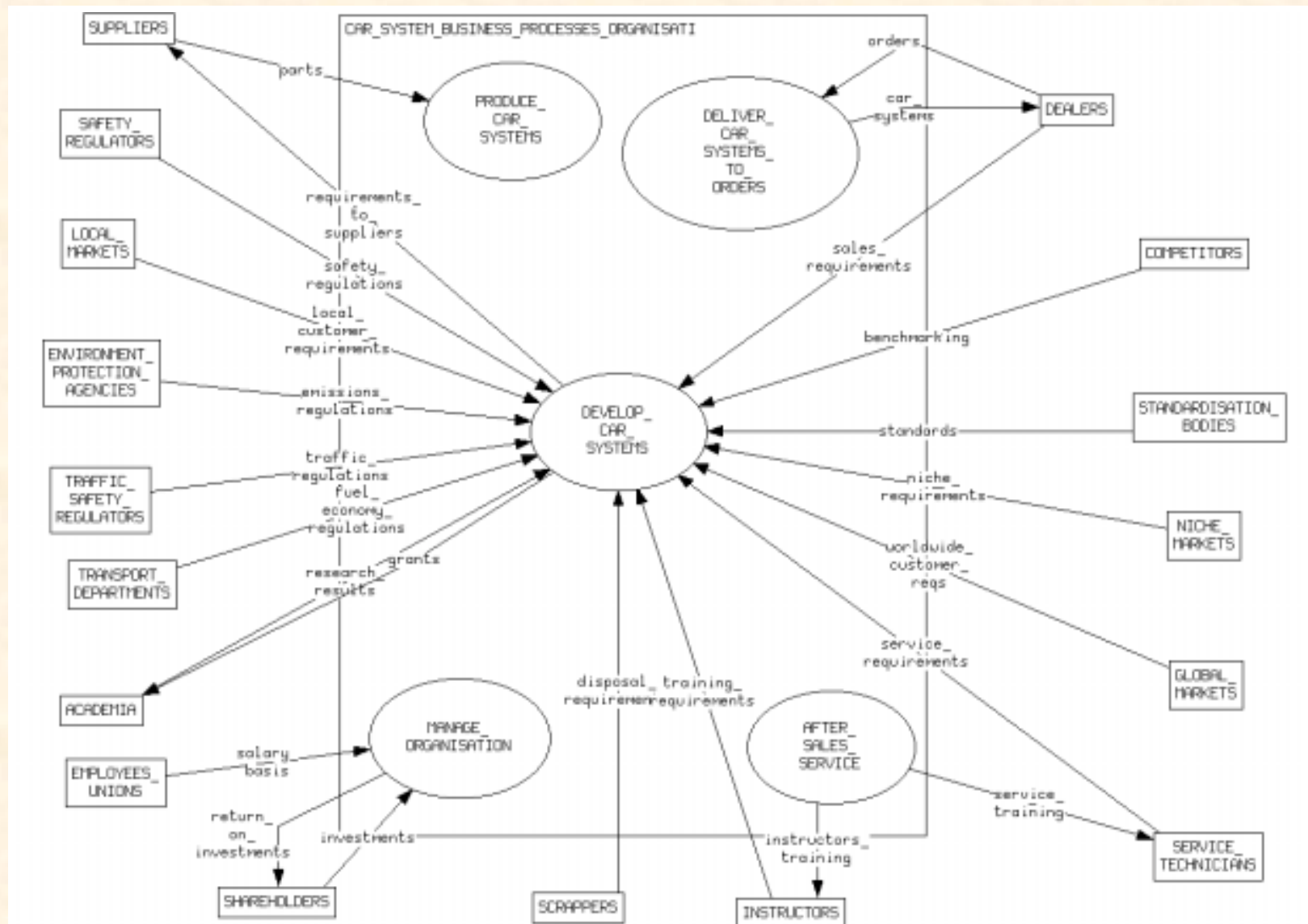


Requirements specification

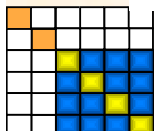
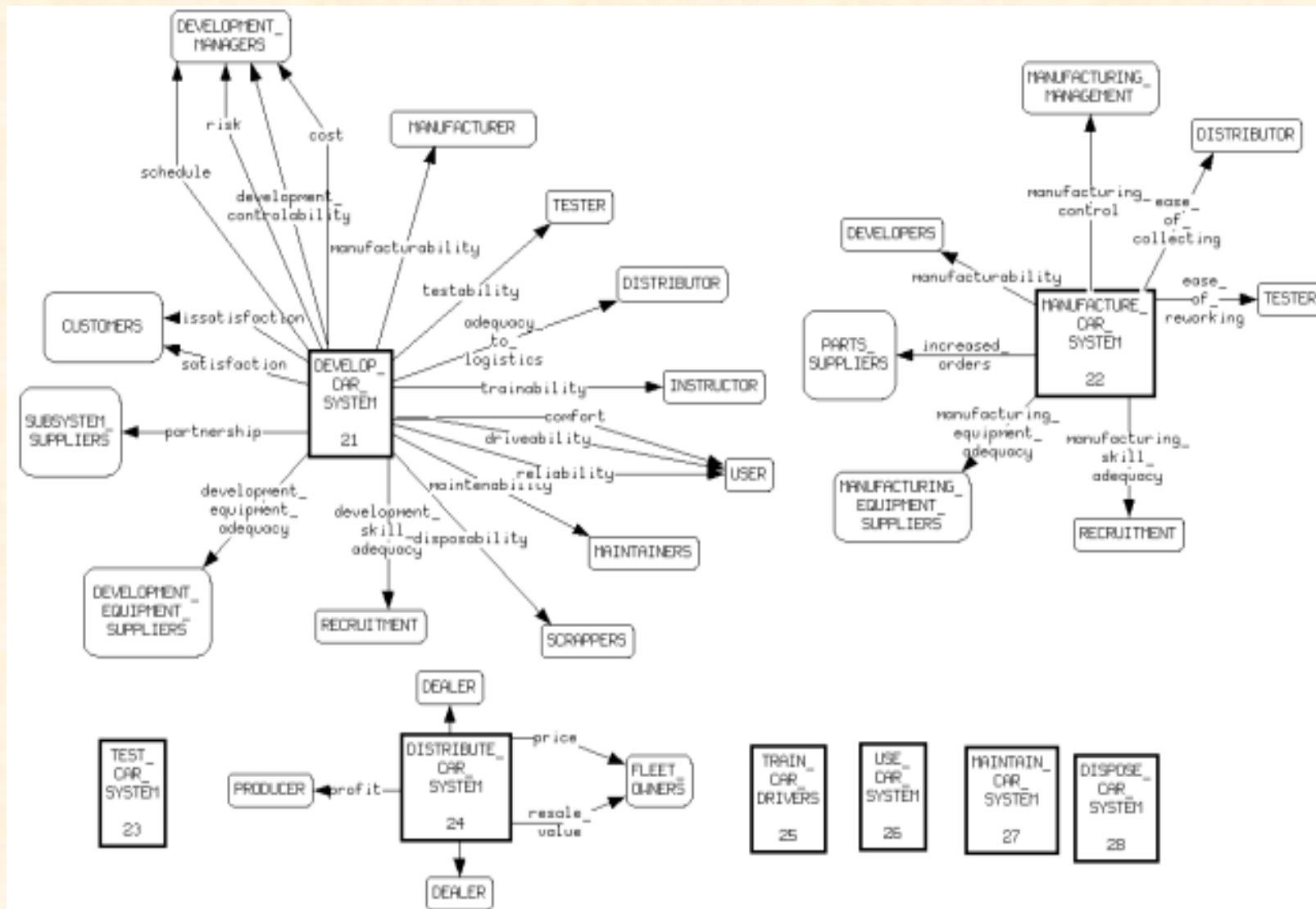
1. Scope (or introduction)	4.6 Environmental requirements
2. Applicable and other reference documents	4.6.1 Classes of environment
2.1 Applicable documents	4.6.x Class
2.2 Other referenced documents	By parameter
3. Definitions, acronyms and abbreviation	4.6.y Environmental envelope(s) for x class
3.1 Definitions	4.7 Resource requirements
3.2 Acronyms	By resource
3.3 Abreviation	4.8 Physical requirements
4. Requirements (and goals)	By parameter
4.1 Identification of external interfaces	4.9 Other qualities
The system shall have the following external interfaces	By other qualities
4.2 Identification of states and modes	By parameter
The system shall [states]	4.10 Design (& Construction) requirements
The system may [permitted states]	4.10.1 General design requirements
The system shall [modes]	Requirements with no secondary actors
4.3 Functional and performance requirements	4.10.2 Characteristics of subordinate elements
By control flow with indenting for decomposition, logical branching, for concurrency Example: functional flow block diagram for a space system	4.10.2.1 Engine
Corresponding Specification Structure	Emulate 4.10 to 4.10.1
4.4 Relationships between states and modes	4.10.2.2 Flight manuals
4.5 External interface requirements	4.10.2.3 Fuel pump
By interface, maybe organized hierrachically	4.10.2.4 Nose wheel
	5. Verification requirements (maybe)
	6. Notes



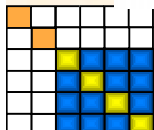
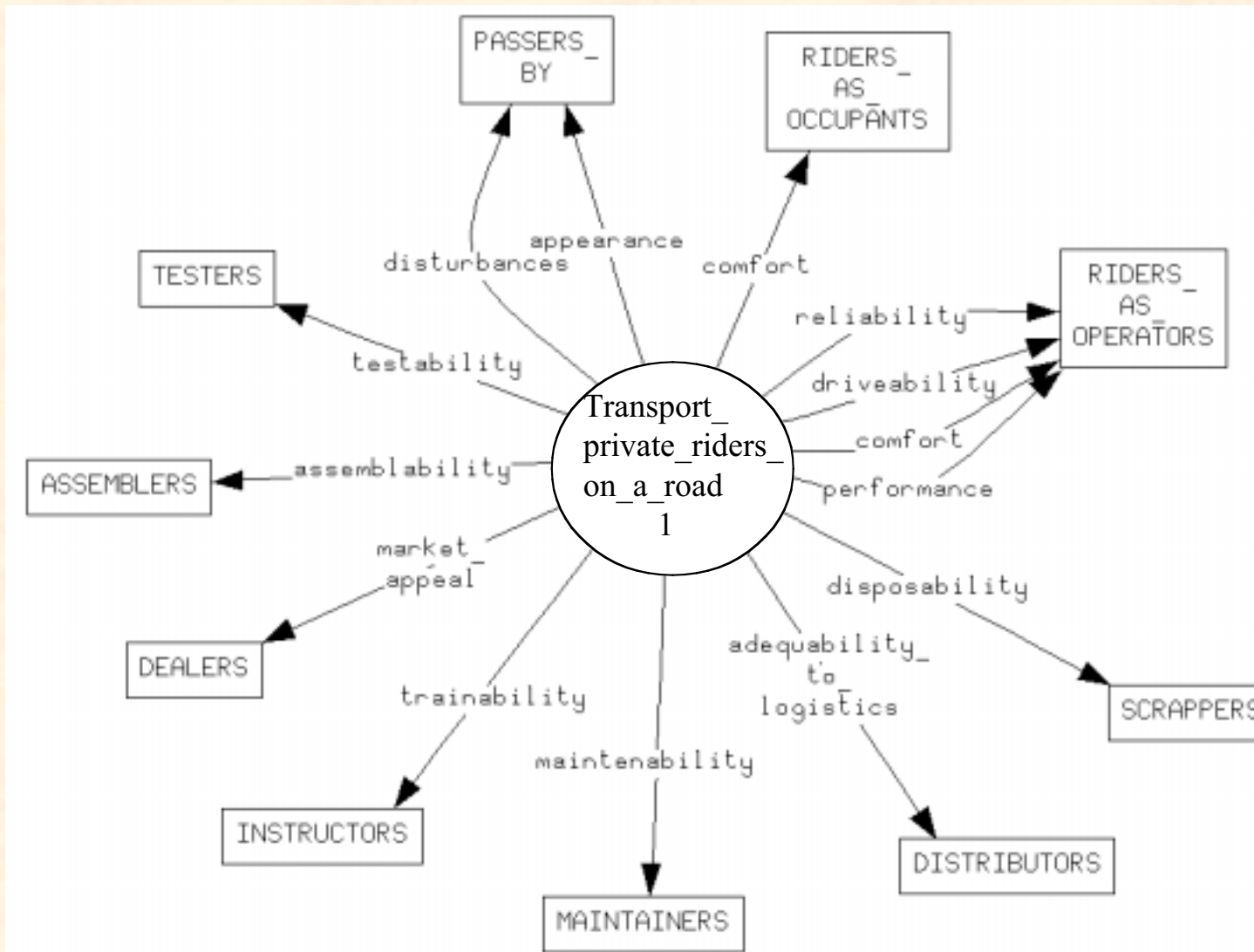
Organization stakeholders and MOEs



Process stakeholders and MOEs

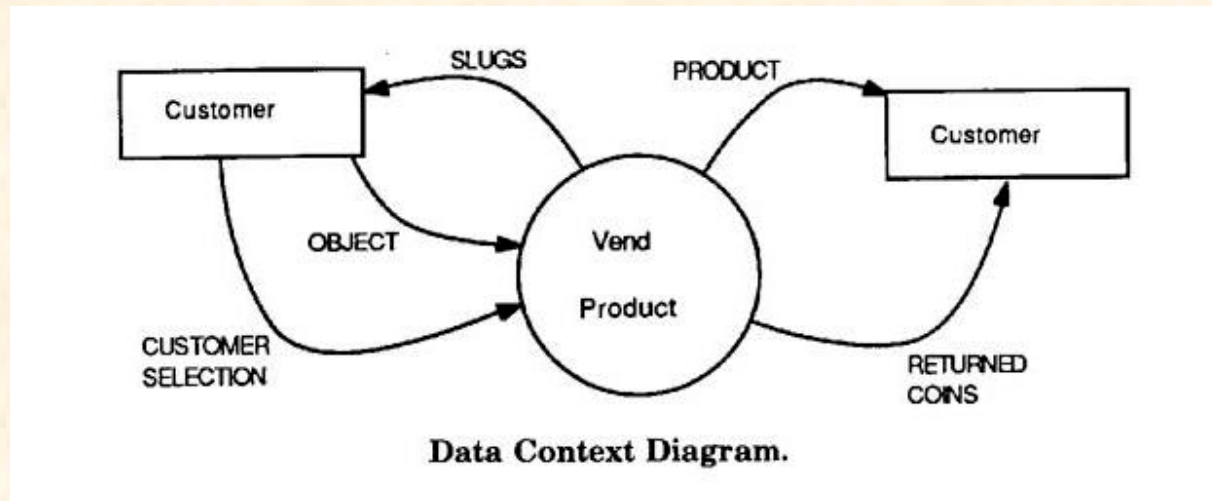


Product stakeholders and MOEs

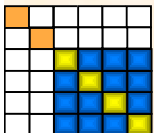


Vending Machine

CONTEXT DIAGRAM

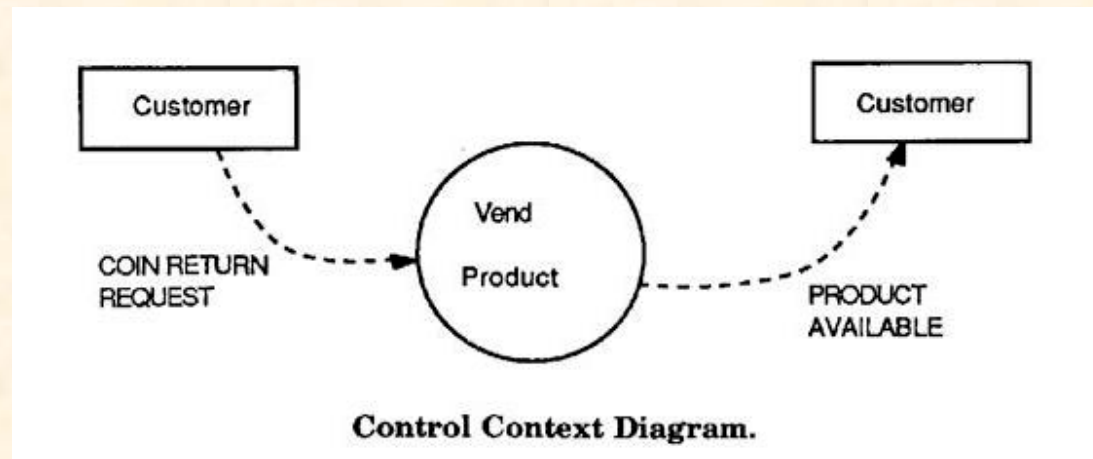


Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. **1989.** ISBN: 0-13598624-9.

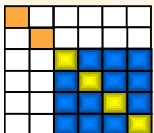


Vending Machine

CONTEXT DIAGRAM

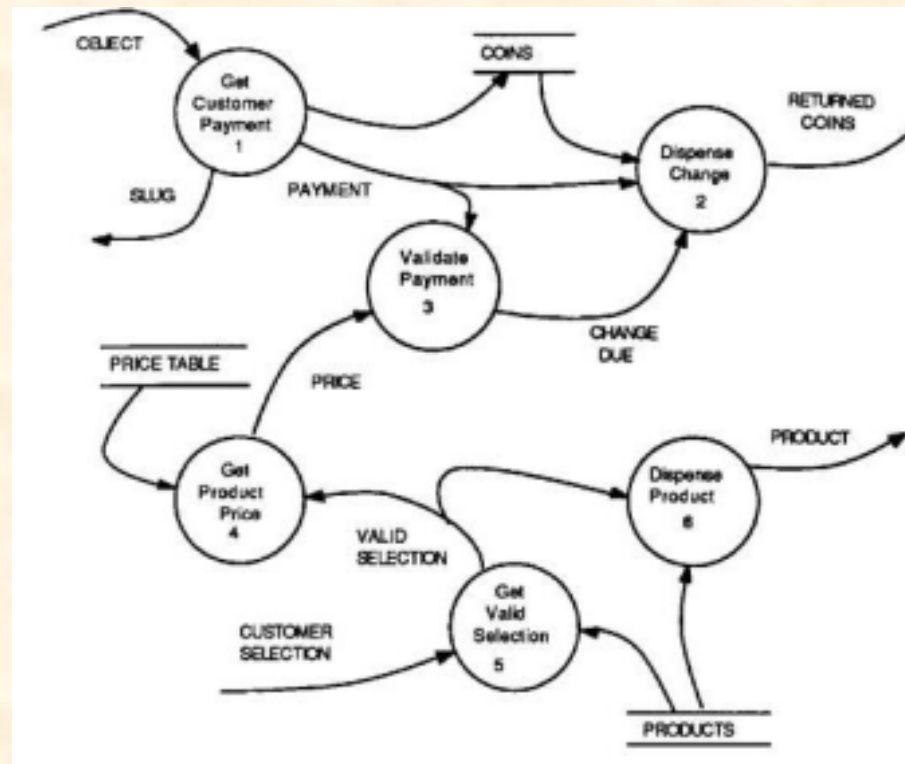


Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. 1989. ISBN: 0-13598624-9.



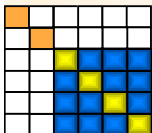
Vending Machine

DATA FLOW DIAGRAM



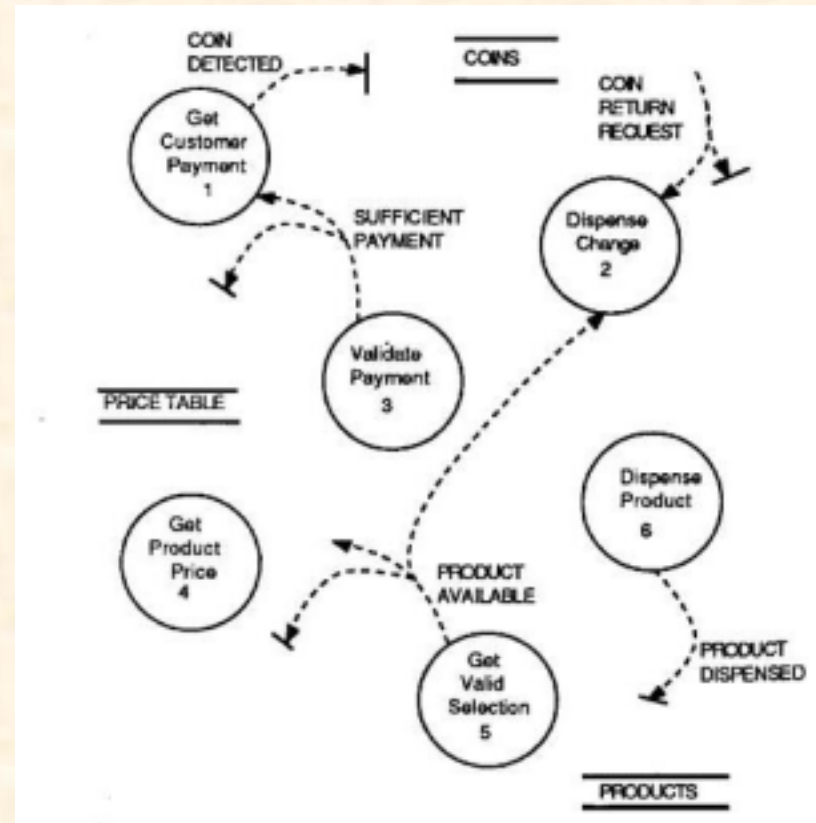
DFD 0: Vend Product

Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. **1989.** ISBN: 0-13598624-9.



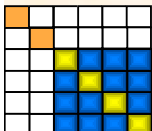
Vending Machine

CONTROL FLOW DIAGRAM



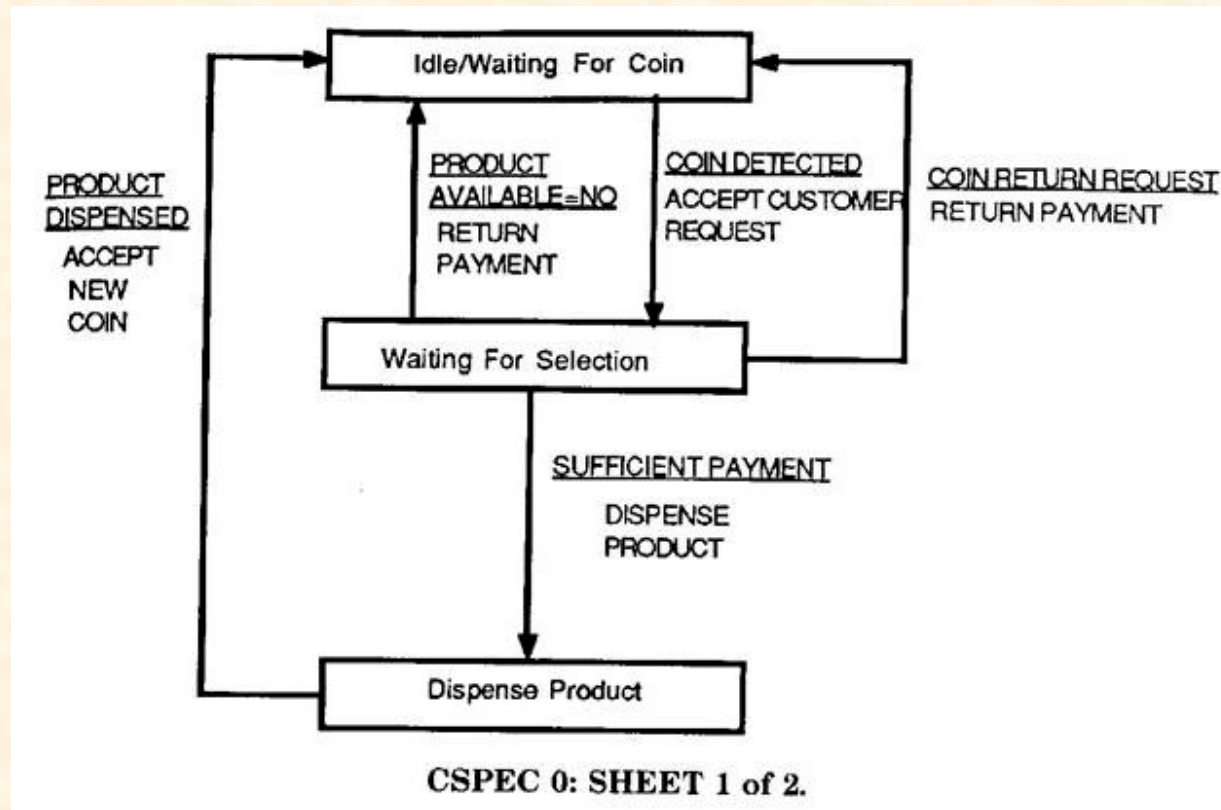
CFD 0: Vend Product

Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. **1989.** ISBN: 0-13598624-9.

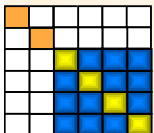


Vending Machine

STATE TRANSITION DIAGRAM



Yourdon, E., 1989. *Modern structured analysis*. Yourdon Press, Englewood Cliffs, New Jersey. 1989. ISBN: 0-13598624-9.



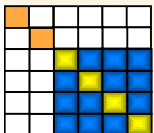
Vending Machine

DECISION TABLE

Control Action \ Process Activated	Dispense Change	Dispense Product	Get Valid Selection
Accept Customer Request	0	0	1
Return Payment	1	0	0
Accept New Coin	0	0	0
Dispense Product	1	1	0

CSPEC 0: SHEET 2 of 2.

Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. **1989.** ISBN: 0-13598624-9.

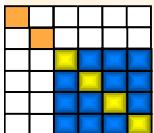


Vending Machine

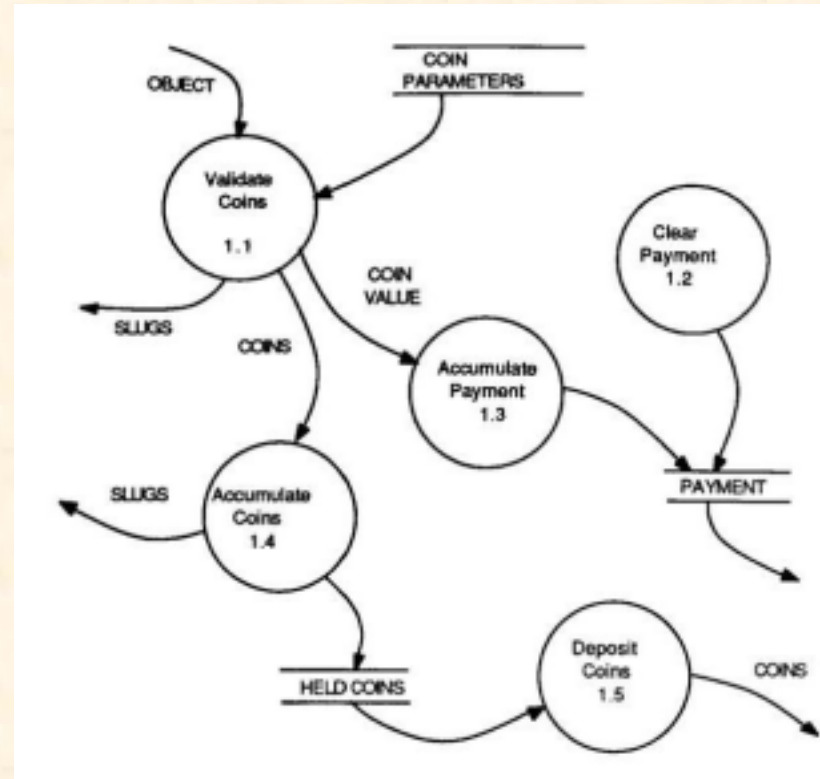
TIMING SPECIFICATION

INPUT	EVENT	OUTPUT	EVENT	RESPONSE TIME
OBJECT	Inserted	SLUGS	Ejected	2 sec. max.
CUSTOMER SELECTION	Entered	PRODUCT AVAILABLE	Displayed	0.5 sec. max.
		PRODUCT	Dispensed	5 sec. max.
COIN RETURN REQUEST	Entered	RETURNED COINS	Returned	2 sec. max.

Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. **1989.** ISBN: 0-13598624-9.

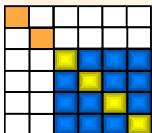


Vending Machine



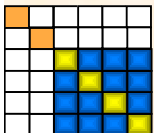
DFD 1 : Get Customer Payment

Yourdon, E., 1989. *Modern structured analysis.* Yourdon Press, Englewood Cliffs, New Jersey. **1989.** ISBN: 0-13598624-9.



Systems boundaries and external system interfaces

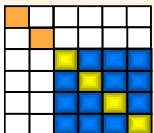
- What is within system boundary and what is outside
 - Primary functions identified
 - Elements in the environment interacting with the system identified



Primary functions

Primary functions:

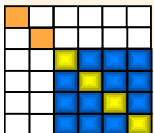
- End product mission/objective
- End product life cycle processes and scenarios
- Business processes that implement the above



Elements in the environment

Elements in the environment:

- elements interacting with the end-product over its life cycle;
- someone or something playing a role in relation to the business organisation.



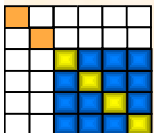
Functional interfaces

Data

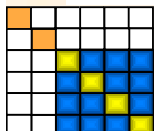
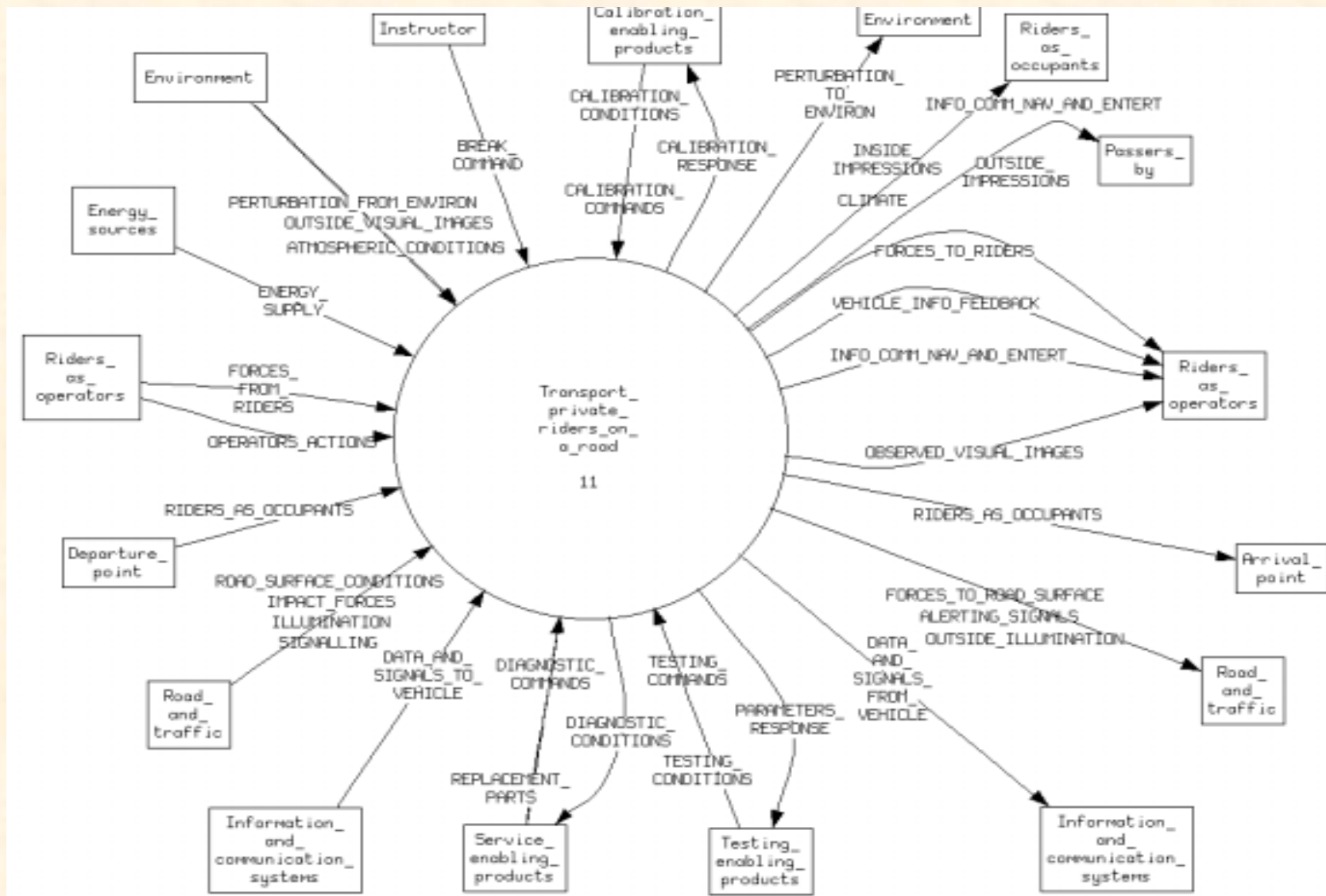
Energy

Material

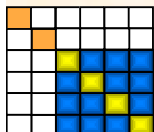
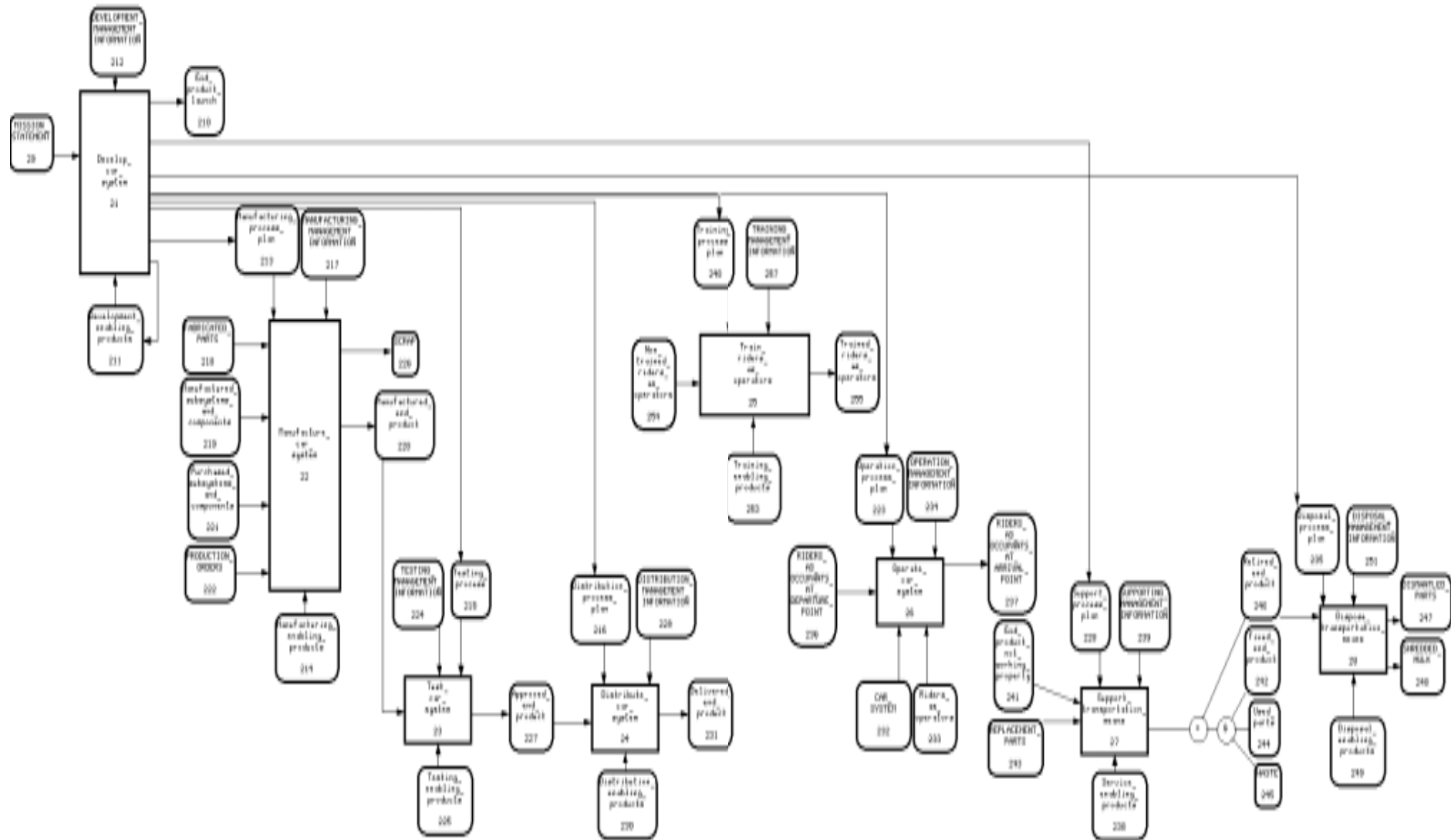
Crossing the boundaries of the system



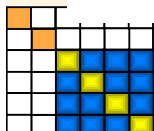
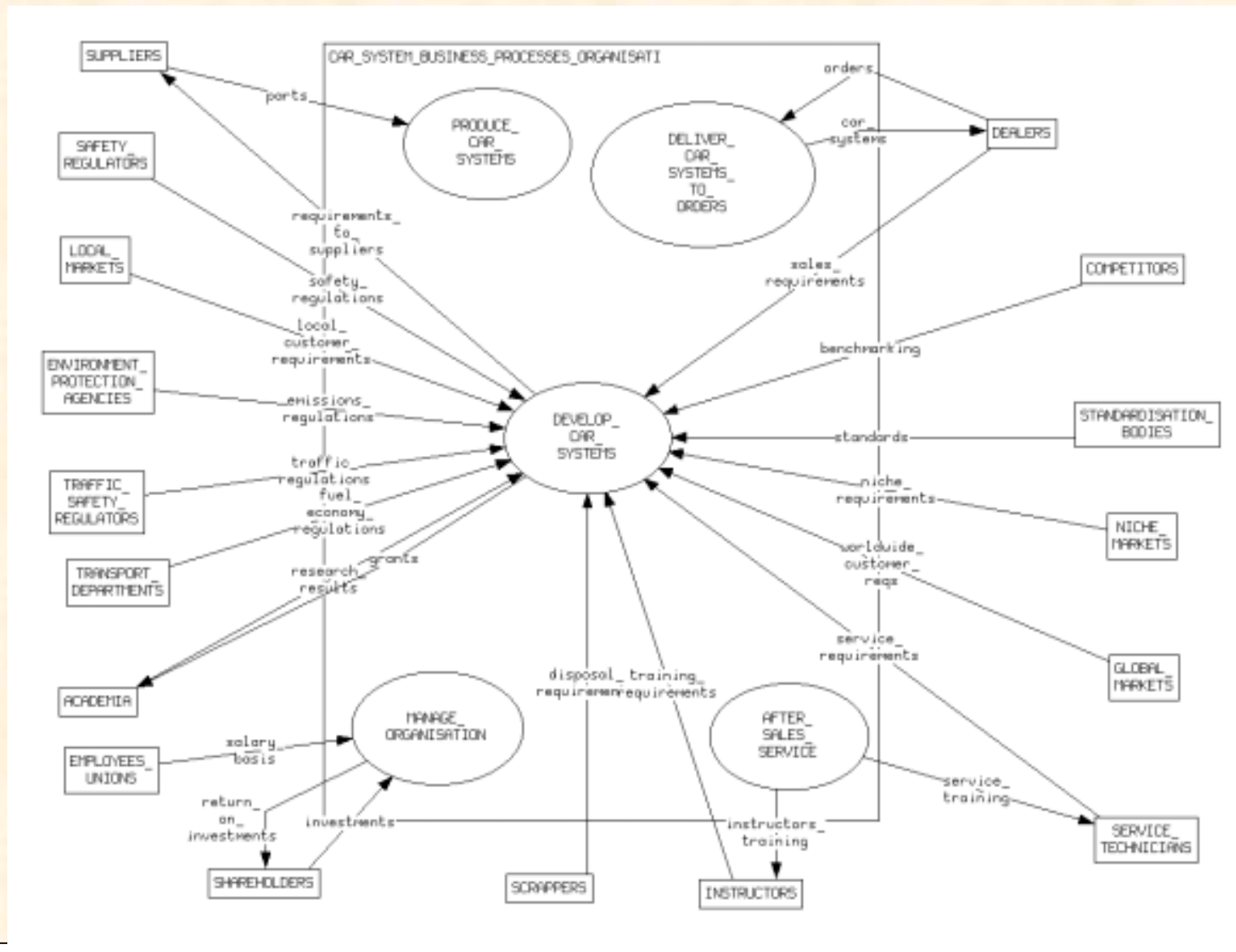
FUNCTIONAL ANALYSIS - PRODUCT



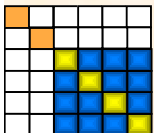
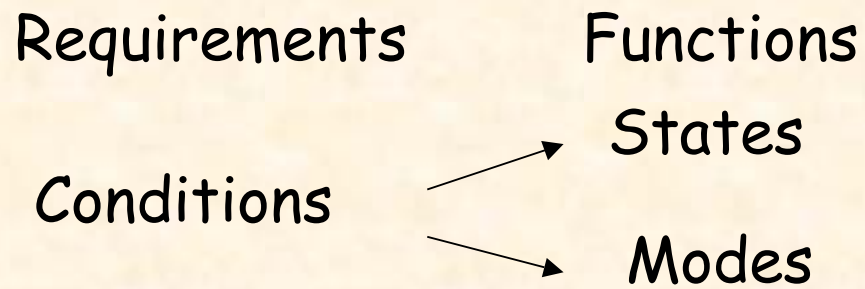
FUNCTIONAL ANALYSIS - PROCESS



FUNCTIONAL ANALYSIS - ORGANIZATION



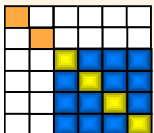
States and modes



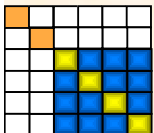
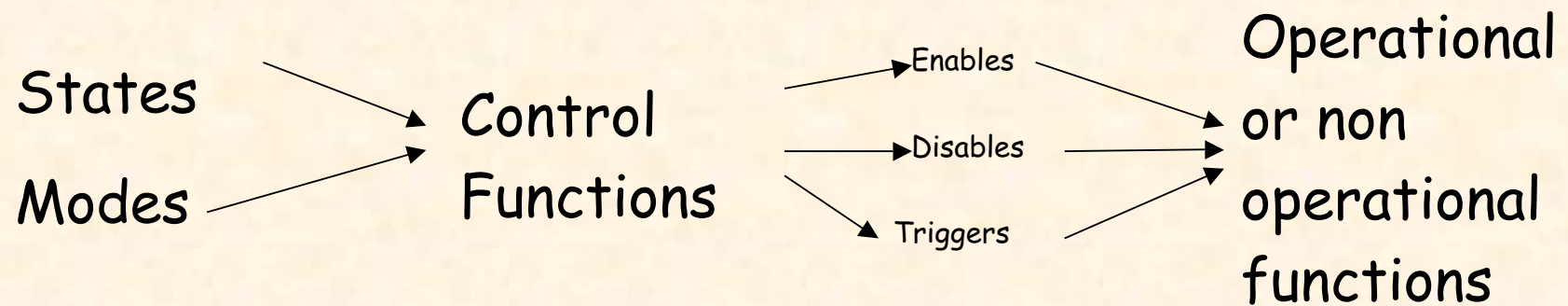
States and modes

STATES - derived from the 'when's or 'while's and define the set of scenarios that characterize the system or system element at a given moment.

MODES - group functionality for a given set of conditions or a given state.



States and modes



Hazard analysis

Hazard - causes a harm to the environment or to the system

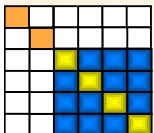
Preliminary hazard analysis

Risk analysis

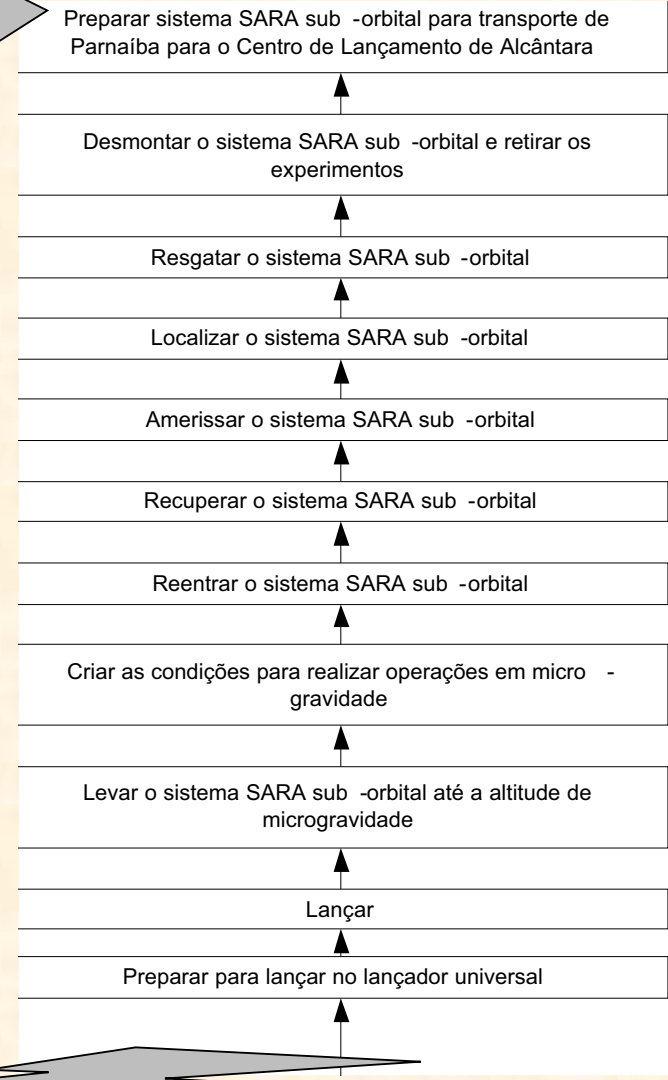
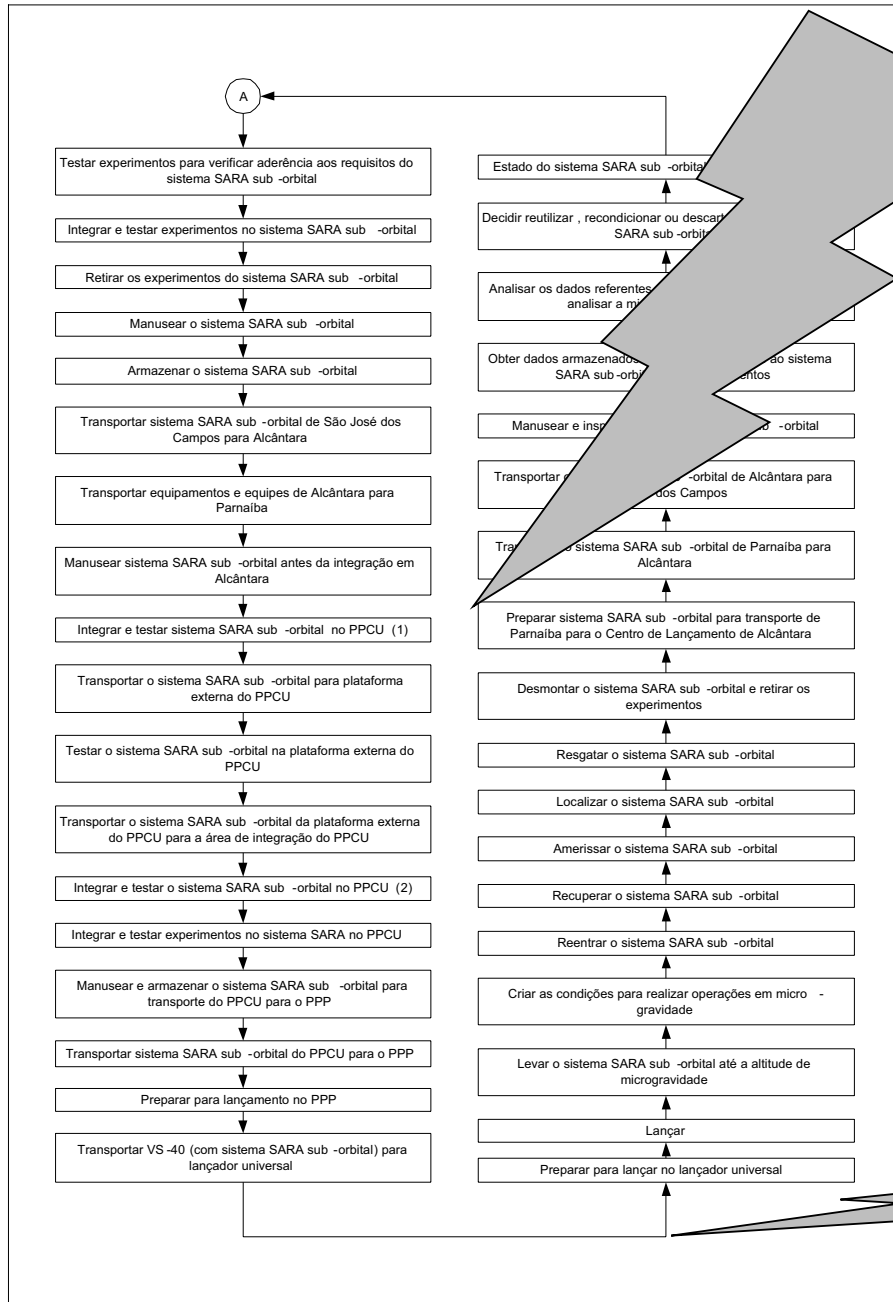
Protective and preventive measures

Protective and preventive functions

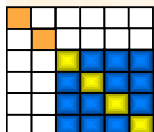
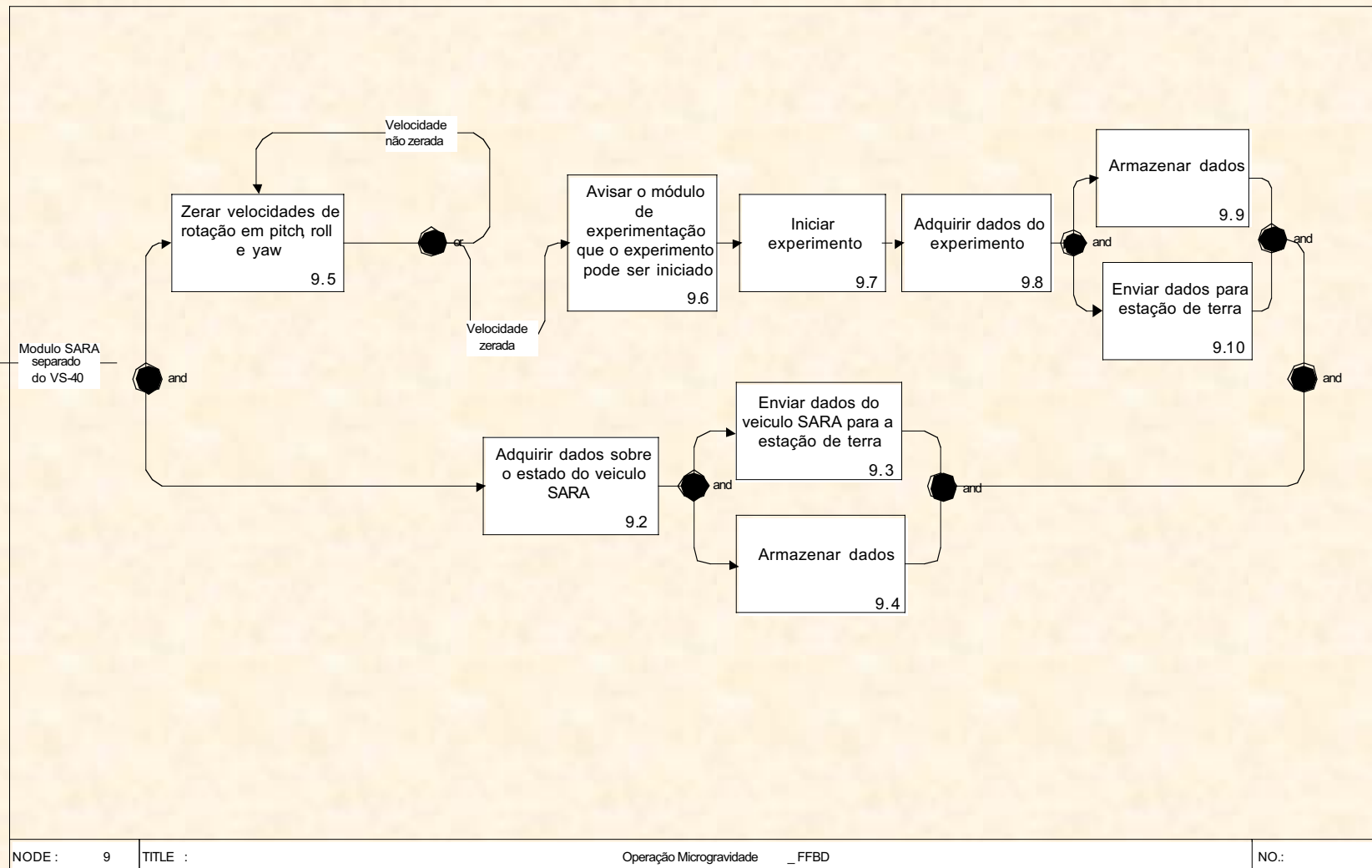
Hazard - environment x system interaction



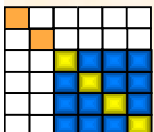
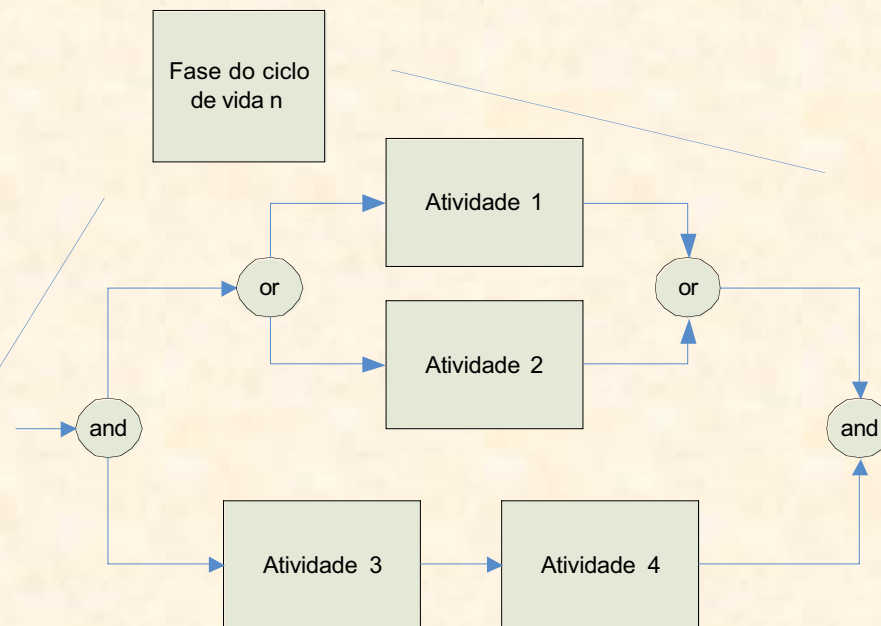
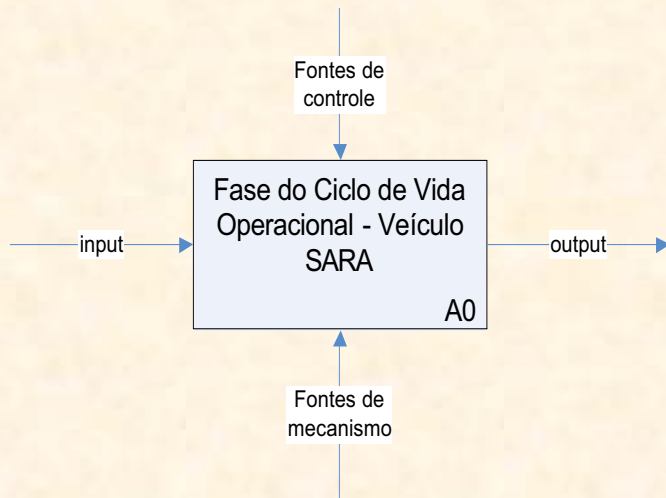
Life cycle approach



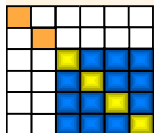
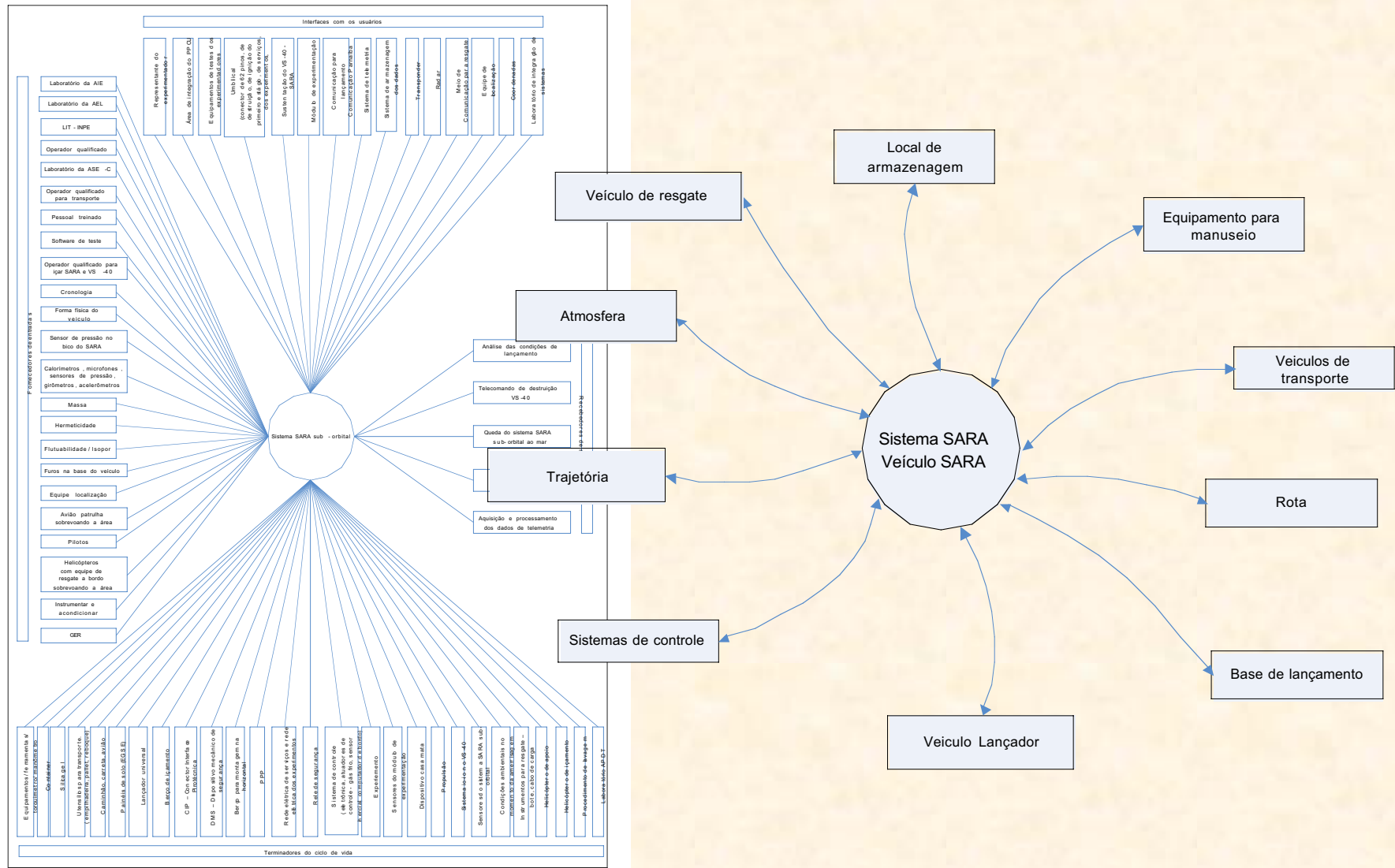
Life cycle process model 1/2



Life cycle process model 2/2



Context

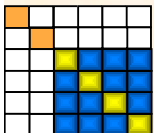


THREE SOURCES OF HAZARDS

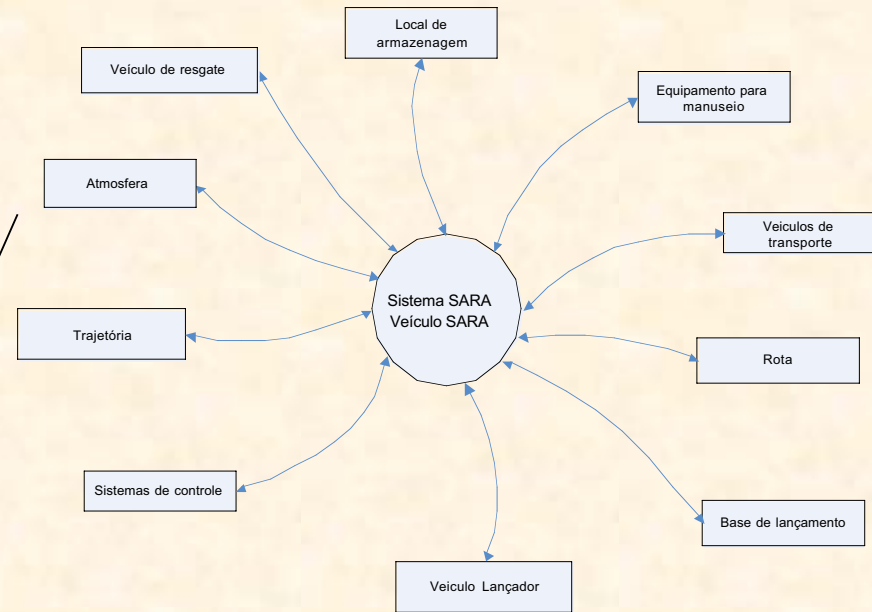
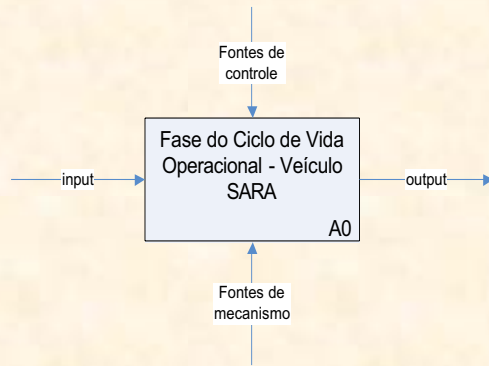
Circumstances - combination of states of environment elements that can cause hazardous events

Interfaces between system and environment - interface failures

Non functions of the mission to be carried out



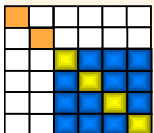
CIRCUMSTANCES



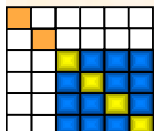
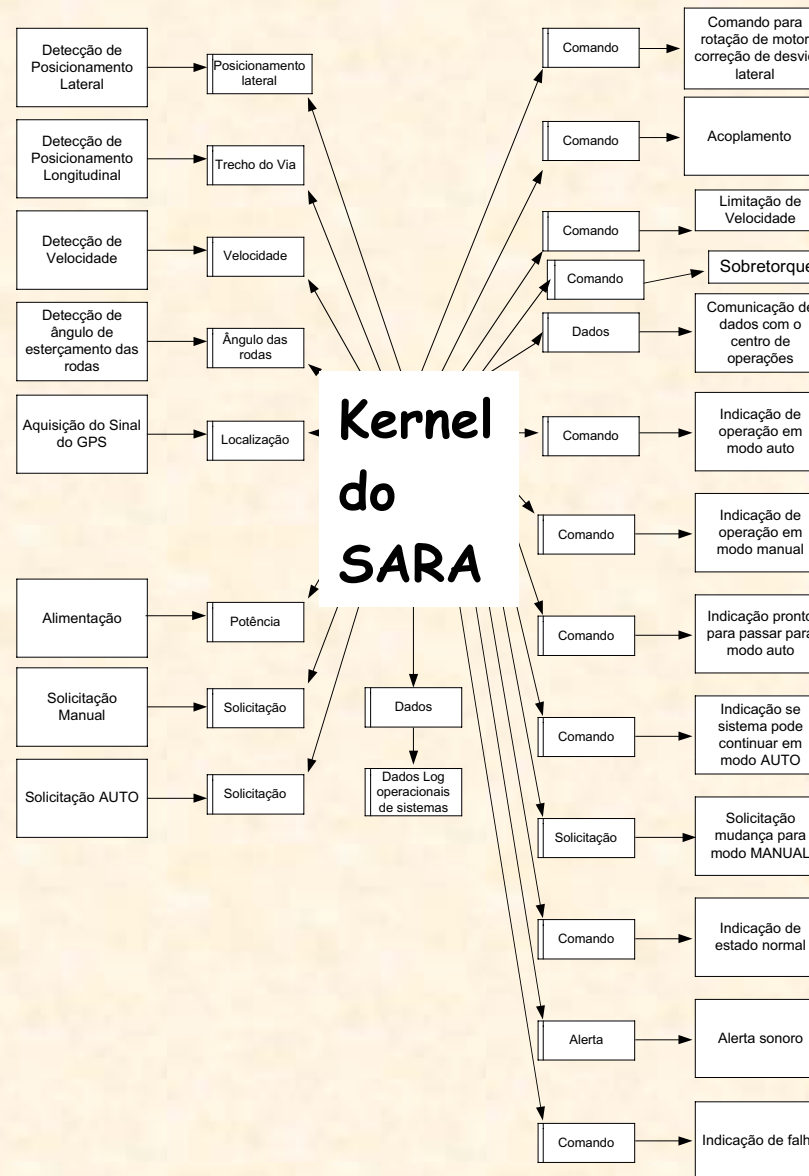
Combinations of states of environment elements

Circumstances

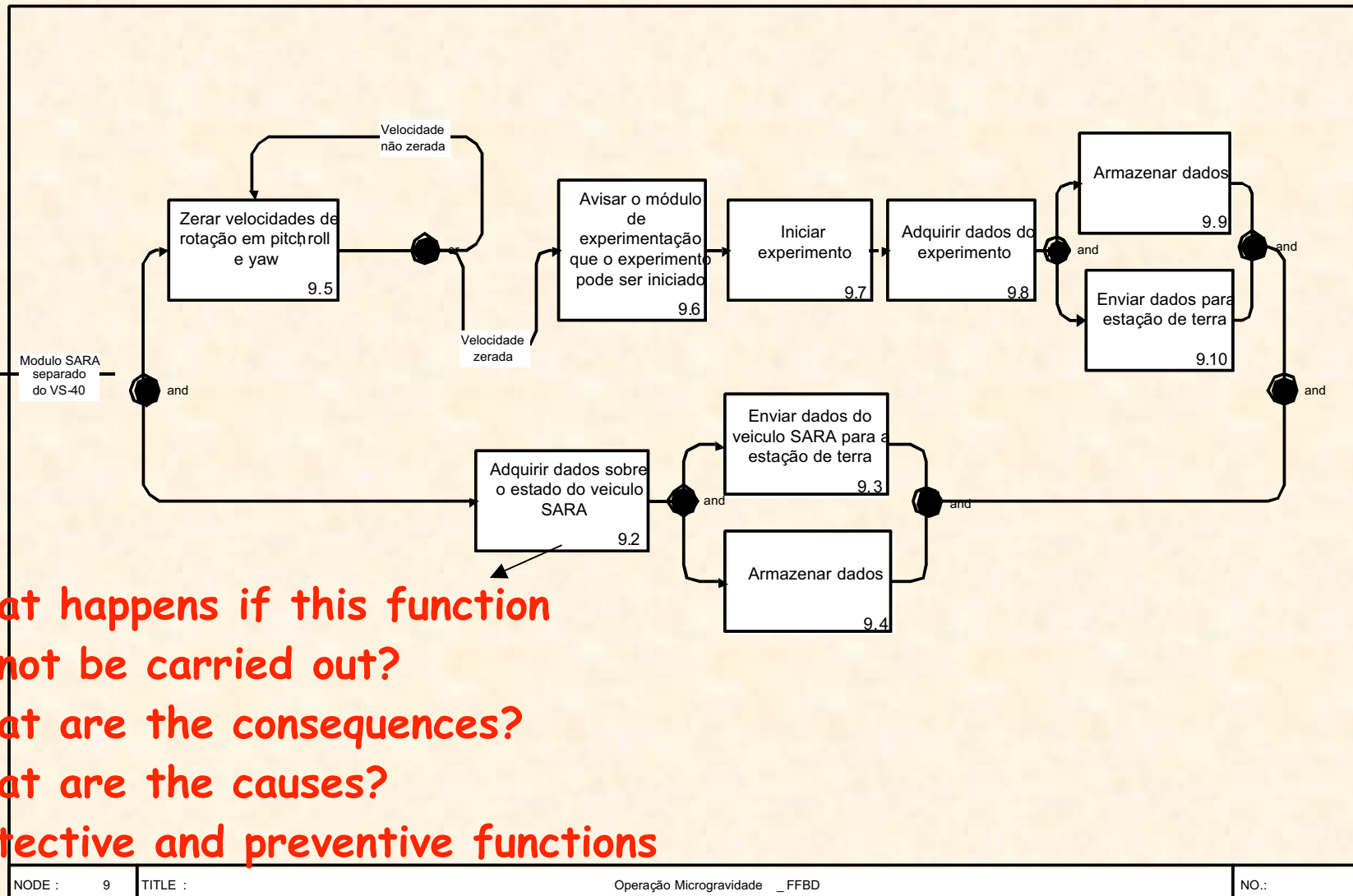
- Chuva
- Granizo
- Vento lateral
- Umidade
- Poeira
- EMI (principalmente raios e eletricidade estática)



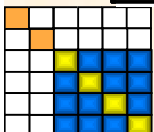
Interface failures



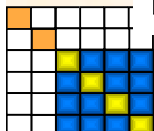
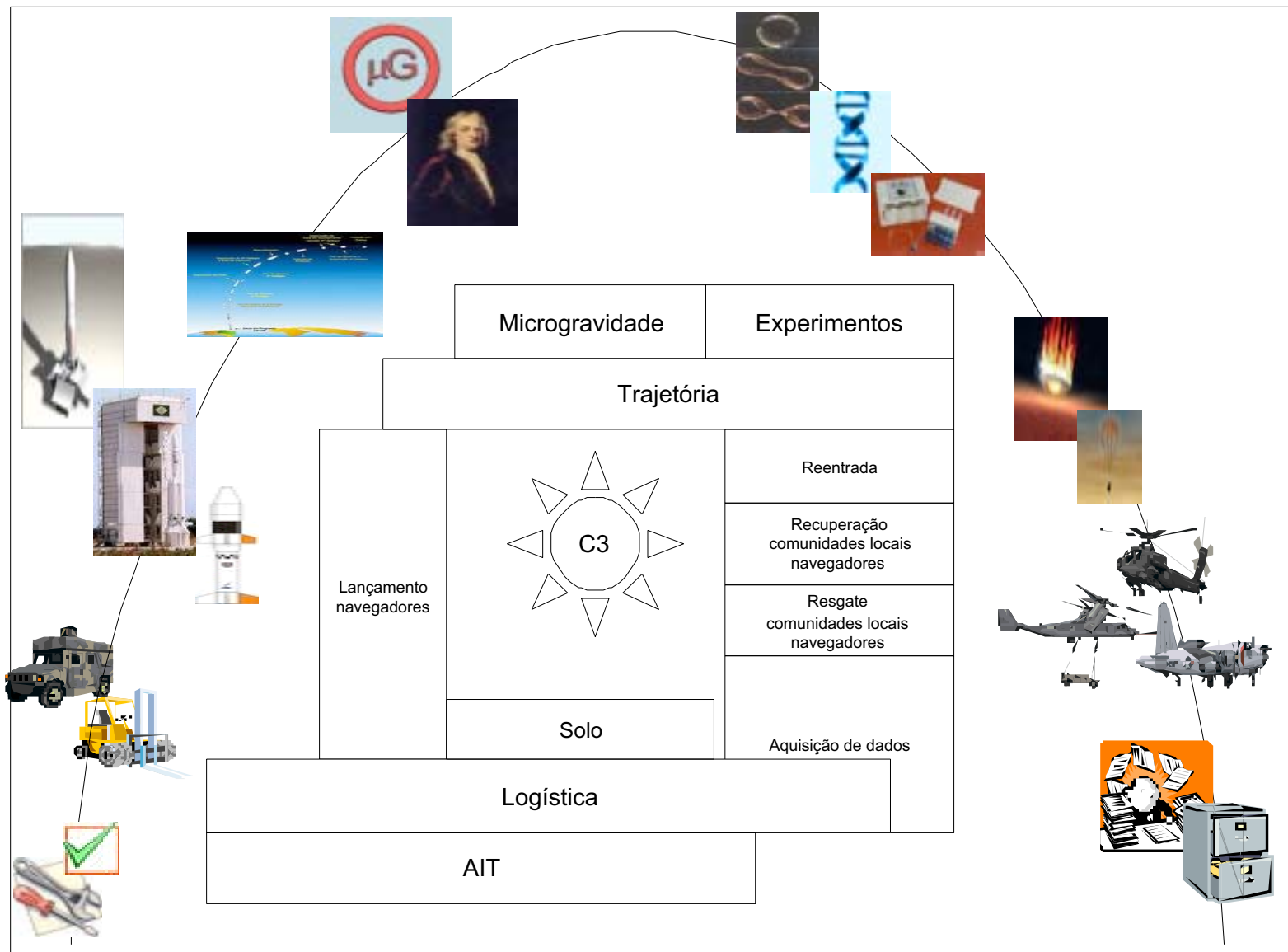
Non functions



What happens if this function cannot be carried out?
What are the consequences?
What are the causes?
Protective and preventive functions



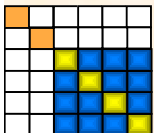
Mission architecture



FMECA

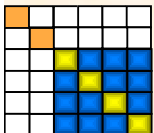
Failure modes for operational and non operational functions

Derive detection, prevention and protection functions



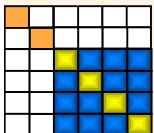
Functional behaviour

- determine the responses (outputs) of the function(s) to stimuli (inputs);
- understand the functional behaviour of subfunctions under various conditions and check the integrity of the functional arrangement logic;
- identify and define states and modes for which subfunctions exhibit different behaviours;
- identify and define a functional time line for each operational and non-operational scenario.

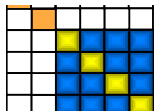
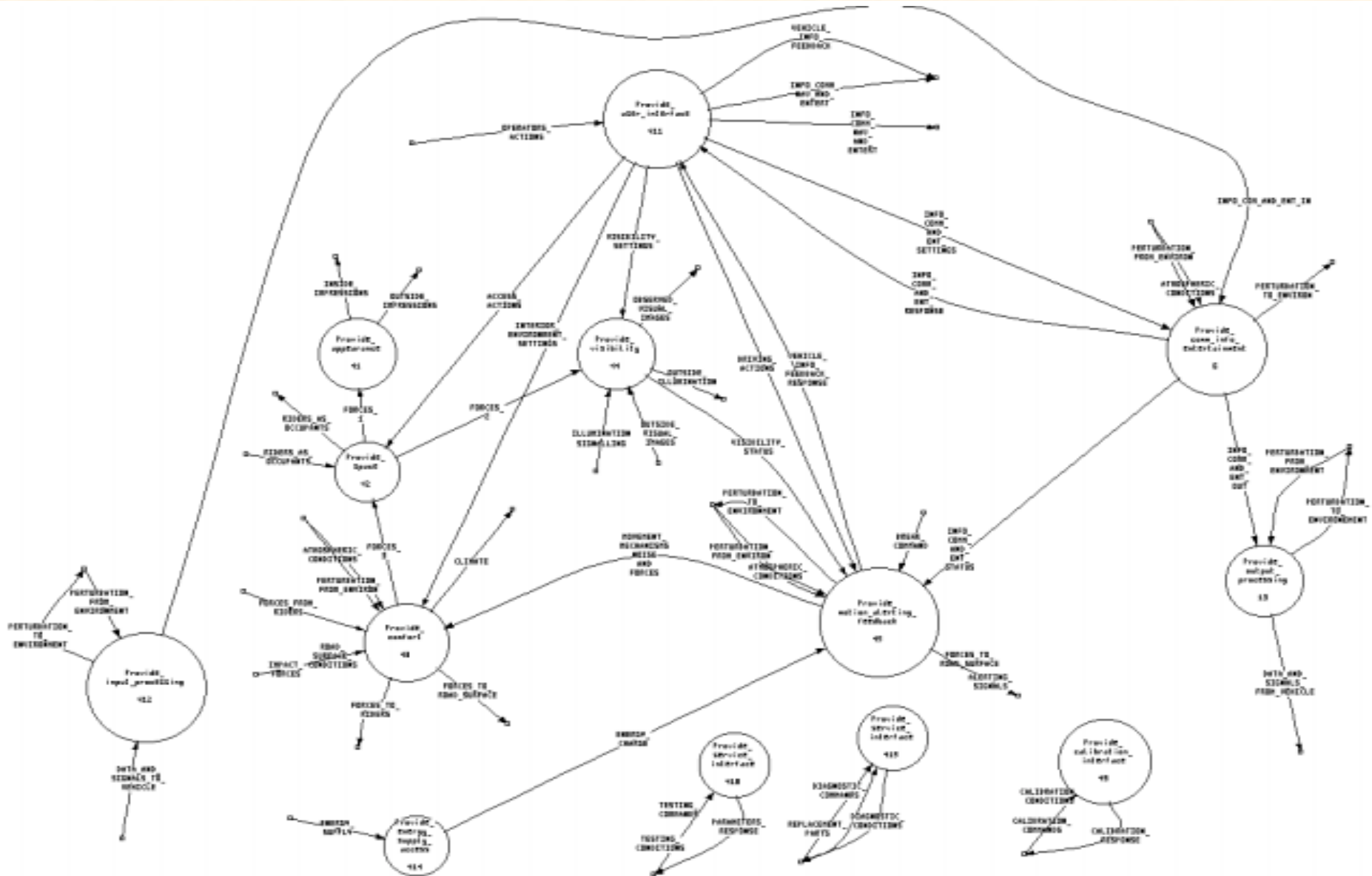


Functional interface

- to define the start/end states
- inputs/outputs for each function
- state transitions are completely defined within functions

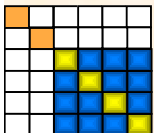


FUNCTIONAL DECOMPOSITION



Functional attributes

- performance requirements;
- inputs and outputs in any of the functional analysis models;
- timing and resource utilisation
- states and modes of operation;
- reliability, maintainability and risk attributes derived
- from failure mode effects and criticality and
- hazard analysis of product, process and organisation.



SUMMARY

