PMR 5020

Metodologia do Projeto de Sistemas

Aula 3: Introduzindo a Engenharia de Requisitos

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Plano de Aula

Nosso objetivo hoje é começar a comparar a perspectiva (ponto de vista) do pensamento clássico sobre design (começando pelo design estruturado) com o do design moderno (especialmente do design de sistemas).

Certamente vamos concluir que a fase inicial de design é o centro desta discussão.

Leitura da semana

System Theory: a worldview and/or a metodology
Matjaz Mulej, vice-president of IFSR.

Matjaz Mulej

Professor Emeritus, **University of Maribor (Slovenia, Europe) Systems and Innovation Theory**.
More than 1.600 publications in more than 40 countries
Dialectical Systems Theory; Innovative Business Paradigm and Methods.
key words: Dialectical Systems Theory, Innovation of Management and of values/culture/ethics/norms,
Law of two-generation cycles of values, **Law of requisite holism**, (corporate) social responsibility, USOMID methodology of creative cooperation.
ex- dean of ***Faculty of Economics and Business, University of Maribor*** *ex- vice-rector of* ***University of Maribor***
for ***research, international & inter-university cooperation***
School Institute's website http://www.epfip.uni-mb.si
Head of the expert board of IRDO
Institute for Development of Social Responsibility http://www.irdo.si
Teaching ***systems theory as a basis of requisitely holistic creative behaviour*** *since 1970 and its* ***application to innovation of management*** *since 1981*
Since 1992, co-chair of the ***STIQE*** *biannual international conference*
"linking Systems Theory, Innovation, Quality, Entrepreneurship and Environment"
'grand-father' of the yearly international conference ***PODIM*** *since1979*
"Entrepreneurship, Innovation, and Management"

(LvB, 1979, pp. XXI-XXII) says that systems are mental pictures of real or abstract entities, concepts that represent something existing from a selected perspective / viewpoint / aspect

...one-sidedness is unavoidable, but beneficial and dangerous, all at the same time; every human must unavoidably be specialized in a fragment of the immense huge given knowledge of today. Alone, though, it can do much less benefit than in cooperation / network of mutually different specialists (e.g. a management team, a doctors/nurses/etc. team, a professors or teachers team, a sports team, a trainers team, etc.)

Requisite Holism

←----------		----------→
Fictitious holism (inside a single viewpoint)	Requisite holism (a dialectical system of essential viewpoints)	Total = real holism (a system of all viewpoints)

Holismo e realidade

Actual attributes of real features		*Considered attributes of thinking about real features*
Systemic	Complexity	Consideration of whole's attributes that parts do not have
Systematic	Complicatedness	Consideration of parts' attributes that whole does not have
Dialectic	Basis for complexity	Consideration of interdependences of parts that make parts unite into the new whole
Requisite realism / materialism	Basis for requisite holism of consideration	Consideration that selection of the systems of viewpoints must consider reality in line with the law of requisite holism for results of consideration to be applicable

Pensamento holistico X Pensamento clássico

Systems / Systemic / Holistic Thinking	*Un-systemic / Traditional Thinking*
Interdependence/s, Relation/s, Openness, Interconnected-ness, Dialectical System	Independence, One-way dependence, Closeness, A single viewpoint / system
Complexity (plus complicatedness)	Simplicity or Complicatedness alone
Attractor/s	No influcntial forcc/s, but isolation
Emergence	No process of making new attributes
Synergy, System, Synthesis	No new attributes resulting from relations between ele-ments and with environment
Whole, holism, big picture	Parts and partial attributes only
Networking, Interaction, Interplay	No mutual influences

complicatedness *noun*

the state or quality of having many interrelated parts or aspects <the *complicatedness* of the home theater system may require that it be installed by a professional>

Synonyms complexness, complicacy, complicatedness, complication, elaborateness, intricacy, intricateness, involution, knottiness, sophistication

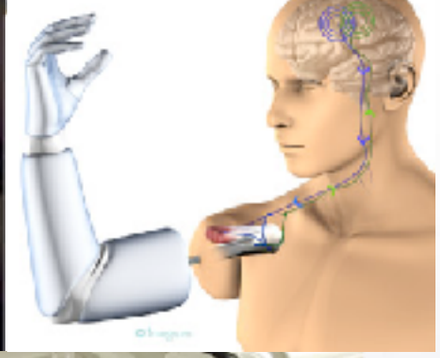
Related Words diversity, heterogeneity, heterogeneousness, multifariousness; impenetrability, incomprehensibility, inexplicability

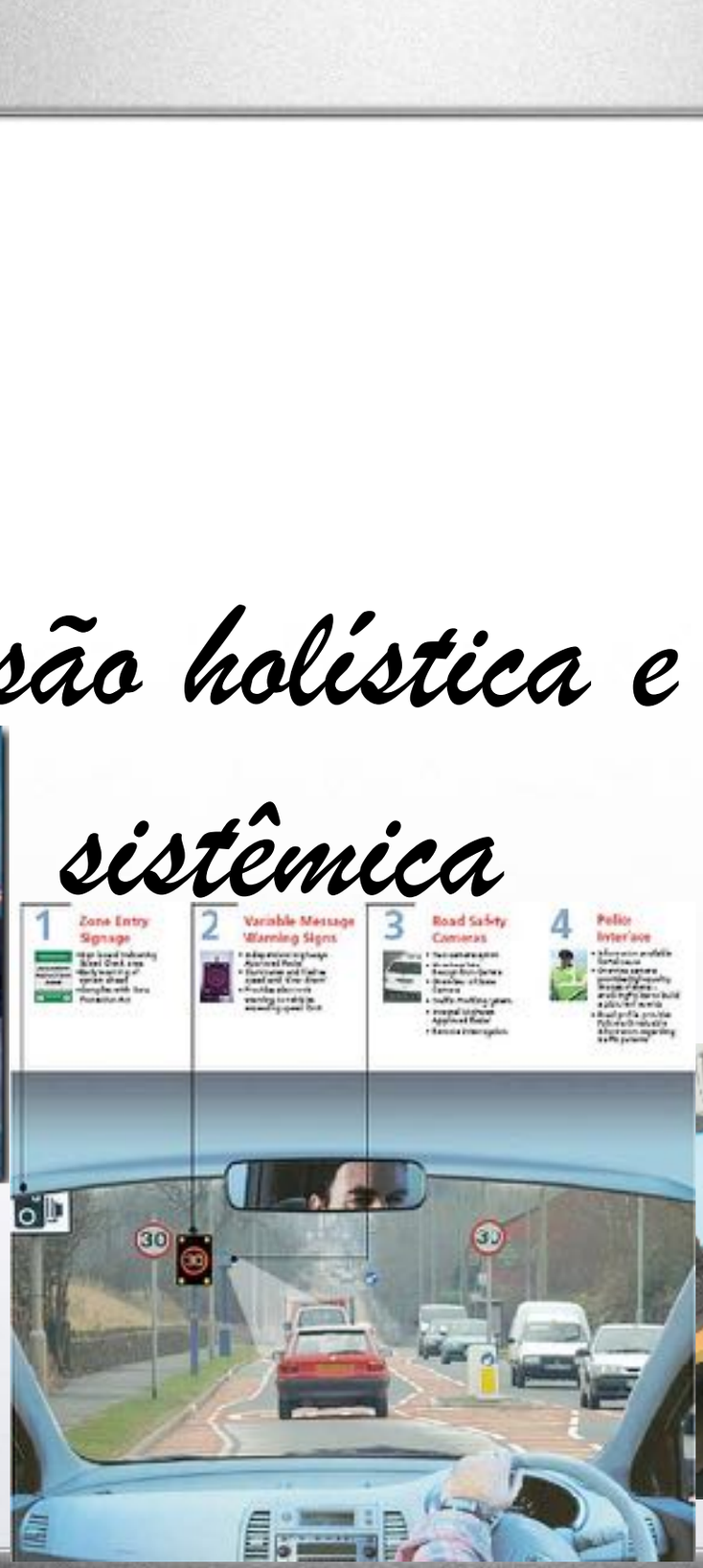
Near Antonyms simplification; homogeneity, uniformity

Antonyms plainness, simpleness, simplicity

Merry-Webster Dictionary

Visão holística e sistêmica





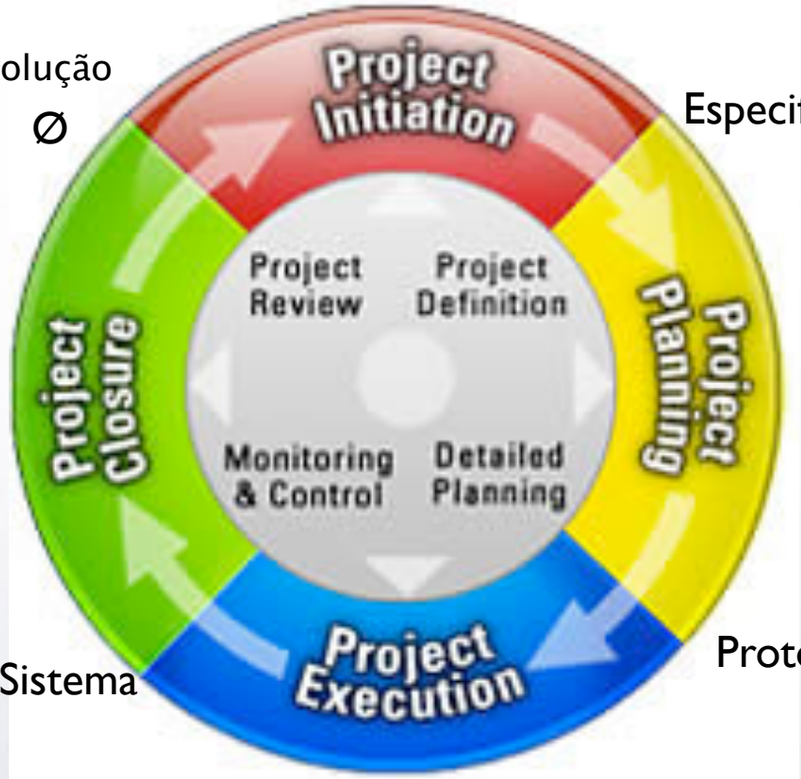
Design de Sistemas

O processo de projeto como disciplina

Eliciação,
Análise de Requisitos
Modelagem de requisitos
Validação

Demanda por evolução
Ø

Especificação



Contextualização
Encapsulamento
Treinamento
Plano de eliminação

Modelagem preliminar
Modelagem Formal
Verificação
Teste Preliminar

Sistema

Protótipo

Deployment
Teste de Campo
Planejamento da manutenção

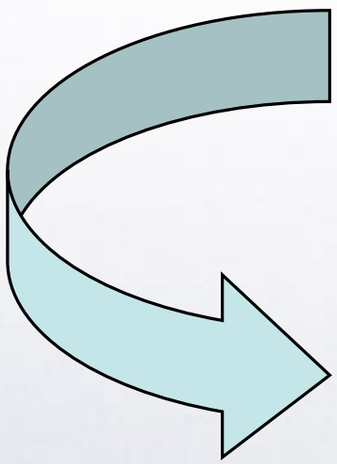
Um problema desta fase de projeto é sem dúvida a incompleteza do "modelo", e necessidade de usar várias representações (e mudar de um para outra) sem perder o foco do que é o artefato.

Em todo processo de projeto a documentação é essencial.

SADT: Structured Analysis and Design Technique

Criada nos anos 80 para subsidiar o projeto de criação da primeira máquina de comando numérico, especialmente a criação do código G.

Marca, D., SADT: Structured Analysis and Design Technique, McGraw Hill, 1988.



- Direcionado para programação
- Baseado no conceito de blocos funcionais
- Blocos são disjuntos e includentes

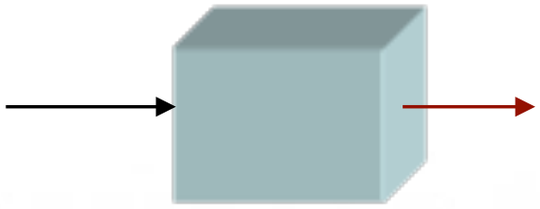
SADT: Structured Analysis and Design Technique

Um ***bloco*** é um conjunto genérico de instruções de programa, onde uma dada instrução é identificada como a entrada do bloco e outra (diferente da primeira) é identificada como a saída.

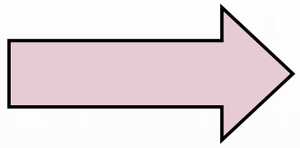
Se A e B são blocos de um mesmo programa, então A e B são ditos independentes se e somente se $A \cap B = \varnothing$.

Se A e B são tais que $A \cap B \neq \varnothing$ então $(A \subseteq B)$ OU $(B \subseteq A)$

Elementos de estruturação



Elementos próprios



Base de elementos constituintes (componentes)

Elementos próprios indivisíveis são chamados primos. Um conjunto LI de elementos primos pode constituir uma base e portanto pode descrever qualquer programa.

Em busca do processo de projeto

O nosso caminho em direção ao estudo do design e dos processos de projeto começa por:

i) identificar os "grandes métodos" ou paradigmas clássicos;

ii) estudar o papel da representação formal;

iii) estudar a fase principal que é a fase de definição do projeto;

iv) estudar o papel da modelagem e prototipagem no design mecatrônico.

Mechatronic Design

Análise Estruturada: Coceitos Básicos

➜ Process (data transformation)
- activities that transform data
- related by dataflows to other processes, data store, and external entities.

➜ Data flow
- indicate passage of data from output of one entity to the input of another
- represent a data group or data element

➜ Data store
- a place where data is held for later use
- data stores are passive: no transformations are performed on the data

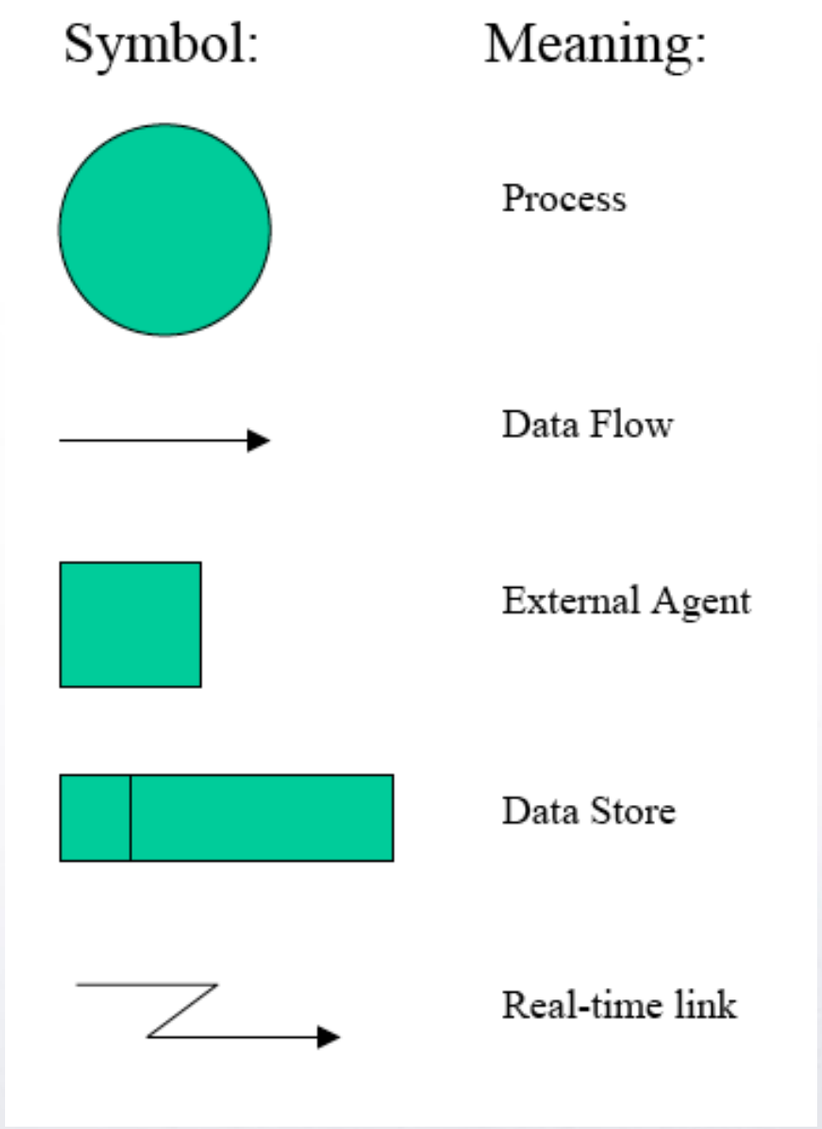
➜ External entity
- an activity outside the target system
- acts as source or destination for dataflows that cross the system boundary
- external entities cannot interact directly with data stores

➜ Data group
- a cluster of data represented as a single dataflow
- consists of lower level data groups, or individual elements

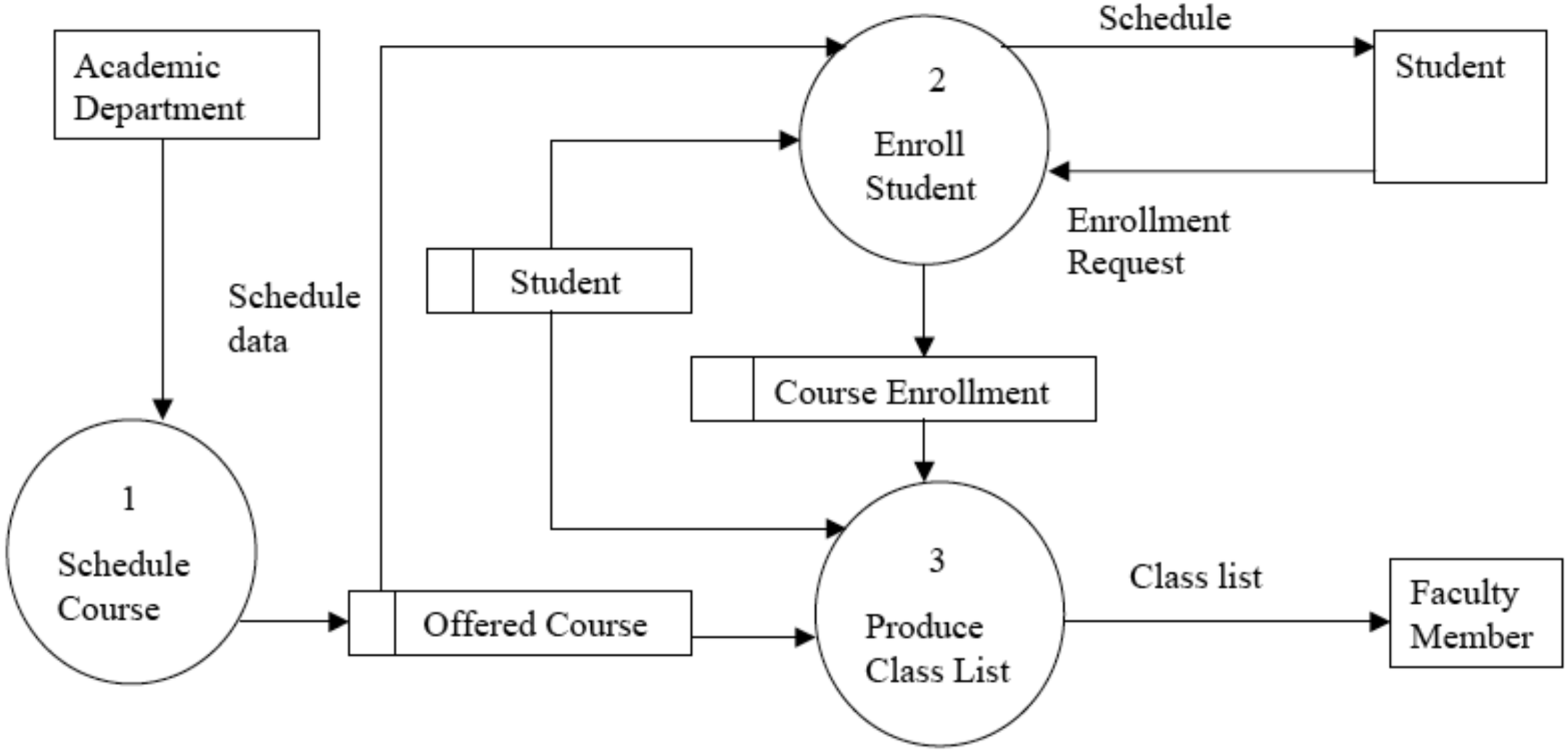
➜ Data element
- a basic unit of data

DFD: Diagrama de Fluxo de Dados

A representação de design por diagramas é anterior aos métodos atuais e foi inserida – da forma disciplinada dos DFD's – com o métodos estruturado.

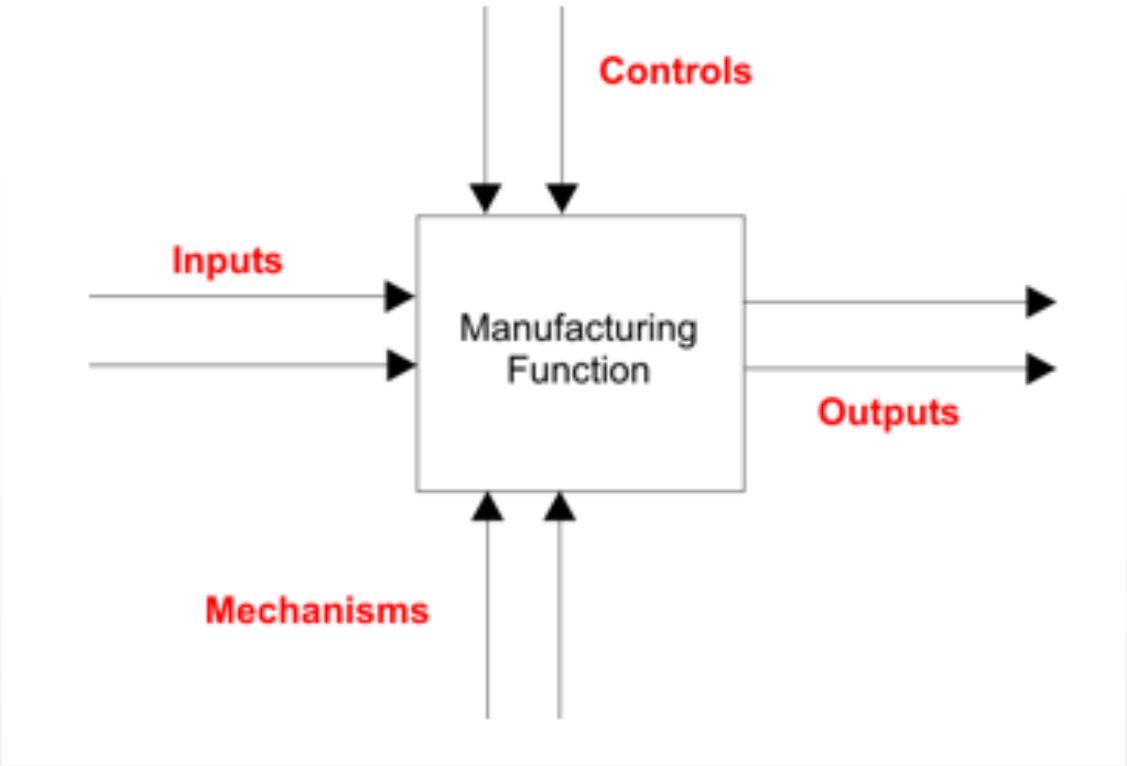


Um exemplo: a matrícula semestral de estudantes



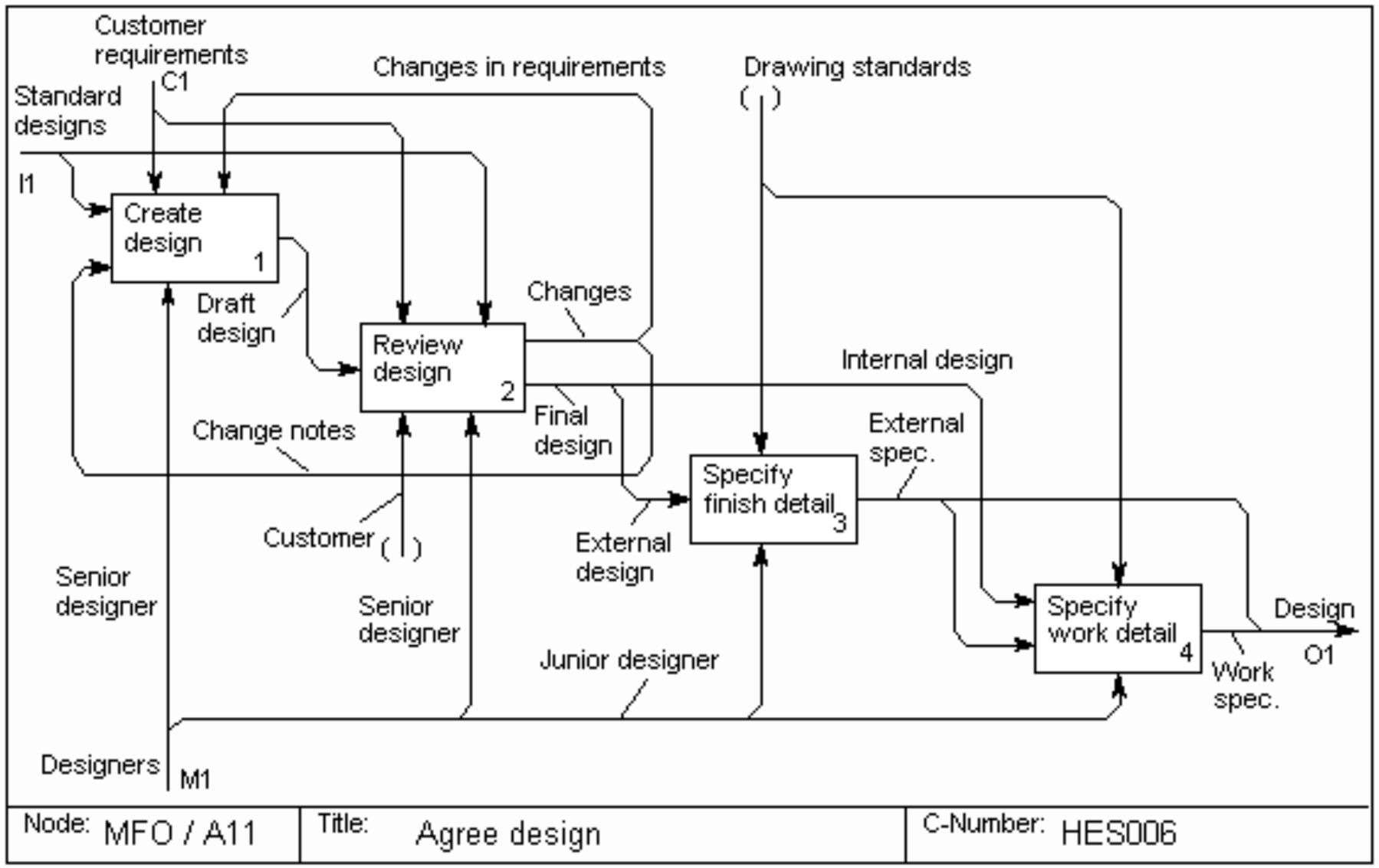
IDEF: *Integrated Design Technique*

IDEF0

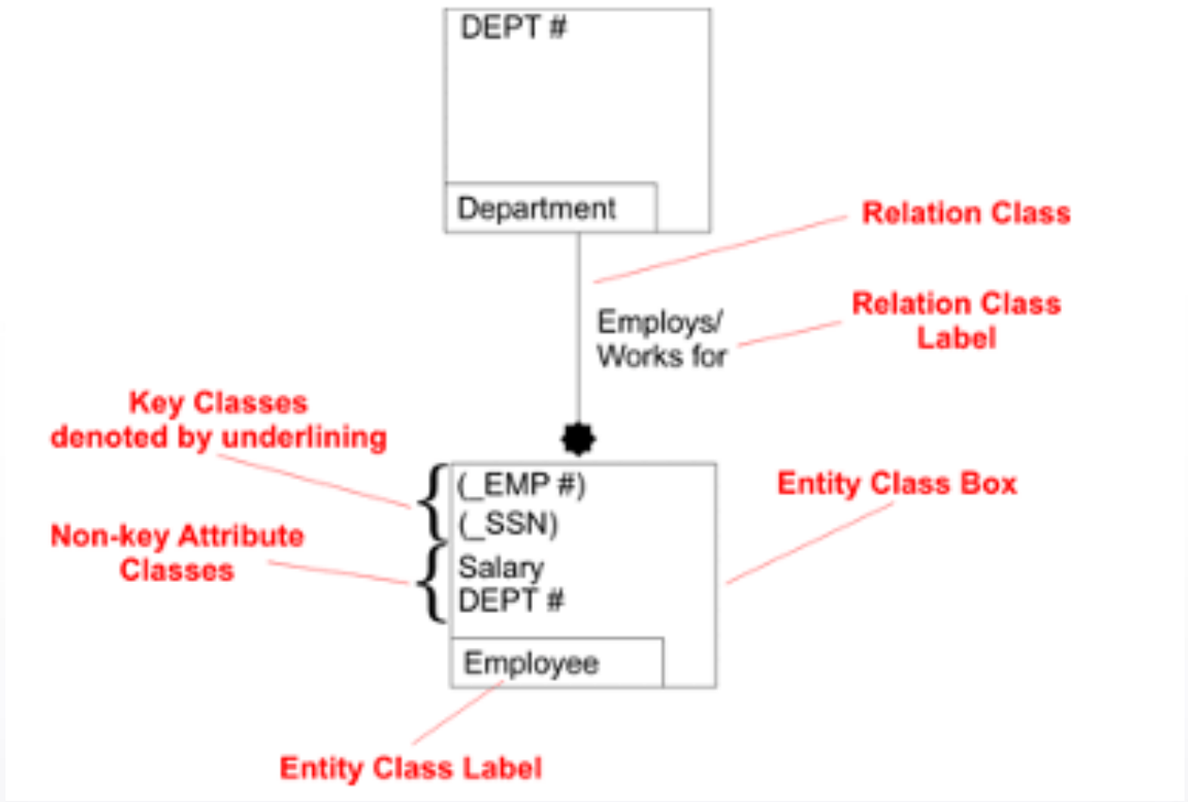


Particularmente desenhado para modelagem funcional

IDEF0: Exemplo

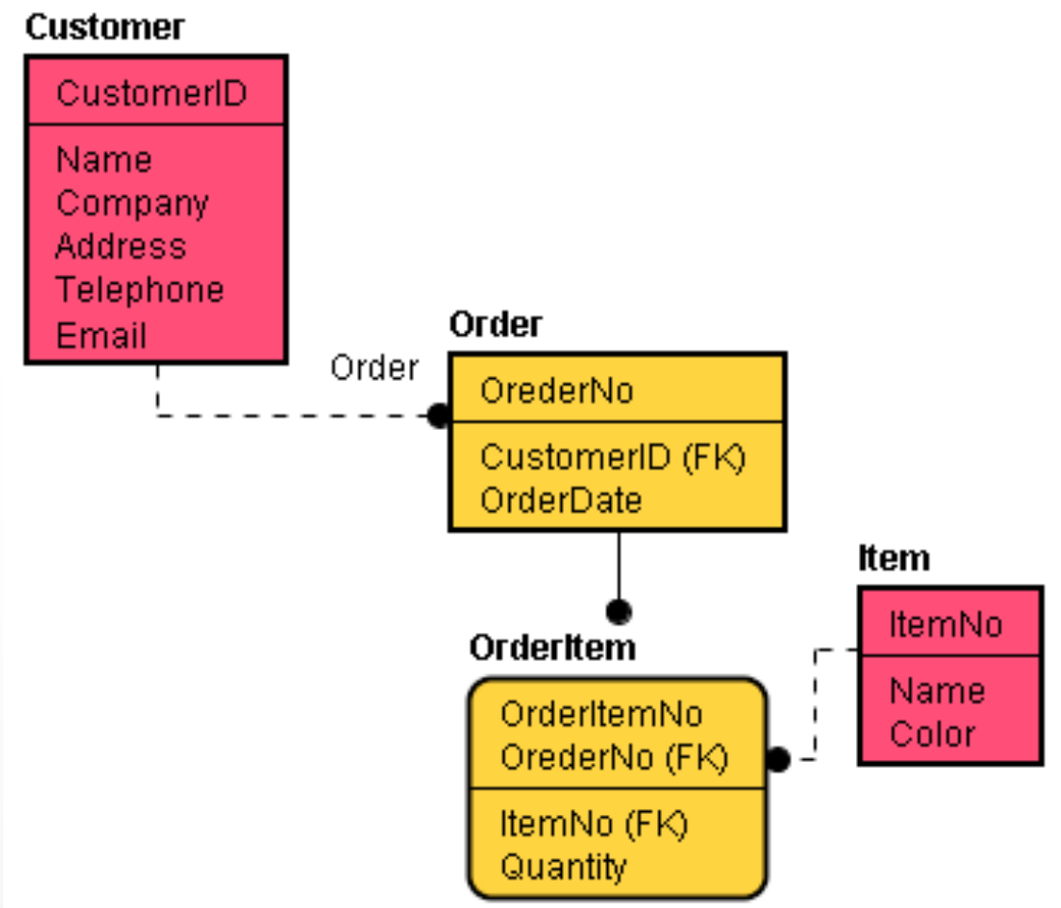


IDEF1



Modelagem e identificação da informação e seu fluxo.

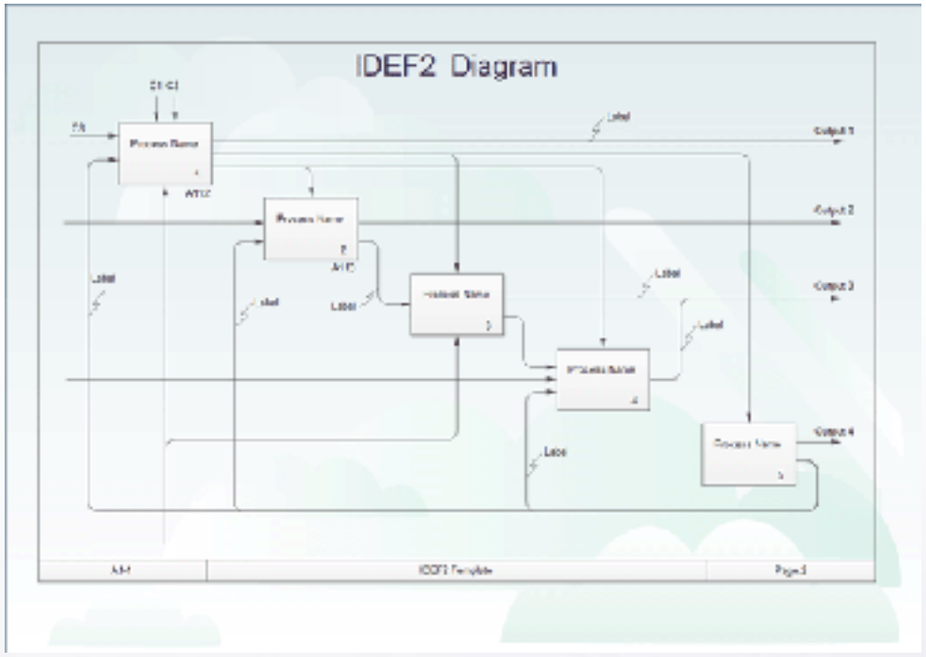
IDEF1x



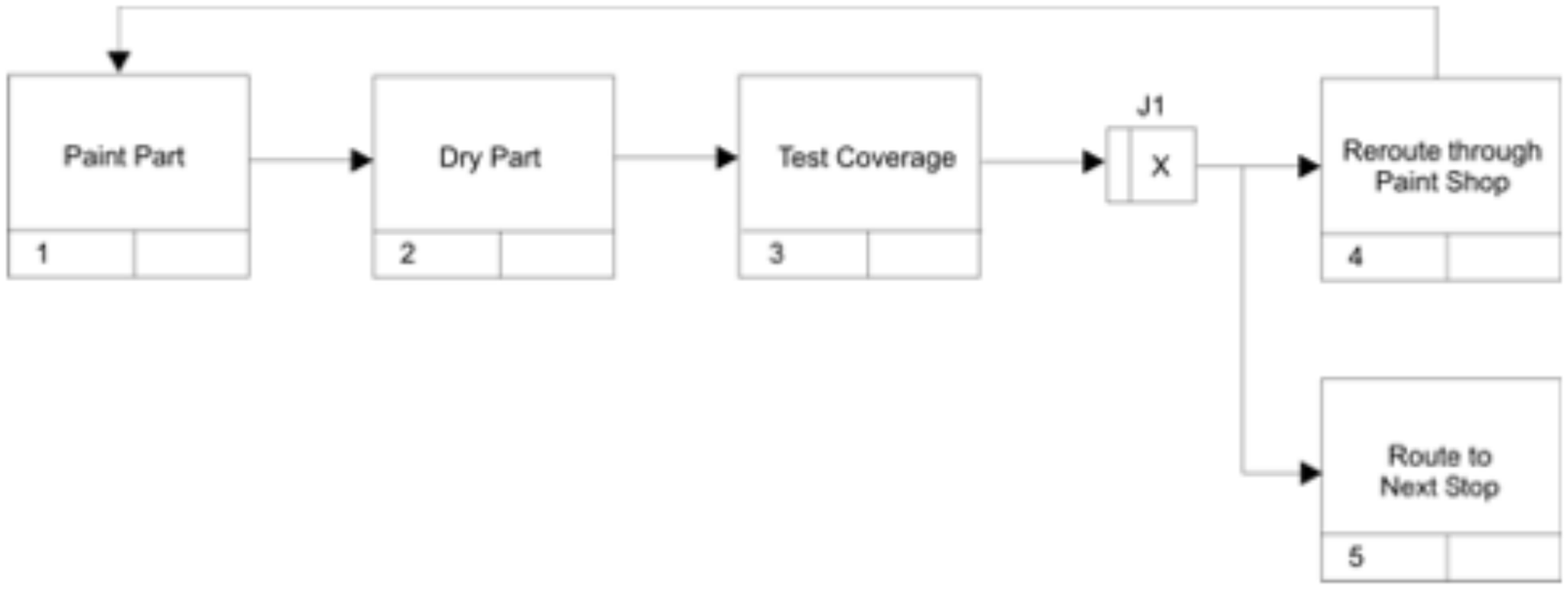
Modelagem de dados (diagrama E-R)

O controverso IDEF2 !

O IDEF2 foi inicialmente dedicado à representação da interface com o usuário (funcionalmente). Portanto passou também a significar a especificação de um processo de simulação do sistema, na interação com o seu "contexto". Surgiu então a polêmica entre a especificação do que o sistema pode e deve fazer e o estabelecimento de um modelo capaz de prever o comportamento deste sistema.



IDEF3



Divide os processos de transformação (funcionais) em *unities of behavior* (UOB) e modela o fluxo e controle entre eles.

O IDEF4 foi inserido para permitir a descrição de sistemas orientados a objetos.

O IDEF5 permite a descrição usando ontologias e a representação de rationales.

A familia IDEF tem acompanhado a evolução das tendências em design e por isso mesmo continua atual e ainda usada por uma faixa do mercado.

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IDEF0 Diagram Software

IDEF Definition

IDEF is based on the Structured Analysis and Design Technique (SADT), a graphical approach to system description, introduced by Douglas T. Ross in the early 1970s. Since then, system analysts at Softech, Inc. have refined and used SADT on a wide variety of problems. In 1981, the U.S. Air Force Program for Integrated Computer-Aided Manufacturing (ICAM) standardized and made public a subset of SADT, called IDEF.

IDEF0 diagram was originally used to apply structured methods to better understand how to improve manufacturing productivity. IDEF0 was initially created at Northrop Corporation in 1966, and first available commercially by SofTek in 1972. An **IDEF0 activity diagram** contains one level of decomposition of a process. Boxes within a diagram show the subprocesses of the parent process named by the diagram. Arrows between the boxes show the flow of products between processes.

IDEF0 diagrams typically include the following components:

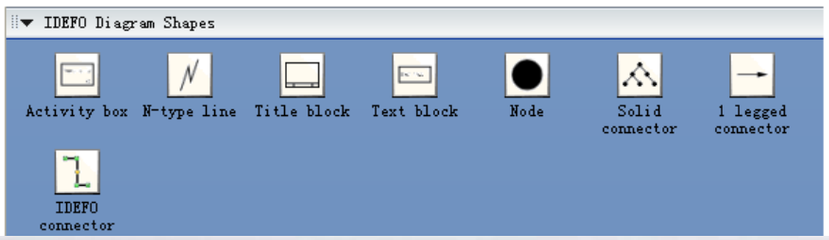
Context diagram - The topmost diagram in an IDEF0 model.

Parent/child diagram - An IDEF0 decomposition hierarchy using parent/child relationships.

Node trees - Tree-like structures of nodes rooted at a chosen node, and used to represent a full IDEF0 decomposition in a single diagram.

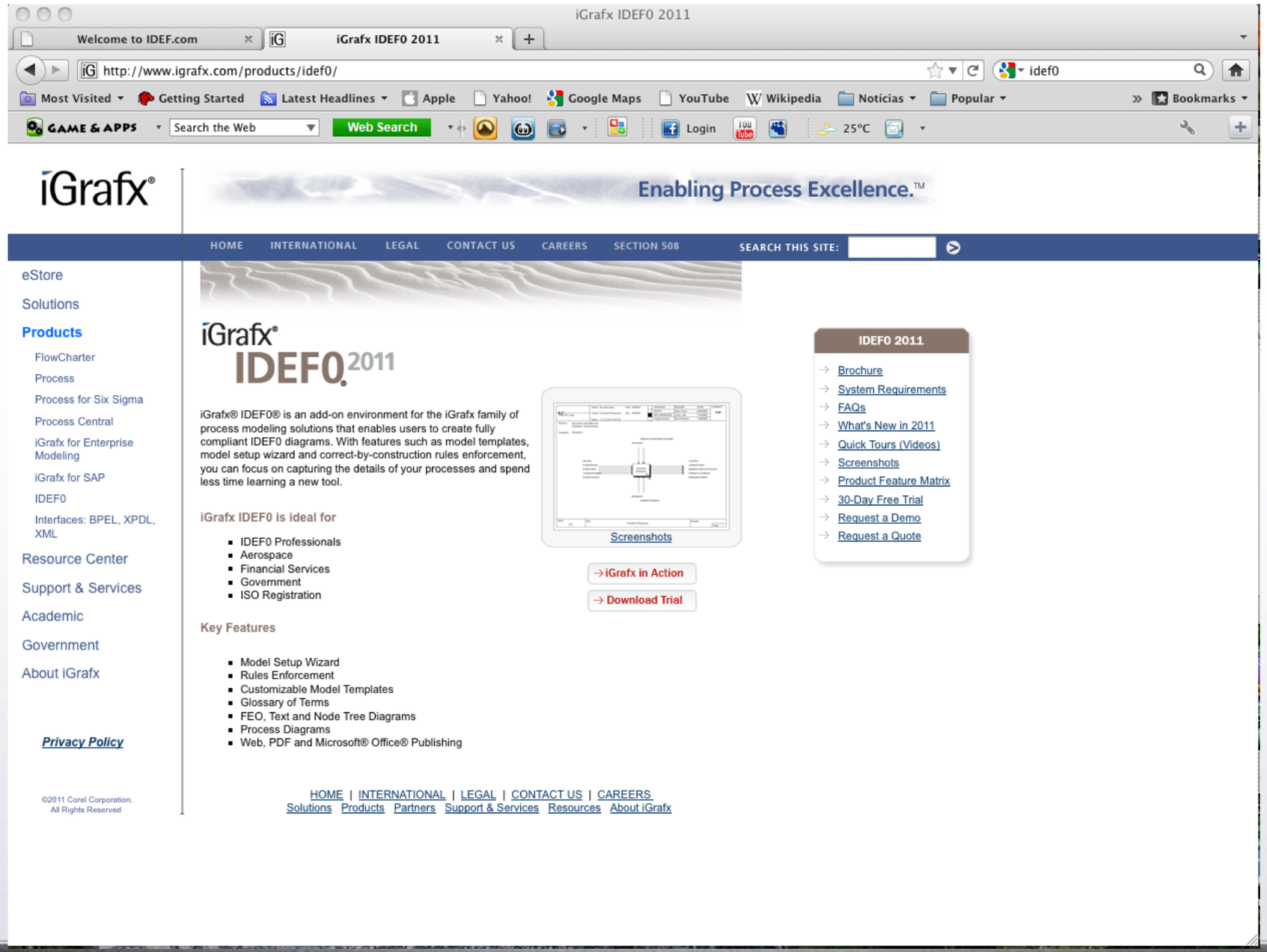
Create hierarchical diagrams using IEDF0 process charting models for model configuration management, need and benefit analyses, requirements definitions, and continuous improvement models.

Free Download IEDF0 Software and View All Examples



Easy to Create

- Basic Flowchart
- Highlight Flowchart
- Audit Flowchart
- Process Flowchart
- Cross Functional Flowchart
- Value-Added Flow Chart
- SDL Diagram
- Data Flow Diagram
- Work Flow Diagram
- IDEF0 Flowcharts
- Organizational Chart
- Mind Map
- Business Diagram
- Business Process
- Cycle Diagram
- Hierarchy Diagram
- Marketing Chart and Diagram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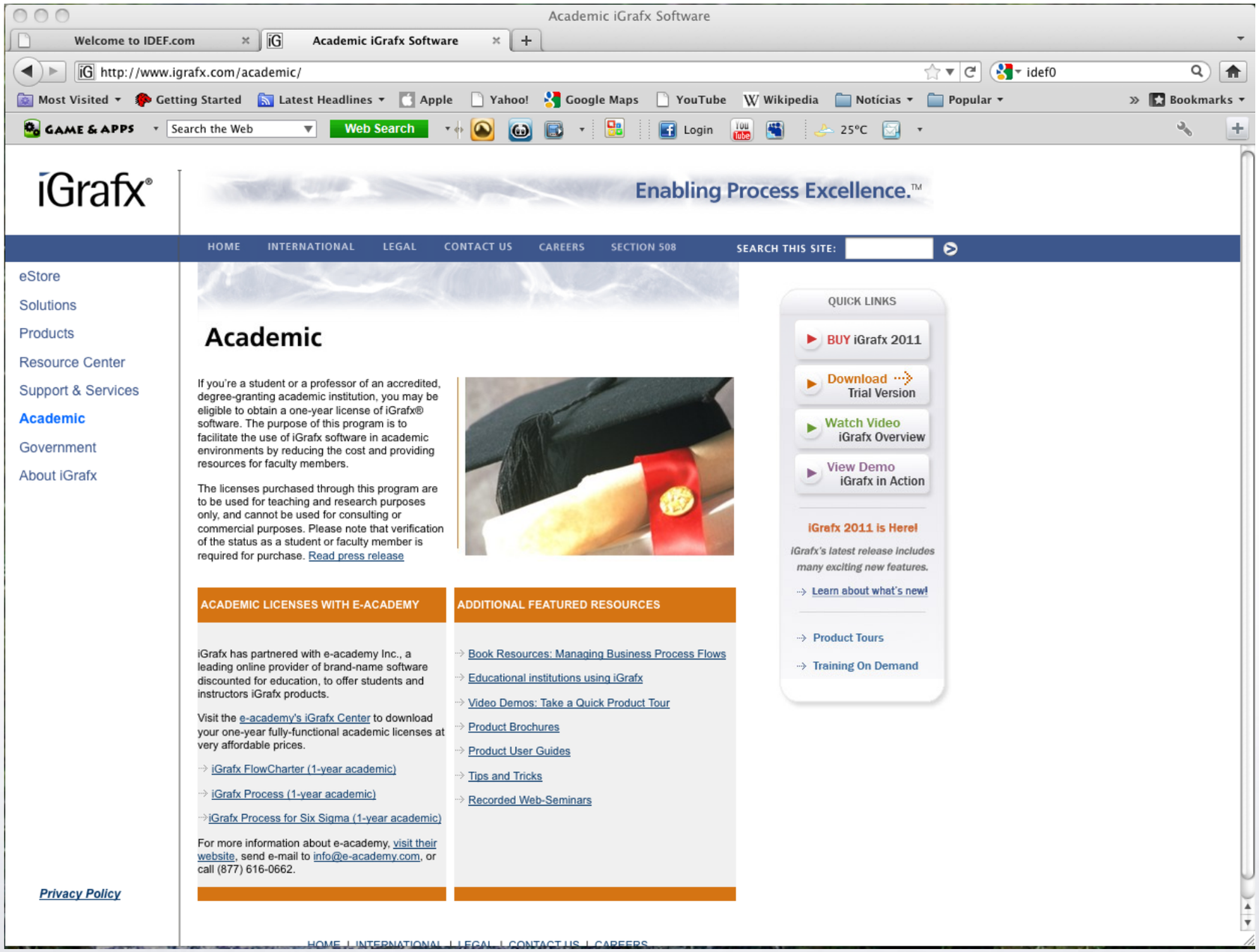
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Gerência do Projeto

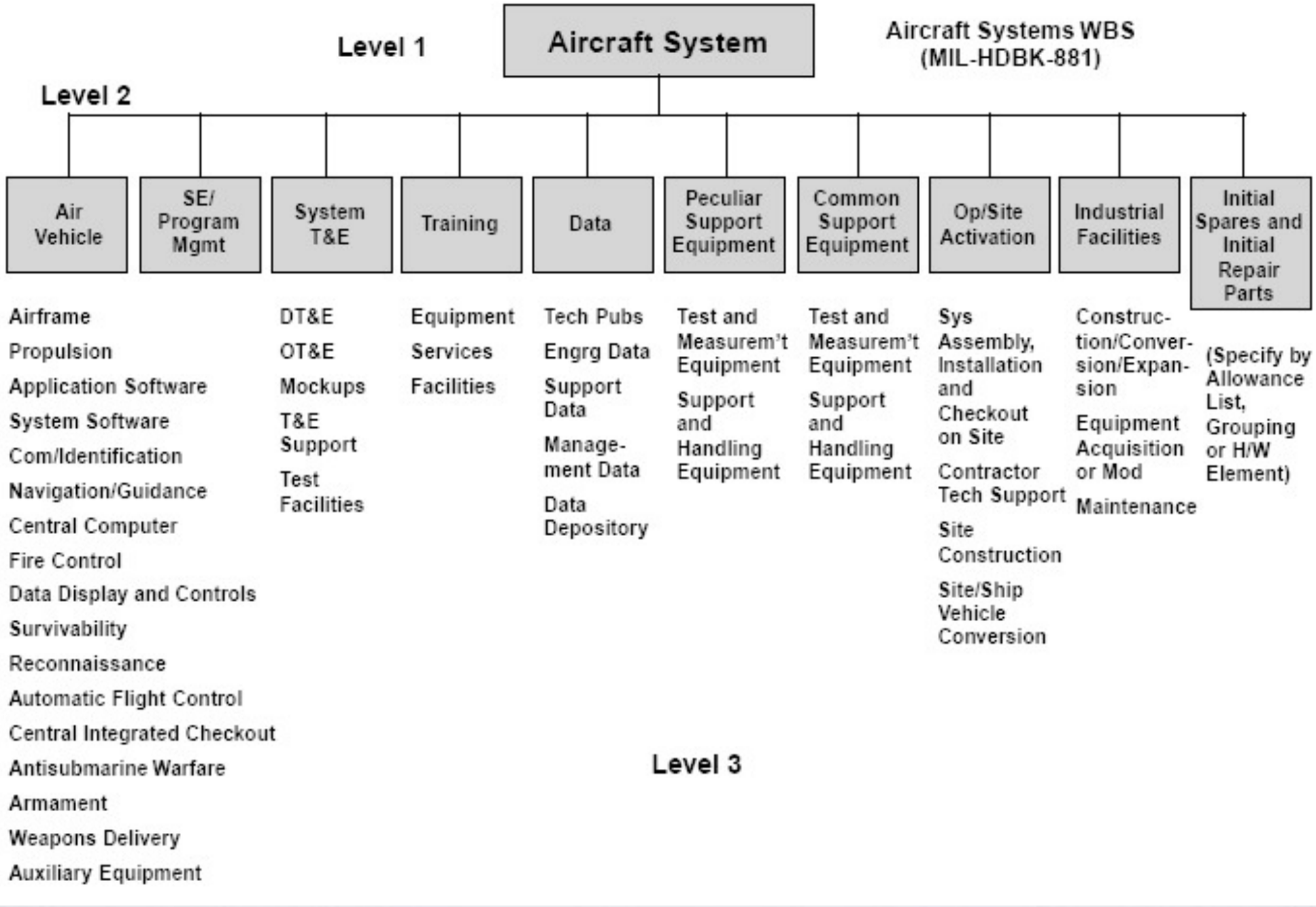
1957 - projeto Polaris, criação do PERT (Program Evaluation and Review Technique)

1962 - NASA e o Dept. of Defense (DoD) introduziram o WBS (Work Breakdown Structure)

Elementos de uma WBS (por nível)

1. Definição do escopo do projeto e do "produto" que seria entregue;
2. Data de inicio e fim do projeto do escopo;
3. "Budget" do escopo;
4. Equipe relacionada com o projeto

O projeto é visto como um "produto"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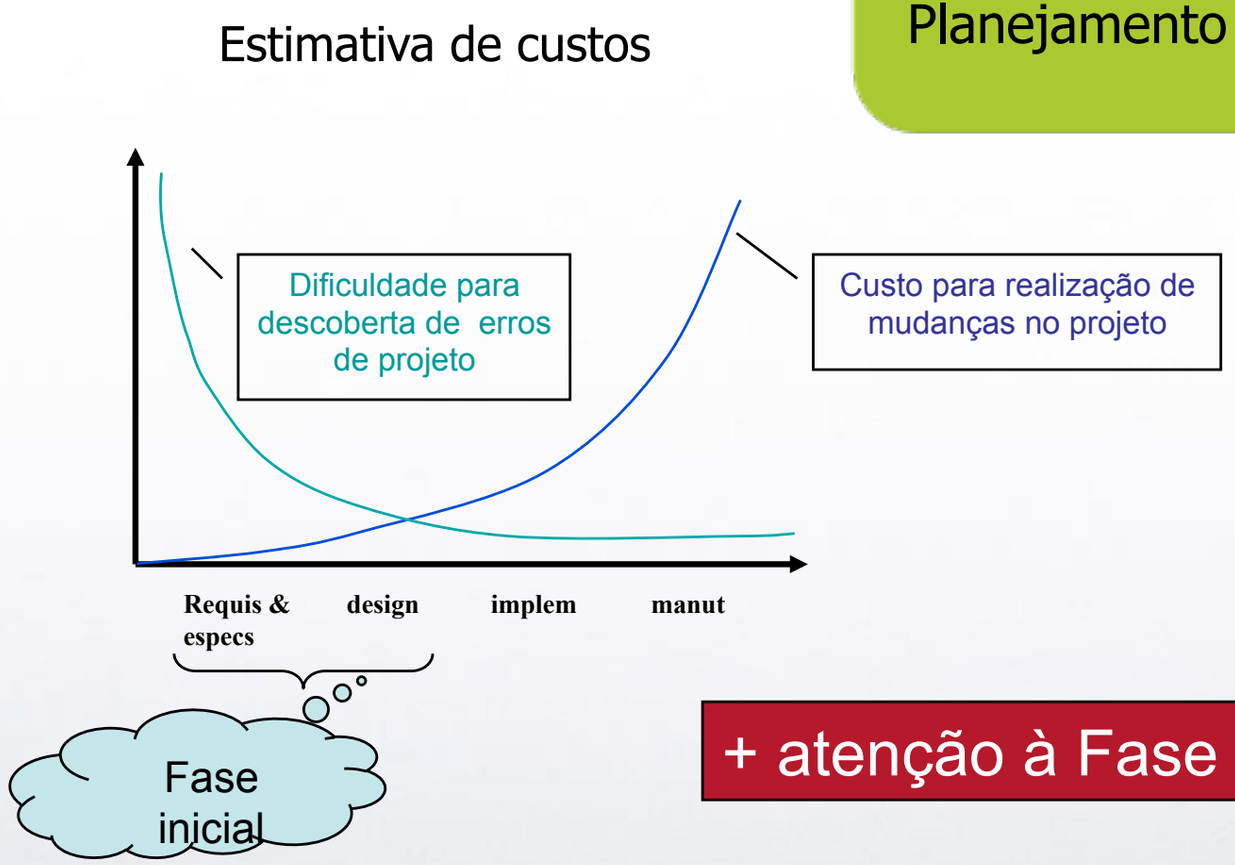
Aircraft System
Aircraft Systems WBS
(MIL-HDBK-881)
Level 2
Air Vehicle
SE/ Program Mgmt
System T&E
Training
Data
Peculiar Support Equipment
Common Support Equipment
Op/Site Activation
Industrial Facilities
Initial Spares and Initial Repair Parts
Airframe
Propulsion
Application Software
System Software
Com/Identification
Navigation/Guidance
Central Computer
Fire Control
Data Display and Controls
Survivability
Reconnaissance
Automatic Flight Control
Central Integrated Checkout
Antisubmarine Warfare
Armament
Weapons Delivery
Auxiliary Equipment
DT&E
OT&E
Mockups
T&E Support
Test Facilities
Equipment
Services
Facilities
Tech Pubs
Engrg Data
Support Data
Manage-ment Data
Data Depository
Test and Measurem't Equipment
Support and Handling Equipment
Test and Measurem't Equipment
Support and Handling Equipment
Sys Assembly, Installation and Checkout on Site
Contractor Tech Support
Site Construction
Site/Ship Vehicle Conversion
Construc-tion/Conver-sion/Expan-sion
Equipment Acquisition or Mod
Maintenance
(Specify by Allowance List, Grouping or H/W Element)
Level 3

Voltando aos princípios

Ciclo de vida
Processo de projeto
Gerenciamento de projeto
Planejamento de projeto



+ atenção à Fase Inicial

Motivação financeira

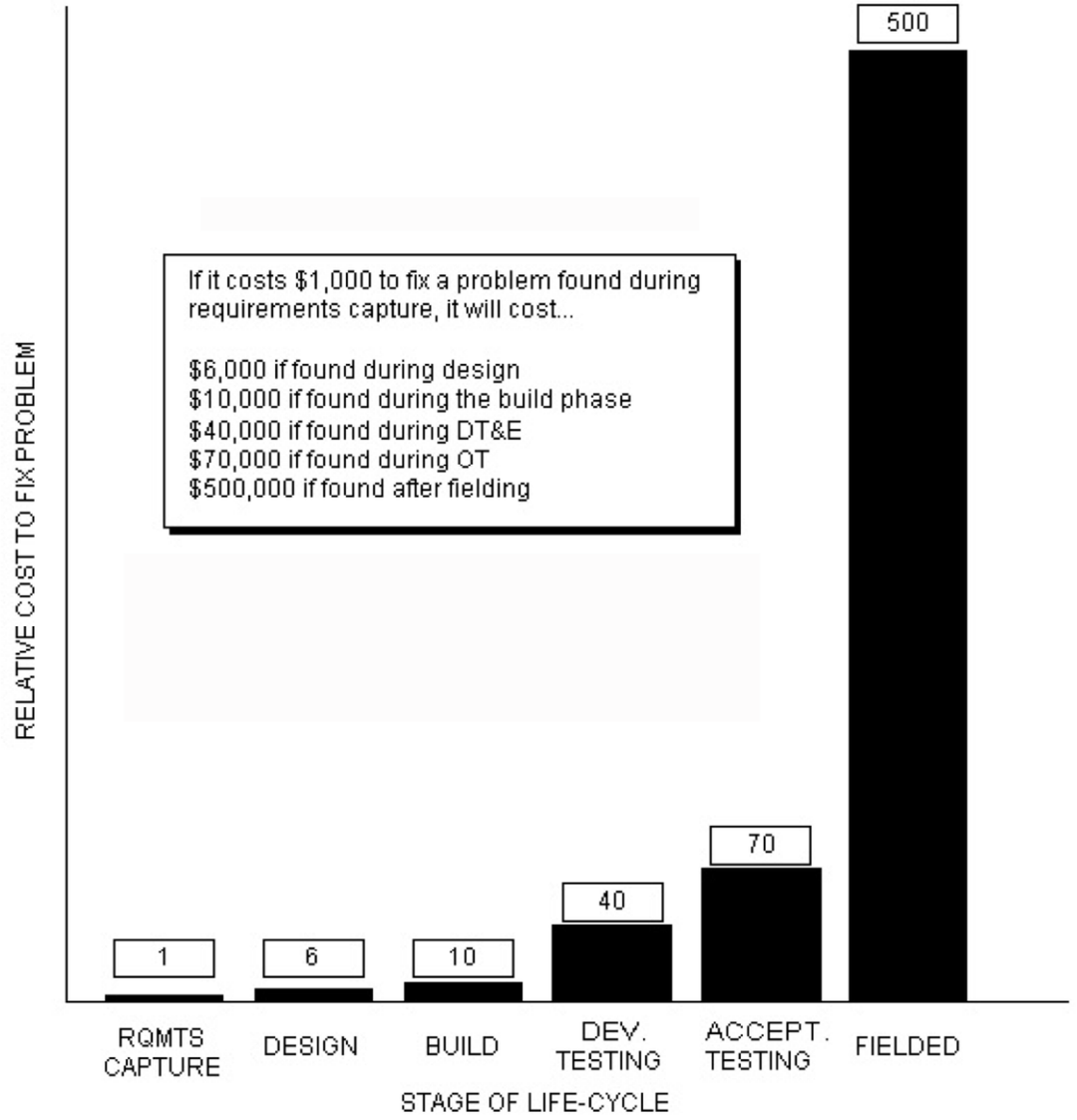


Figura 1: Custo para correção de erros no desenvolvimento de sistemas

Requisitos: Uma visão científica

Nature
(**N**ovel **A**pproaches to **T**heory **U**nderlying **R**equirements **E**ngineering)
ESPRIT Basic Research Project 6353

- a theory of knowledge representation that embraces subject, usage and development worlds surrounding the system, including “expressive freedoms”.
- a theory of domain engineering that facilitates the identification, acquisition and formalization of knowledge domain, as well as similarity-based matching of and classifying of software engineering knowledge.
- A process engineering theory that promotes context and decision based control of the development process.

Metas para a Engenharia de Requisitos

Metas tradicionais

Eliciação de requisitos à partir de usuários preferenciais (*stakeholders*), de usuários finais, e dos próprios engenheiros de desenvolvimento

Análise e integração dos diversos pontos de vista e introdução de requisitos não-funcionais, organizacionais e de performance

Documentação dos requisitos

Novas metas

Introdução do **CARE (Computer Aided Requirement Engineering)** onde o processo de análise e integração dos requisitos é feito, além de fornecer bases para decisões de projeto.

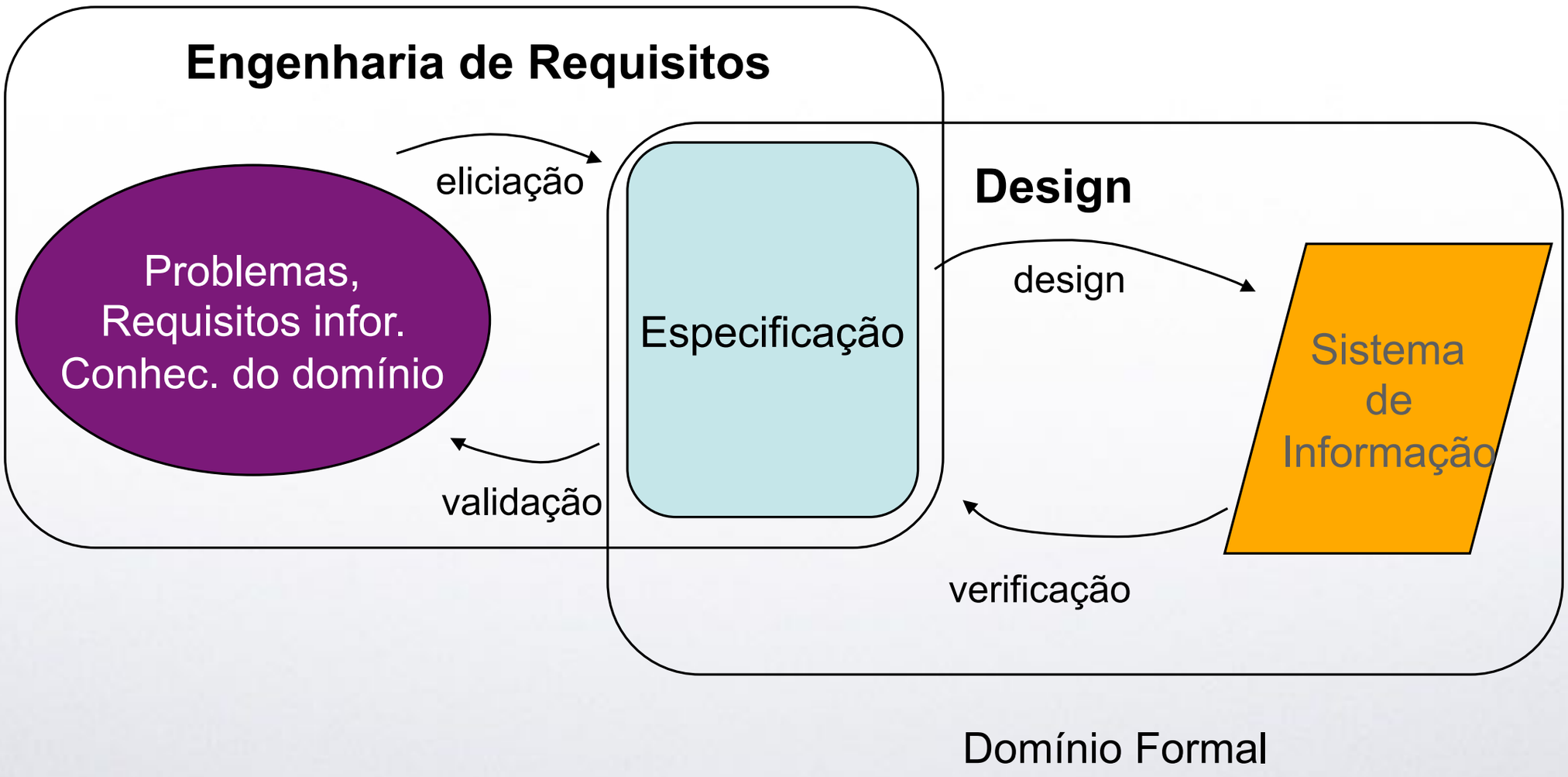
A reutilização de requisitos baseado em uma estrutura orientada a objetos onde a base de uma família de requisitos é o seu **modelo de referência**.

A engenharia reversa de modelos de requisitos e formação de uma **biblioteca global de modelos**.

A **re-engenharia** de sistemas e processos de negócios baseado na RE

O que é capturado de fato?

Jarke, M., Bubenko, J., Rolland, C., Sutcliff, A., Vassilious, Y.; Theories Underlying Requirements Engineering: An Overview of NATURE at Genesis.



Estruturando a ER

Em uma tentativa para estruturar a Engenharia de Requisitos podemos entender o seu conteúdo teórico como sendo composto dos seguintes tópicos semi-formais:

Psicologia cognitiva: para entender e contornar as dificuldades que as pessoas têm para verbalizar (formalizar) as suas necessidades;

Antropologia: para prover uma abordagem metódica para o processo de harmonização do comportamento colaborativo homem/máquina.

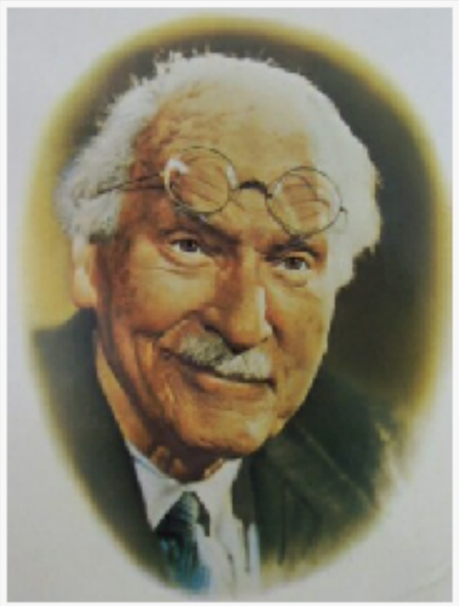
Sociologia: para entender as mudanças políticas, sociais e organizacionais que levam à volatilidade dos requisitos;

Lingüística: porque ER é essencialmente um problema de comunicação.

Nuseibeh, B. and Easterbrook, S., Requirements Engineering: a Roadmap, on Proc. of the Conf. on the Future of Software Engineering, ACM, New York, USA, 2000.

No início era o verbo, isto é, o substantivo...

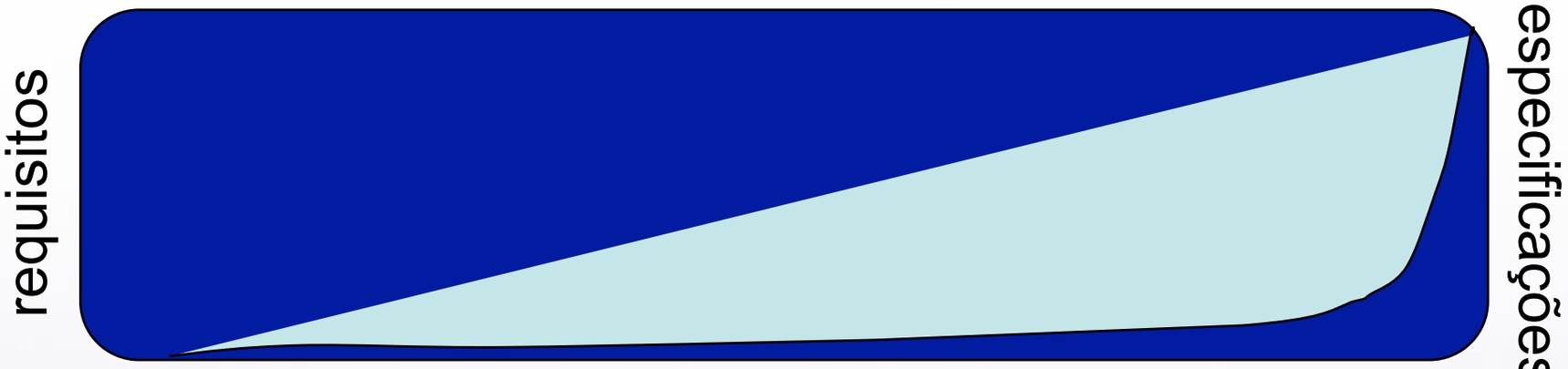
Arquétipo



. . .os arquétipos são conjuntos de "imagens primordiais" originadas de uma repetição progressiva de uma mesma experiência durante muitas gerações, armazenadas no inconsciente coletivo.

Uma visão intuitiva...

Eliciação (elicitation)

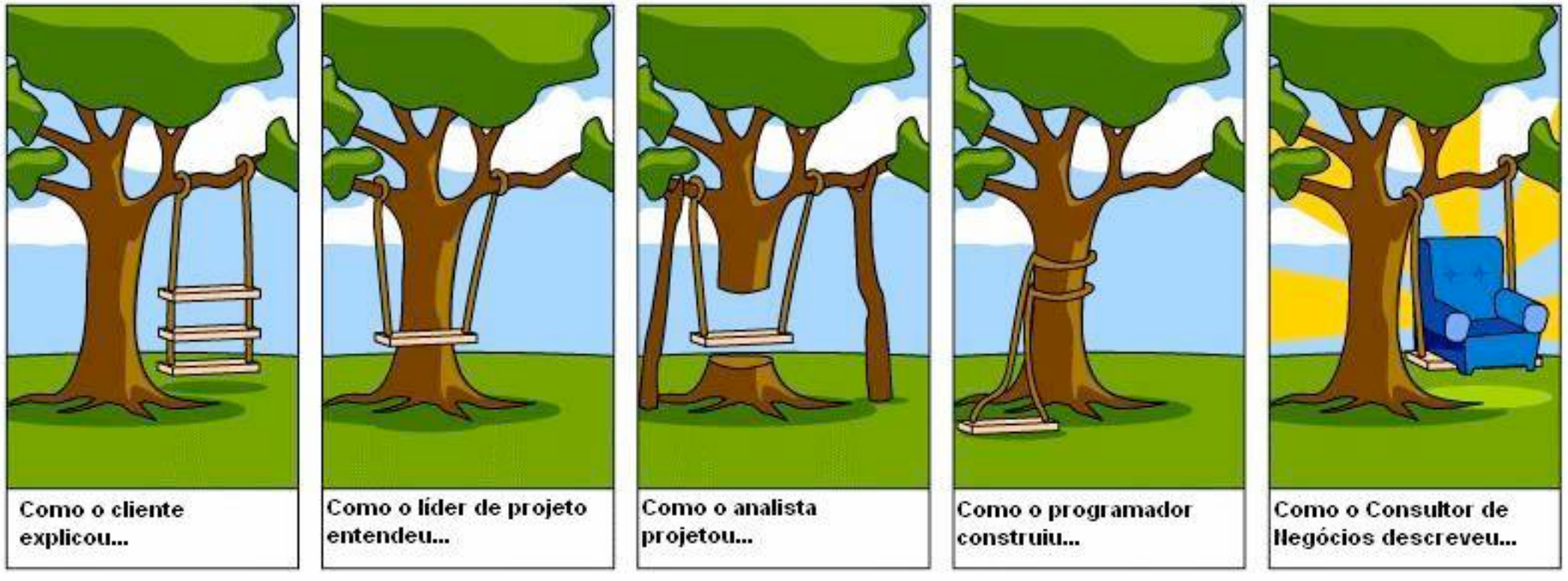


Modelagem e representação formal de requisitos

invariantes

Eliciar é retirar da "cabeça" do usuário ou stakeholder os seus "arquétipos". (J. R. Silva)

Analisar e "modelar" os requisitos consiste em, de fato, "sublimar" os arquétipos do engenheiro tendo como modelo de referencia os arquétipos do usuário ou stakeholder. (J. R. Silva)


Como o cliente explicou...
Como o líder de projeto entendeu...
Como o analista projetou...
Como o programador construiu...
Como o Consultor de Negócios descreveu...
Como o projeto foi documentado...
Que funcionalidades foram instaladas...
Como o cliente foi cobrado...
Como foi mantido...
O que o cliente realmente queria...

O processo de eliciação de requisitos

Processo de eliciação de requisitos pode ser classificado como:

- Métodos tradicionais (baseados na relação direta e direcionada com usuários e stakeholders)

- Técnicas de grupo (direcionados e classes de stakeholders)

- Prototipagem “rápida”(virtual)

- Técnicas orientadas a modelos (model-driven)

- Técnicas cognitivas : direcionadas e controladas por KBSs

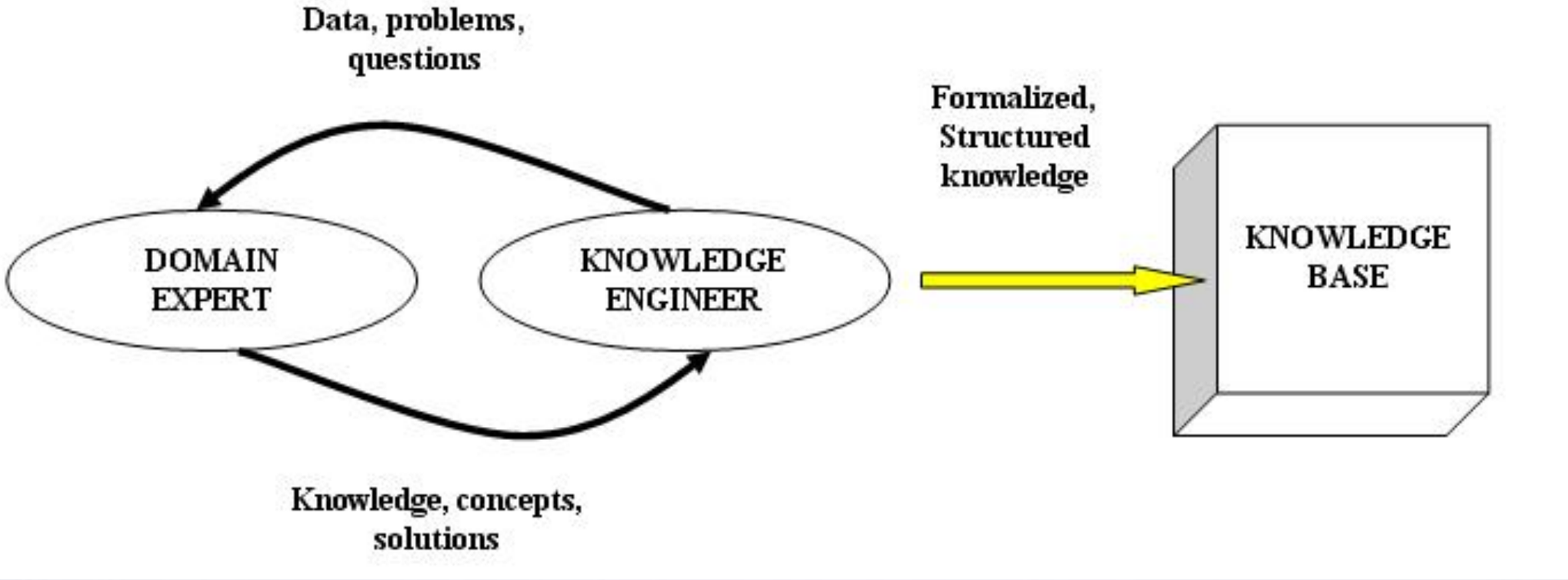
- Técnicas contextuais: direcionadas aos métodos etnográficos.

Modelando Requisitos

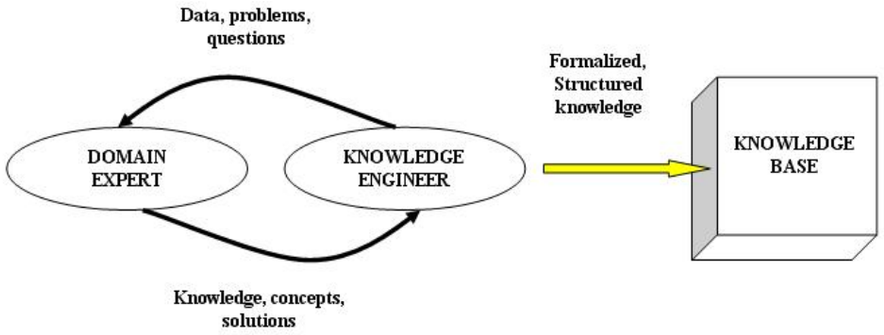
Processo de projeto da ER consiste em modelar sistemas em várias vistas, tais como:

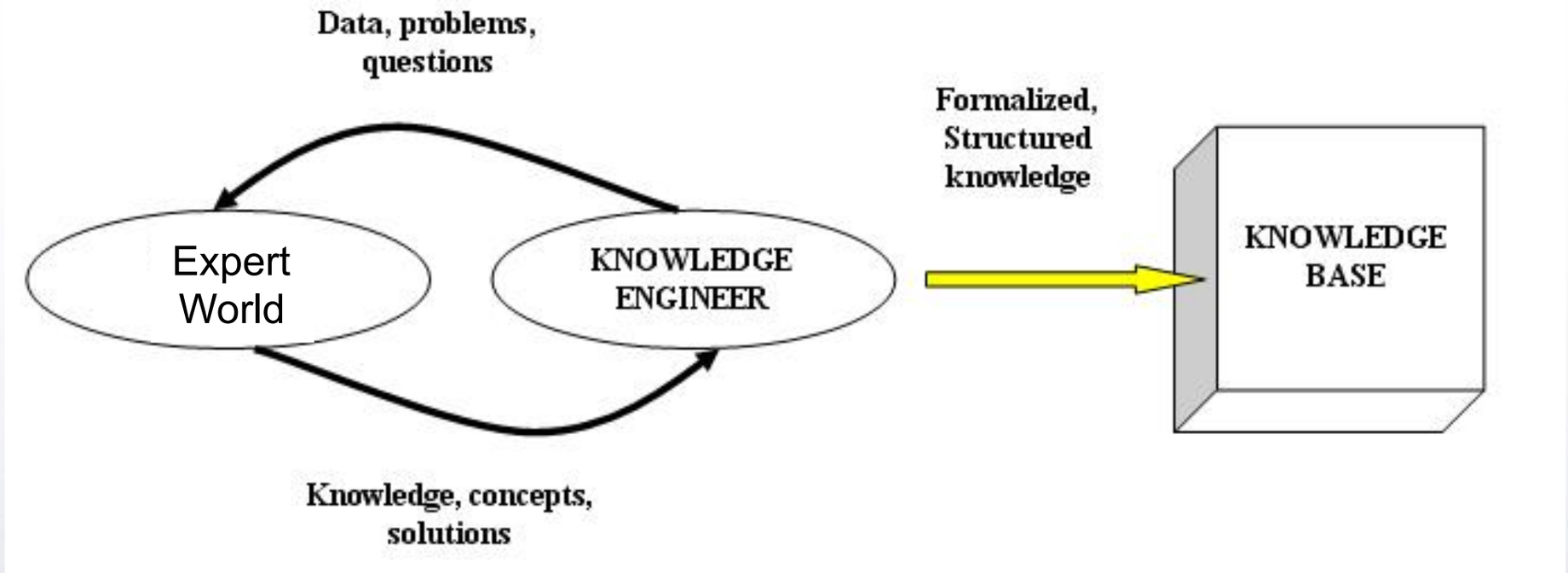
- Modelagem organizacional
- Modelagem Estática (ou modelagem de dados)
- Modelagem Comportamental (ou dinâmica)
- Modelagem Contextual (ou de domínio)
- Modelagem Não-funcional

Knowledge Engineering



O processo de eliciação





O acoplamento de domínios

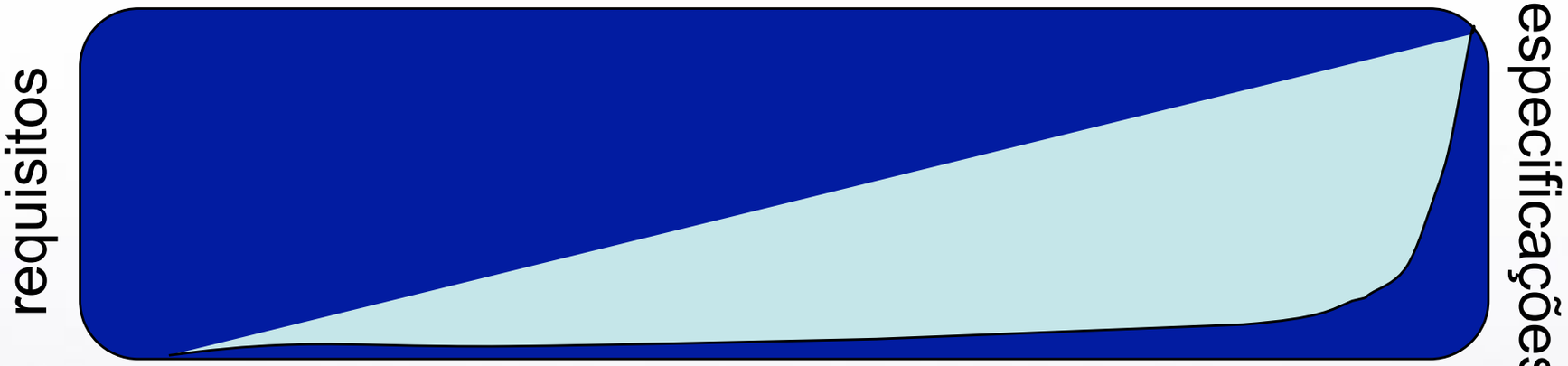
Domínios acoplados

Domínios disjuntos

O problema da análise de requisitos

ER = Eliciação + Modelagem + Análise

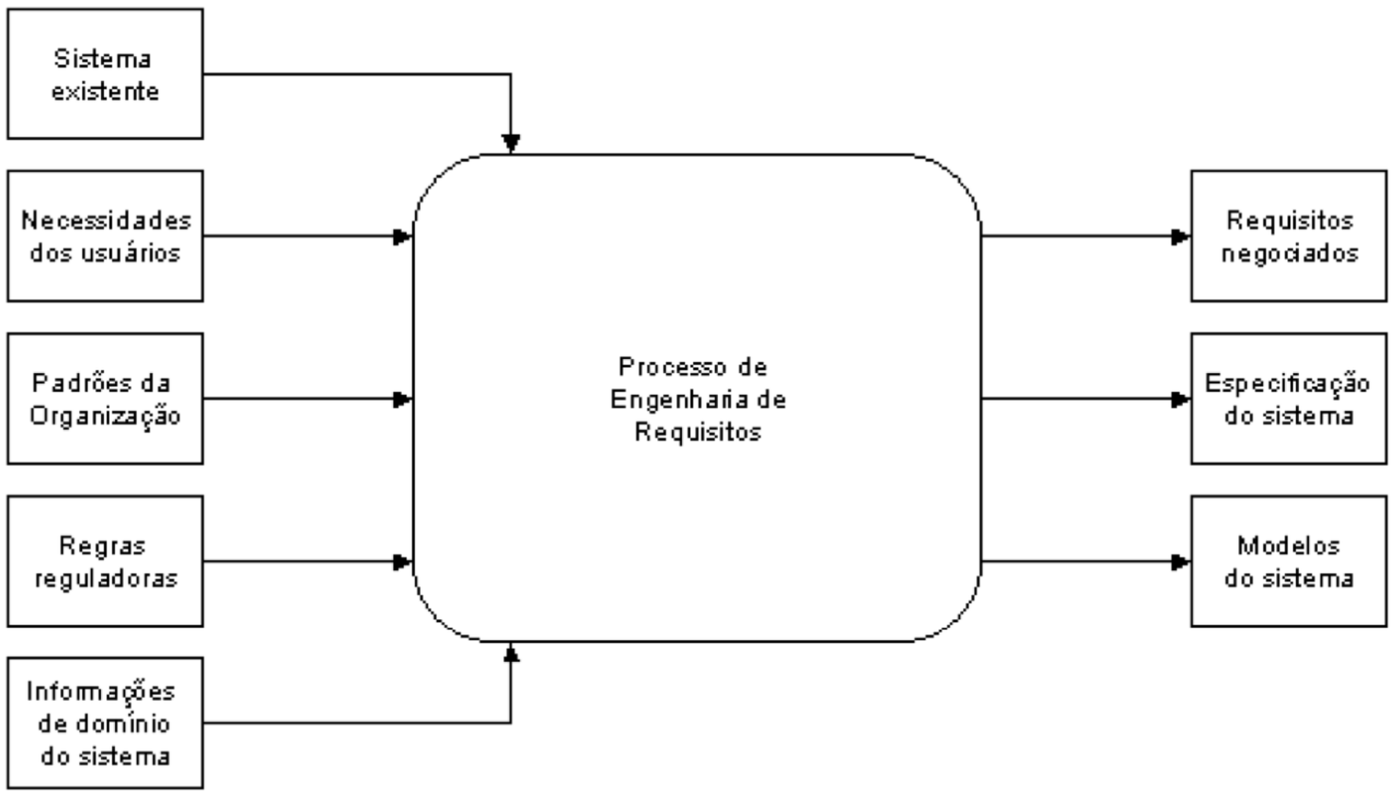
Eliciação (elicitation)

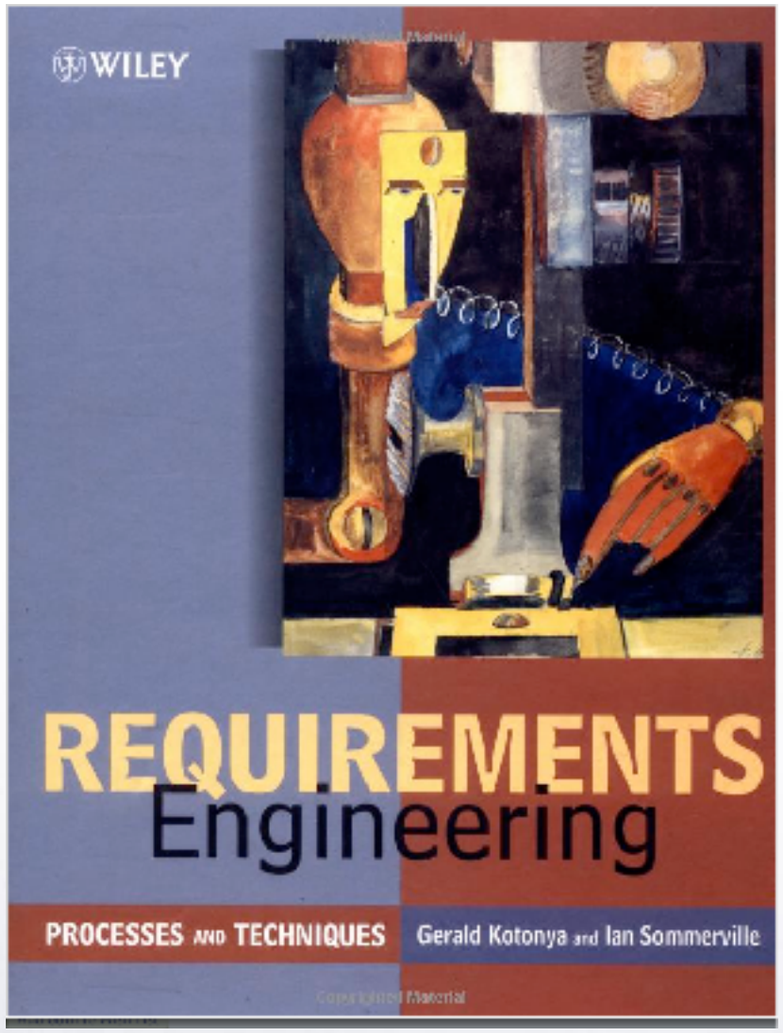


Capacidade de análise

A antecipação da formalização é a base para potencializar a análise dos requisitos

O processo da ER segundo Kotonya e Summerville





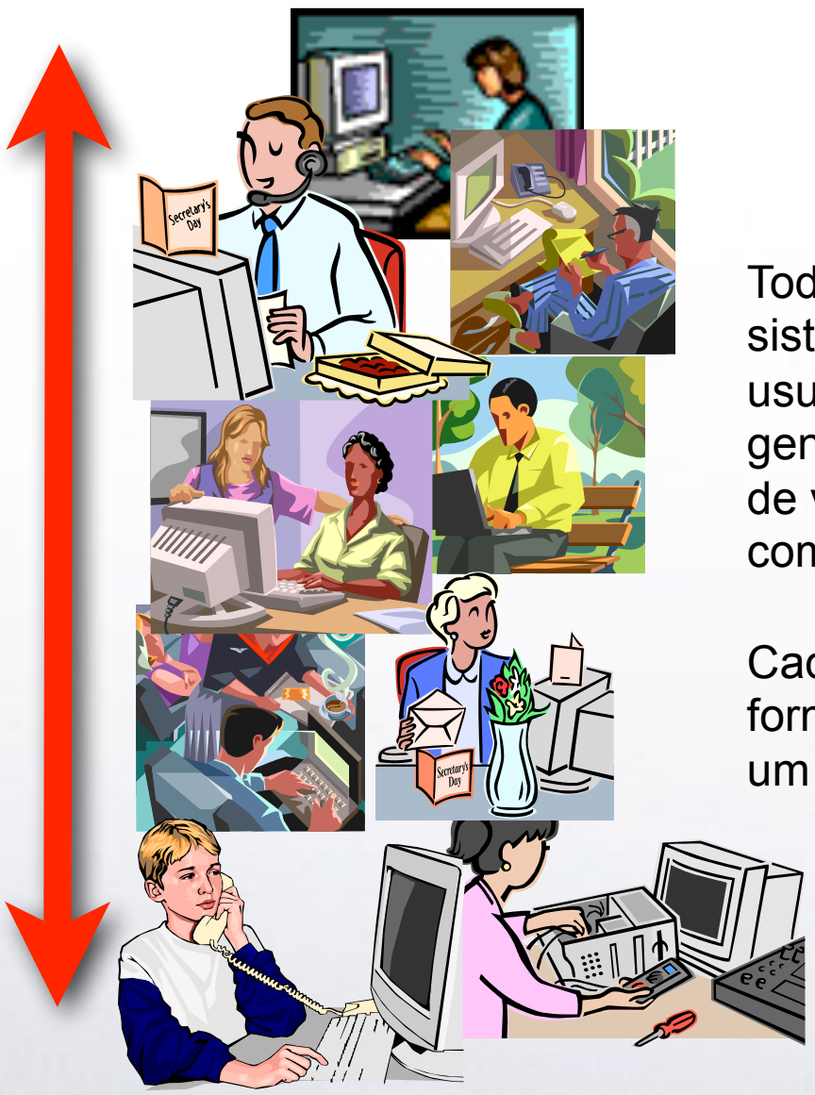
Gerald Kotonya
Computing Department, Lancaster University

and

Ian Sommerville
Computing Department, Lancaster University

Cap. 7 ⇒ Viewpoints

Viewpoints



Todo sistema baseado em recursos computacionais – sistemas computáveis – tem uma gama variada de usuários e interessados nos seus recursos (chamados genericamente de agentes), que podem ser pessoas de variados perfis (profissionais e de relacionamento com o sistema, outros sistemas, máquinas, etc.)

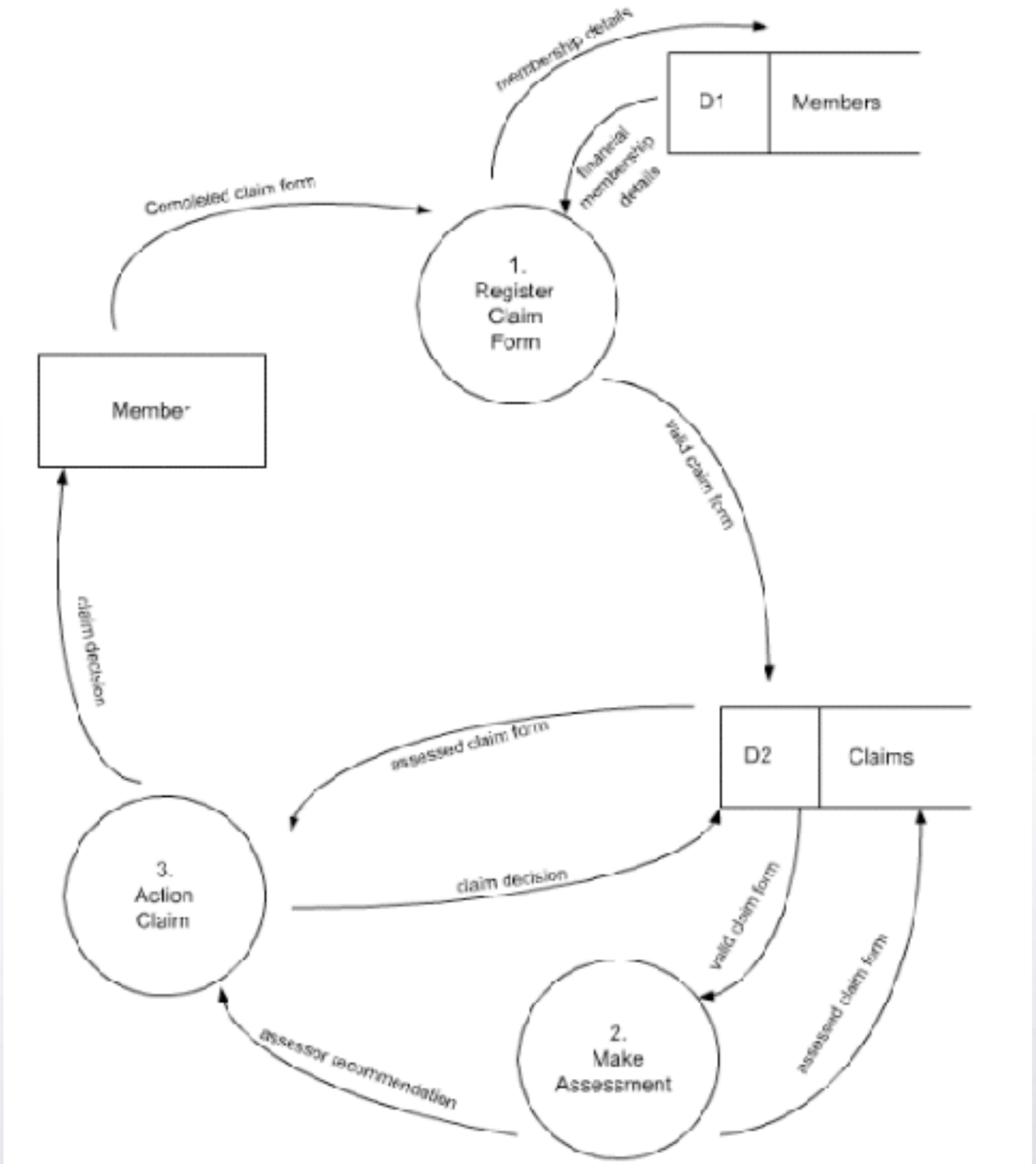
Cada um destes agentes interage com o sistema de forma diferente e requer deste coisas diferentes. Cada um deles mantém o seu ***viewpoint*** sobre o sistema.

Viewpoint Approaches

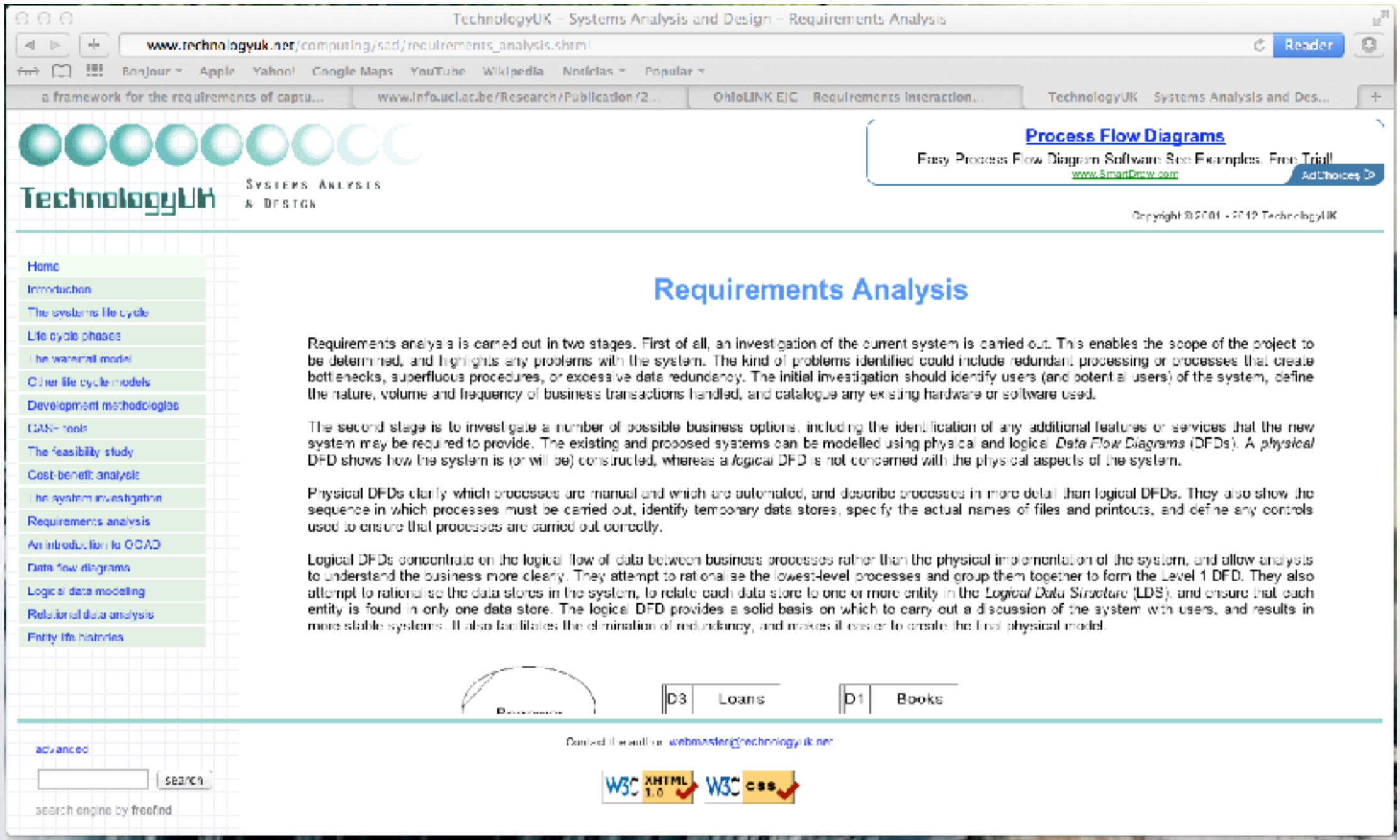
- Structured Analysis and Design Technique (SADT)
- Controlled Requirements Expression (CORE)
- Viewpoint-oriented System Engineering (VOSE)
- Viewpoint-oriented Requirements Definition (VORD)
- Viewpoint-oriented Requirements Validation (VORV)

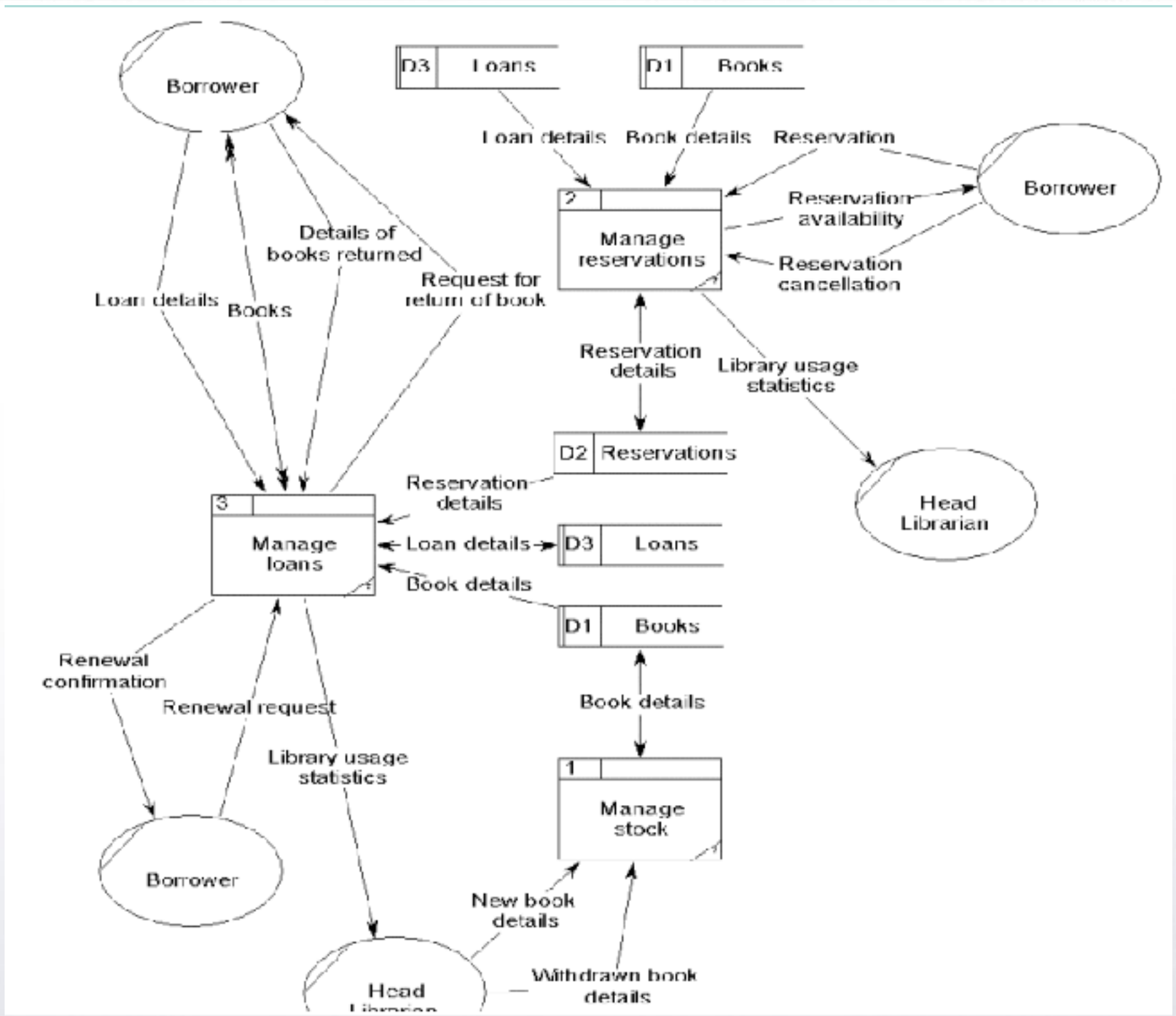
Data Flow Diagram

Ao lado um exemplo de DFD com os requisitos básicos para um sistema que aceita reclamações

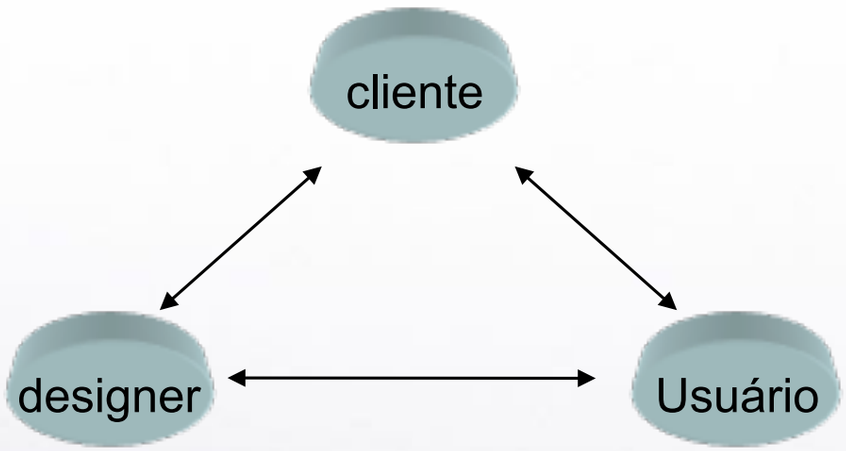


http://www.technologyuk.net/computing/sad/requirements_analysis.shtml



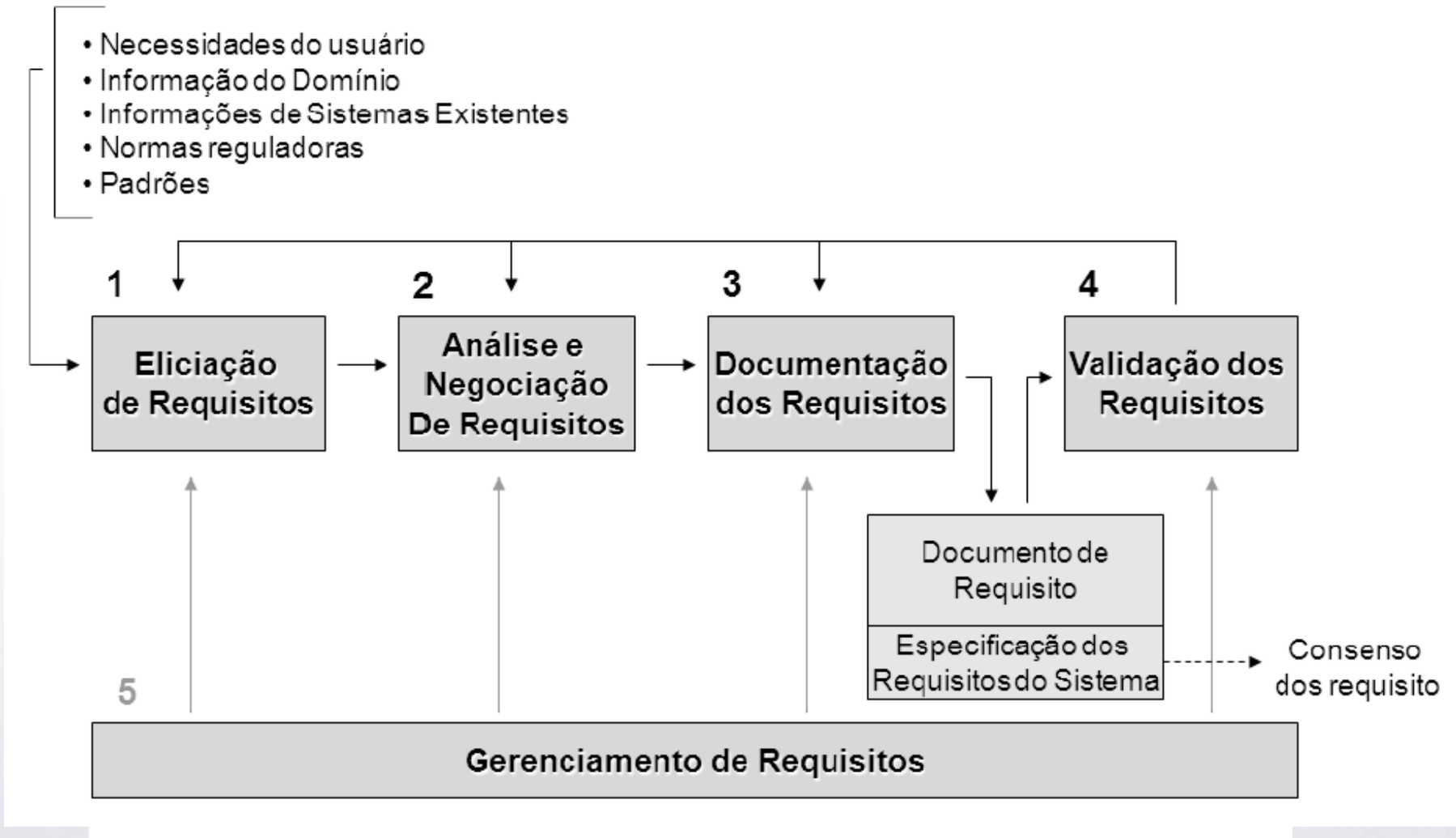

Borrower
D3 Loans
D1 Books
Loan details
Book details
Reservation
2
Manage reservations
Reservation availability
Reservation cancellation
Borrower
Details of books returned
Request for return of book
Loan details
Books
Reservation details
Library usage statistics
D2 Reservations
Reservation details
3
Manage loans
Loan details
D3 Loans
Book details
D1 Books
Head Librarian
Renewal confirmation
Renewal request
Library usage statistics
Book details
1
Manage stock
Borrower
New book details
Withdrawn book details
Head

Conjunto mínimo de agentes e viewpoints



Classes de pontos de vista e classes de agentes

O ciclo de análise de requisitos



O processo da Engenharia de Requisitos

Processo de engenharia de requisitos, composto da eliciação, análise, validação e documentação, é feito segundo métodos que de fato são propostas de sistematizar a modelagem de sistemas - especialmente nesta fase preliminar.

Alguns destes métodos são a base da pesquisa nesta área e ficaram conhecidos por suas características básicas.

Os métodos básicos de análise

Os métodos podem ser caracerizados pelo respectivo esquema de representação:

1. Data-flow models - diagramas de fluxo de dados

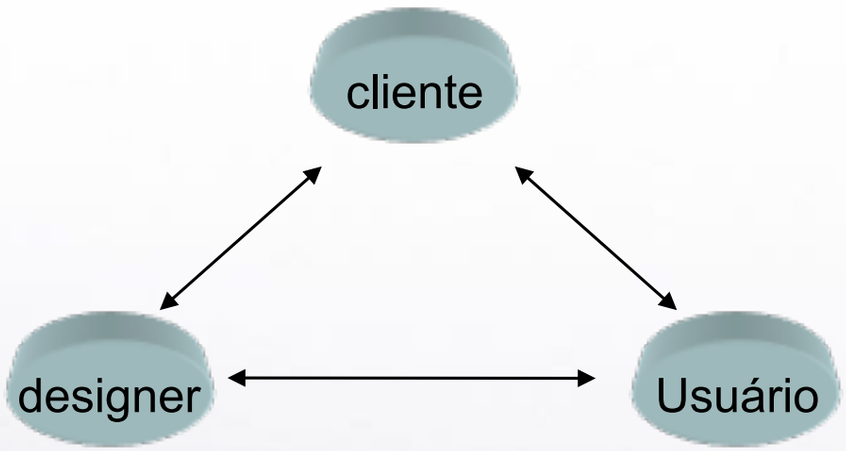
2. Compositional models - baseados em diagramas Entidade-Relação

3. Classification models - baseado em diagramas de objeto

4. Stimulus-response models - baseados em diagramas estado-transição

5. Process models - diagramas de processo, redes de Petri, álgebra de processos, statecharts.

Conjunto mínimo de agentes e viewpoints

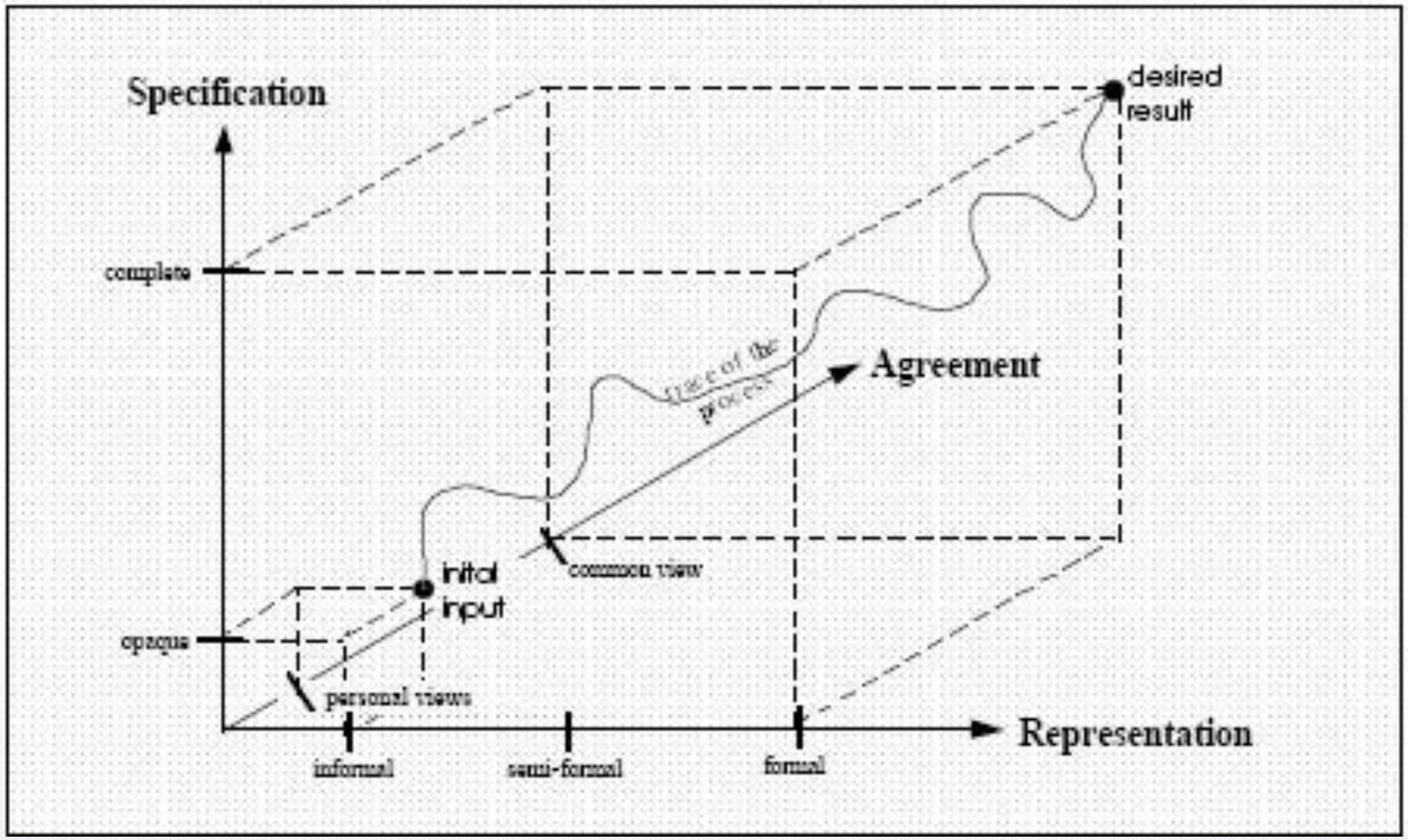


Classes de pontos de vista e classes de agentes

Mapeando as classes de atores

Fazendo um mapeamento com a proposta do NATURE, temos:

Usuário (final)	Usage world
Stakeholder	Subject world
Desenvolvedor	Developed world

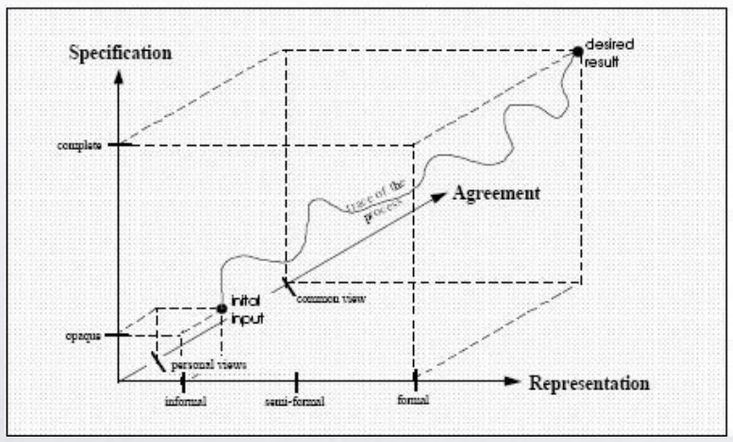


Pohl, K., Assenova, P., Doemges, R., Johannesson, P., Maiden, N., Schmitt, J-P., Plihon, V., Spanoudakis, G.; Applying AI Tecniques to Requirementes Engineering: The Nature Prototype, ESPRIT Basic Research Project 6353, 1994.

Linguagem de representação

Na figura mostrada no slide anterior, o eixo horizontal mostra a evolução da representação do artefato, que passa de uma fase absolutamente informal para uma fase formal, passando por uma fase semi-formal.

É razoável supor que até virar especificação (formal), os requisitos passam por fases diferentes de representação semi-formal.



Home Page of International Requirements Engineering Conference (RE)

This is the home page of the series of conferences that is now called the International Requirements Engineering Conference (RE). This series started as two alternating biennial conference series. One series, in odd years starting in 1993, was the International Symposium on Requirements Engineering (RE). The other series, in even years starting in 1994, was the International Conference on Requirements Engineering (ICRE). The two series merged in 2002 with the holding of the Joint International Requirements Engineering Conference (RE'02), so named to announce the merger. However, starting in 2003, the conference series's name settled to simply ``International Requirements Engineering Conference (RE)".

Whenever a conference is sponsored by the IEEE, then ``IEEE" is prepended to its name.

The number of a conference, coming before ``IEEE" is counted from the beginning of the series it is deemed to be part of. Thus, there were 4 ICREs, 5 International Symposia on RE, and then the International RE Conferences start their numbering from 10, which is 1 more than 4+5!

This web site contains general information about the conference series and links to the home pages of individual conferences that have home pages.

Social Media Pages about the RE Conferences

- Google+
- Twitter
- Facebook page

Conference due dates and calls are typically available at WikiCFP.

24th IEEE International Requirements Engineering Conference

September 12-16, 2016. Beijing, China.

RE'16 Submission Confe

Conference Overview

RE'16 will offer an extensive progra
distinguished keynote speakers and thr
tutorials to develop skills in and advan
industry. Two days of workshops as we
techniques and approaches in particular

RE'16 follows the theme

25th IEEE International Requirements Engineering Conference

September 4-8, 2017. Lisbon, Portuga .

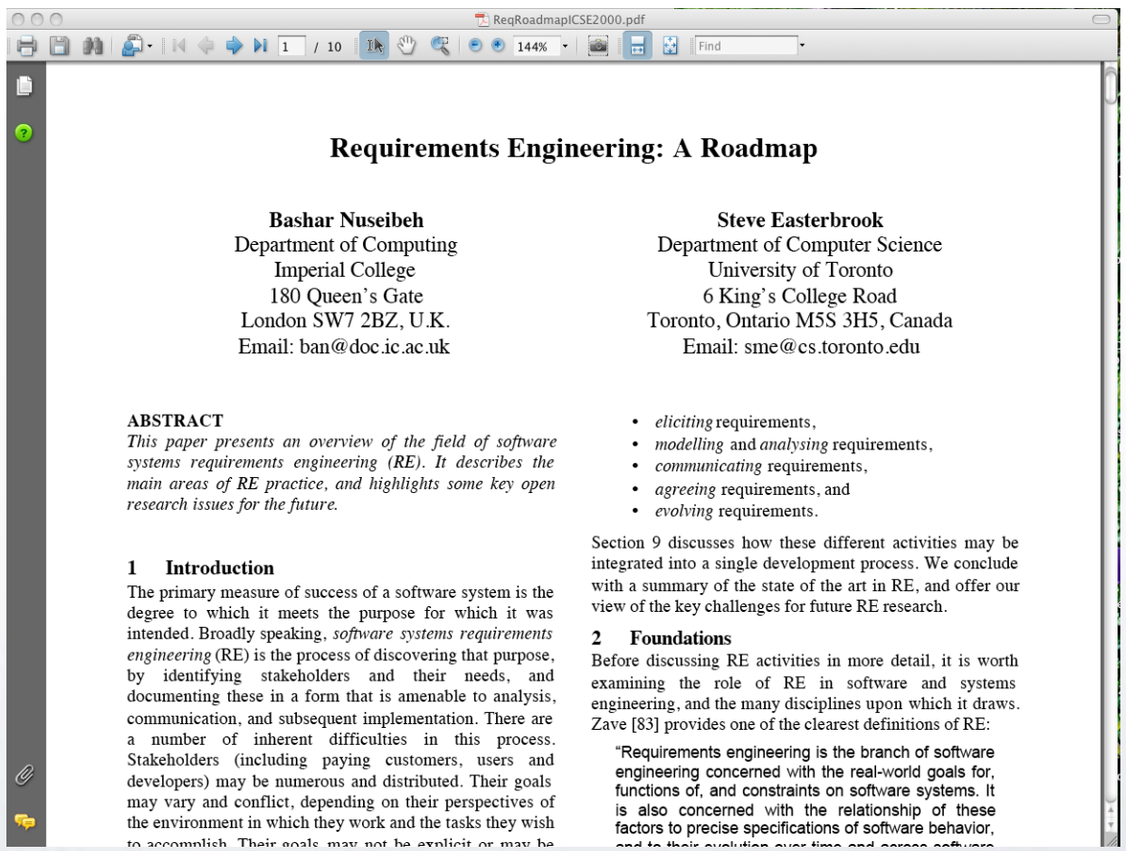
2018: Banff, AB, Canada, 19 -- 24 August 2018

Lisbon is a friendly and tolerant city by tradition. An amalgam of 800 years of cultural influences mingle with modern trends and life style, creating intricate and spectacular contrasts. Spread across seven hills always opening a window

Walid Maalej

Leitura da semana

Nuseibeh, B. and Easterbrook, S., on Proc. of the Conf. on the Future of Software Engineering, ACM, New York, USA, 2000.



ReqRoadmapICSE2000.pdf

1 / 10 144% Find

Requirements Engineering: A Roadmap

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ABSTRACT
This paper presents an overview of the field of software systems requirements engineering (RE). It describes the main areas of RE practice, and highlights some key open research issues for the future.

1 Introduction

The primary measure of success of a software system is the degree to which it meets the purpose for which it was intended. Broadly speaking, *software systems requirements engineering* (RE) is the process of discovering that purpose, by identifying stakeholders and their needs, and documenting these in a form that is amenable to analysis, communication, and subsequent implementation. There are a number of inherent difficulties in this process. Stakeholders (including paying customers, users and developers) may be numerous and distributed. Their goals may vary and conflict, depending on their perspectives of the environment in which they work and the tasks they wish to accomplish. Their goals may not be explicit or may be

- *eliciting* requirements,
- *modelling* and *analysing* requirements,
- *communicating* requirements,
- *agreeing* requirements, and
- *evolving* requirements.

Section 9 discusses how these different activities may be integrated into a single development process. We conclude with a summary of the state of the art in RE, and offer our view of the key challenges for future RE research.

2 Foundations

Before discussing RE activities in more detail, it is worth examining the role of RE in software and systems engineering, and the many disciplines upon which it draws. Zave [83] provides one of the clearest definitions of RE:

> "Requirements engineering is the branch of software engineering concerned with the real-world goals for, functions of, and constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behavior, and to their evolution over time and across software

Exercício:

Vamos escolher um sistema que seja familiar a todos, o sistema de empréstimo e consulta de livros em uma biblioteca. A "função" da biblioteca é fornecer material de acervo (livros, CDs, vídeos, teses, relatórios técnicos, revistas, etc.) para os usuários enquanto cuida da preservação deste acervo. Identifique para este sistema os "atores" e seus respectivos viewpoints. Represente em DFD o módulo de empréstimo que deve ser automatizado computacionalmente.

Obrigado

Reinaldo