# Requirements Engineering
## Process

Les Waguespack, Ph.D.
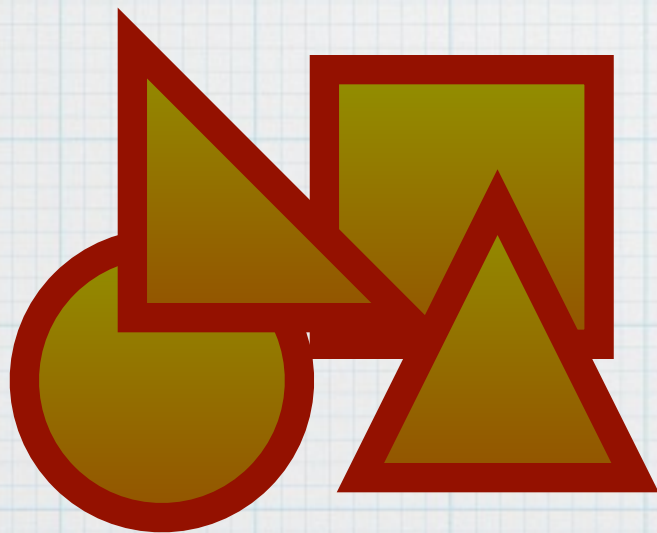
Slides Three

# Copyright and References

* Requirements Engineering, Kotonya & Sommerville, Wiley, Chichester, West Sussex, England, ISBN 0-471-97208-8

* Software Requirements Engineering, Second Edition, Richard H. Thayer and Merlin Dorfman, eds., pp. 7-22. Los Alamitos, Calif.: IEEE Computer Society Press, 1997.

* Use Case Modeling, Bittner & Spence, Addison-Wesley / Pearson Education, Inc., Boston, MA, ISBN 0-201-70913-9

* Writing Effective Use Cases, Cockburn, Addison-Wesley, Boston, MA, ISBN 0-201-70225-8

* UML and the Unified Process - Practical Object-Oriented Analysis and Design, Arlow & Neustadt, Addison-Wesley / Pearson Education, Inc., Boston, MA, ISBN 0-201-77060-1

* Business Modeling With UML, Eriksson & Penker, Wiley, Indianapolis, IN, ISBN 0-471-29551-5

* UML 2 Toolkit, Eriksson, Penker, Lyons & Fado, Wiley, Indianapolis, IN, ISBN 0-471-46361-2

* Enterprise Modeling With UML Designing Successful Software Through Business Analysis, Addison-Wesley, Reading, MA, ISBN 0-201-43313-3

* Object Oriented Systems Engineering, Waguespack, course notes CS390, CS460, CS630, CS771, Computer Information Systems Department, Bentley College, Waltham, MA.

# Outline

1. Scoping The Requirements Engineering Process
2. Requirements Engineering Actors
3. Requirements Engineering & Modeling

# 1. Scoping The Requirements Engineering Process

* ## Understanding the Problem

  * application domain - discipline, competitors, "best practice"
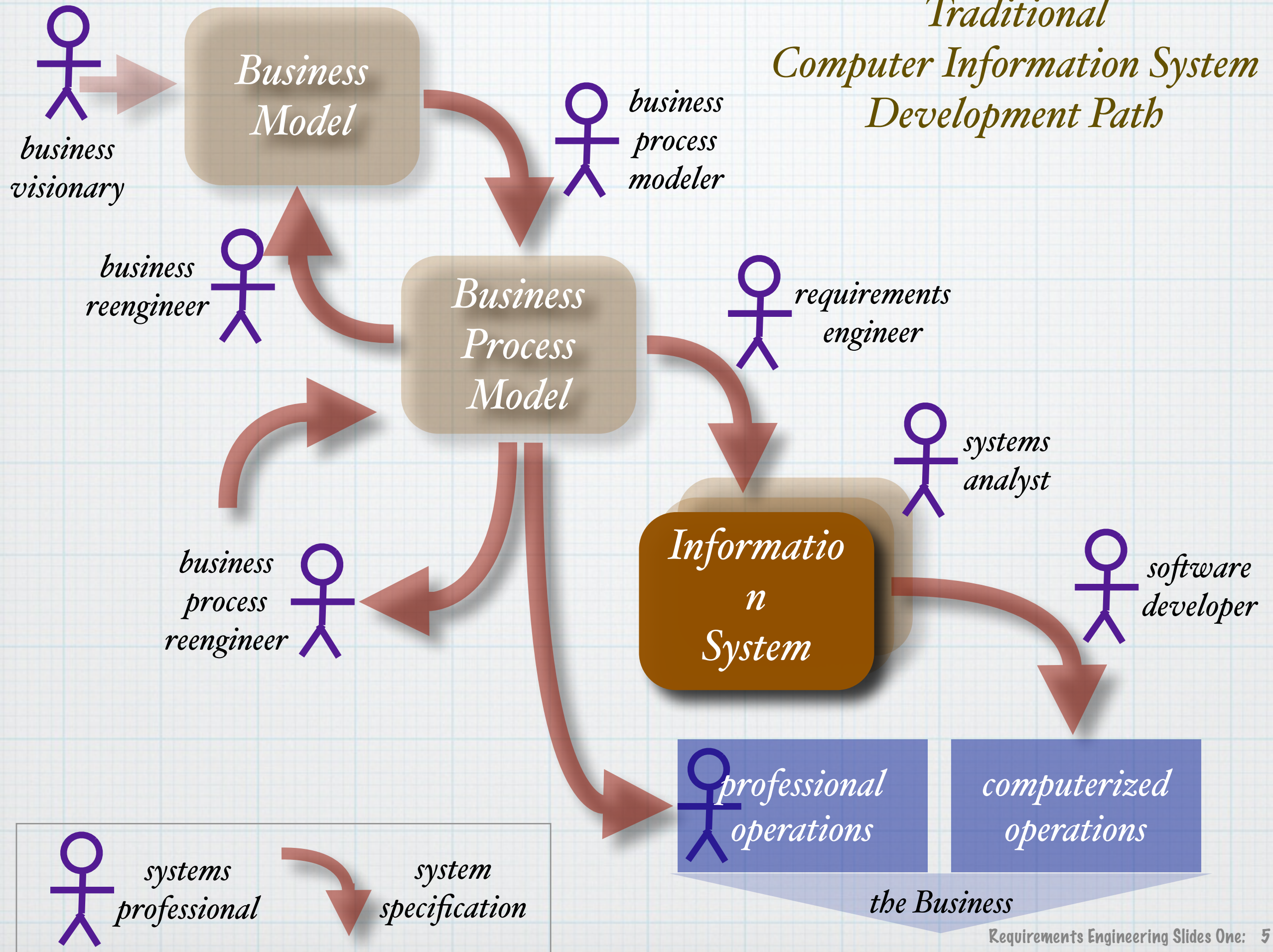
* ## Understanding the Users

  * "business model fit," specific customer problem(s), personnel in the "critical path" of the problem

* ## Understanding the Constraints

  * "business process fit" - stakeholder perspectives

Traditional
Computer Information System
Development Path

business
visionary

Business
Model

business
process
modeler

business
reengineer

Business
Process
Model

requirements
engineer

systems
analyst

business
process
reengineer

Information
System

software
developer

systems
professional

system
specification

professional
operations

computerized
operations

the Business

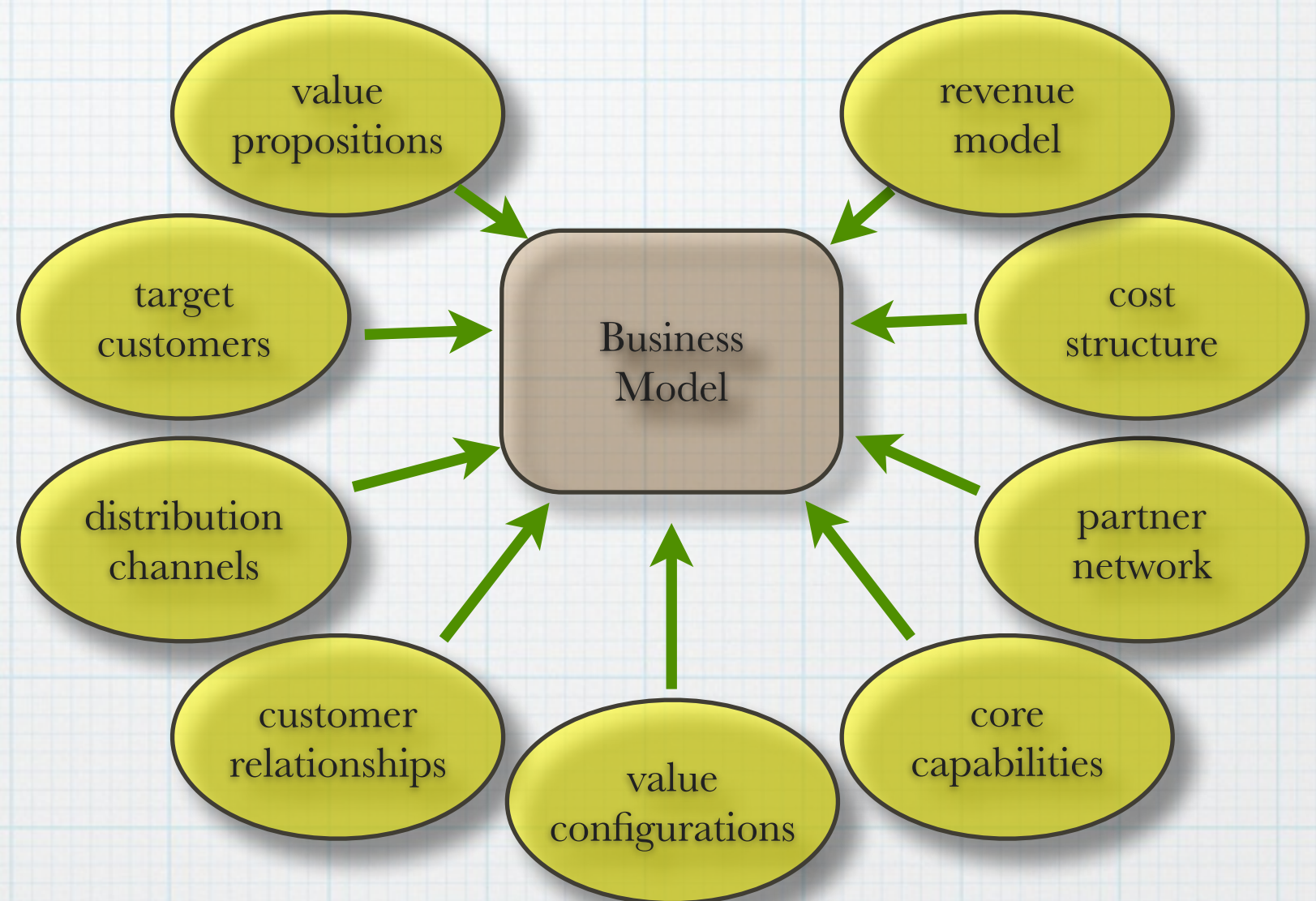Modeling and Reengineering Informed by Experience
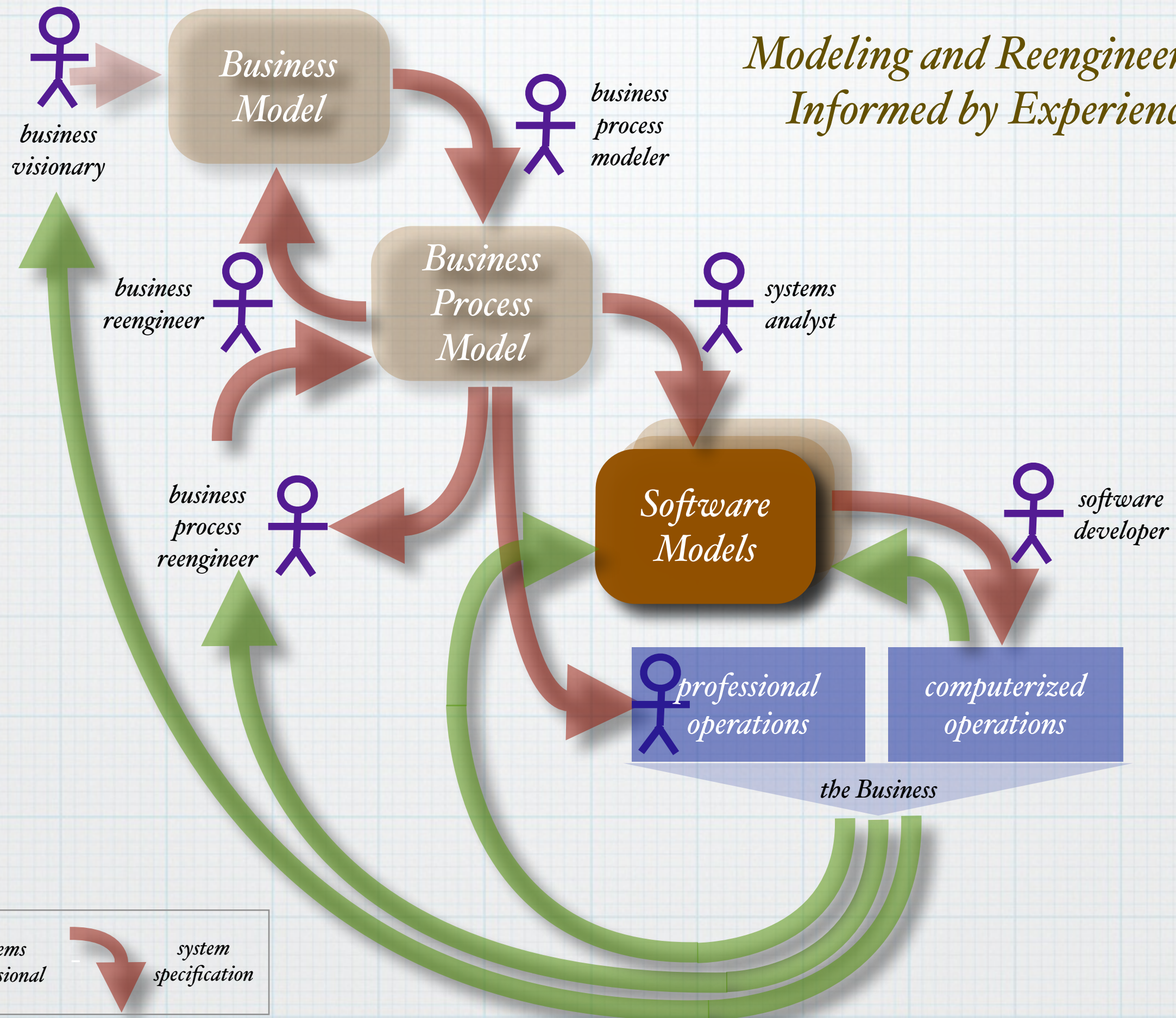
# Business Model Level

* **This level describes the purpose and function of the business entity irrespective of technology and implementation**

* **It establishes the core values of the enterprise**

value propositions

revenue model

target customers

cost structure

Business Model

distribution channels

partner network

customer relationships

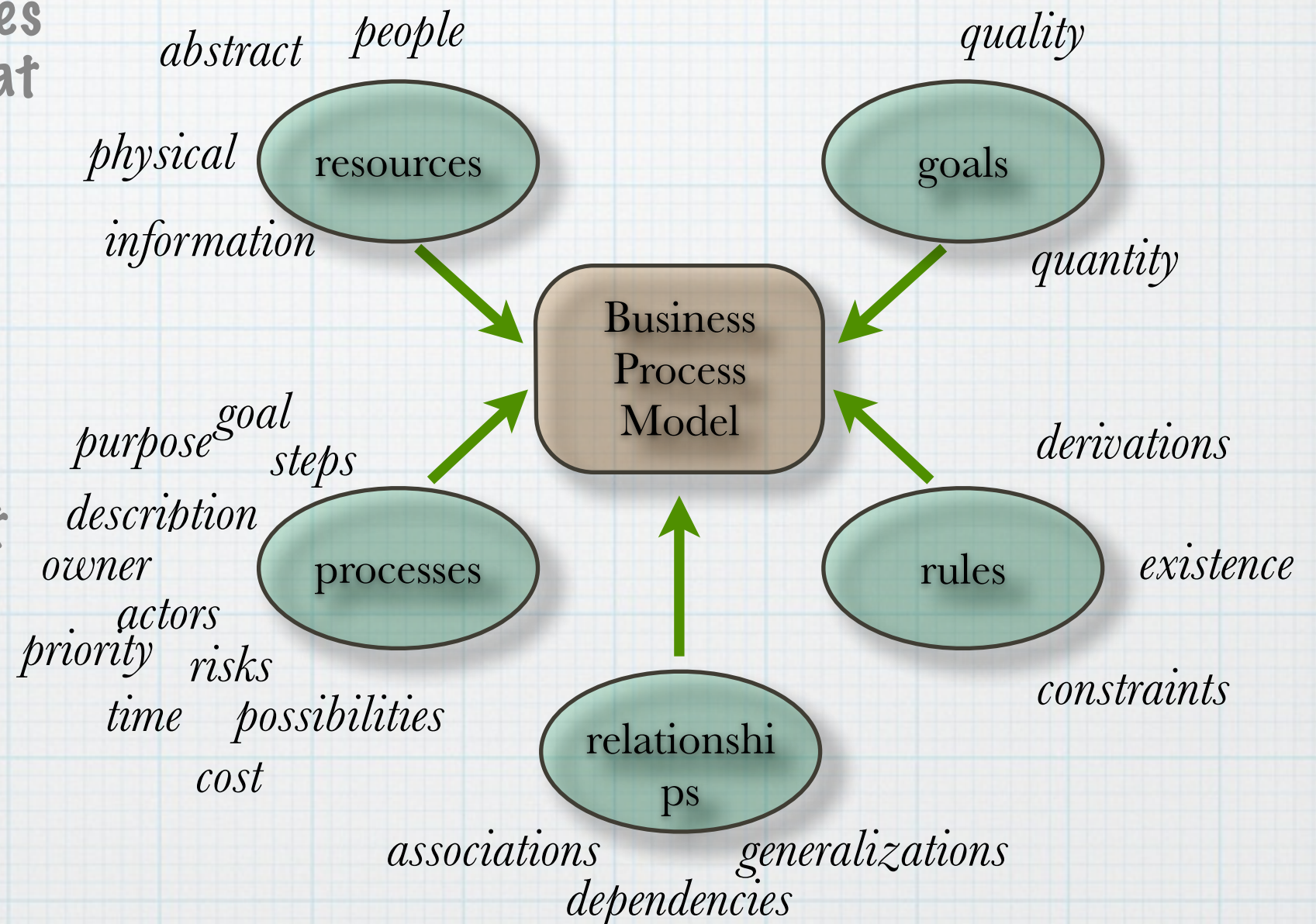value configurations

core capabilities

# Business Model Focus

* **value propositions**: The company's offers which bundle products and services into value for the customer. A value proposition creates utility for the customer.

* **target customer segments**: The customer segments a company wants to offer value to. This describes the groups of people with common characteristics for which the company creates value. The process of defining customer segments is referred to as market segmentation.

* **distribution channels**: The various means of the company to get in touch with its customers. This describes how a company goes to market. It refers to the company's marketing and distribution strategy.

* **customer relationships**: The links a company establishes between itself and its different customer segments. The process of managing customer relationships is referred to as customer relationship management.

* **value configurations**: The configuration of activities and resources.

* **core capabilities**: The capabilities and competencies necessary to execute the company's business model.

* **partner network**: The network of cooperative agreements with other companies necessary to efficiently offer and commercialize value. This describes the company's range of business alliances.

* **cost structure**: The monetary consequences of the means employed in the business model.

* **revenue model**: The way a company makes money through a variety of revenue flows.

Wikipedia

# Process Model Level

* **This level describes the activities that define each operation of the business**

* **There may be several of these descriptions that together explain business operations**

abstract *people*

*physical*

*information*

resources

*quality*

goals

*quantity*

Business Process Model

*goal*
*purpose* *steps*

*description*

*owner*

*actors*

*priority* *risks*

*time* *possibilities*

*cost*

processes

*derivations*

rules

*existence*

*constraints*

relationships
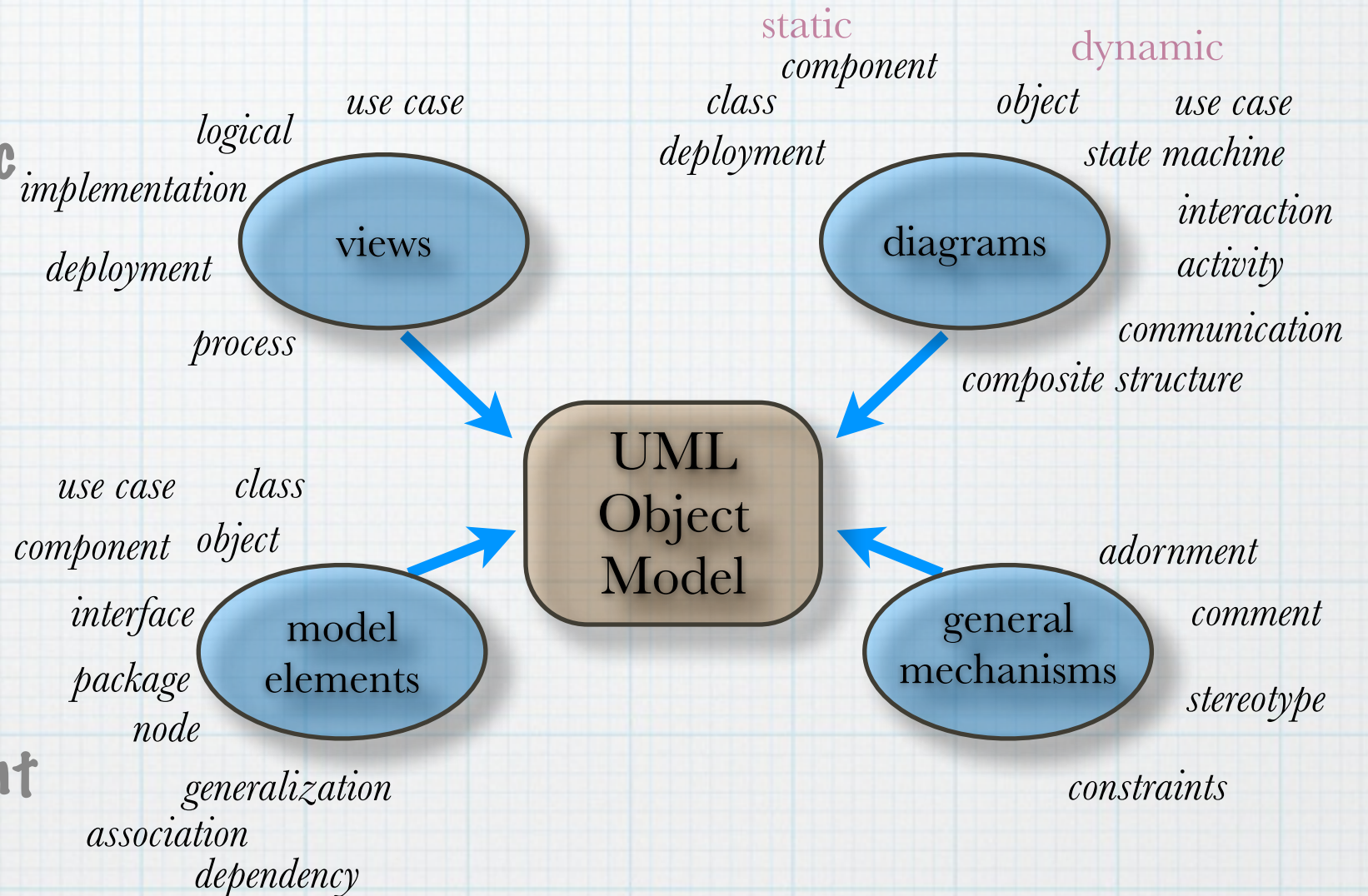
*associations* *generalizations*

*dependencies*

# Business Process Focus

* **resources**: Abstract (i.e. information) and Physical (i.e. people) involved in the execution of business practice to achieve a business objective.

* **processes**: Business activities defined by a purpose, steps and a goal - described by process owner, the actors in the process, the priority in the business, timing constraints, cost and potential outcomes.

* **goals**: The purpose of the business process characterized by both quantitative (how many, how much) and qualitative (how well, how good) suitable for measurement and assessment.

* **rules**: The controls on the business function including how in knowledge / resources may be transformed, limitations on process behavior or resource consumption, and characterization of business stability.

* **relationships**: The interdependency in time and resource of various business processes including generalization / specialization and association / aggregation.

Ericksson / Penker

# Information System Level

* This level focuses on IS specific static and dynamic structures leading to programming and implementation

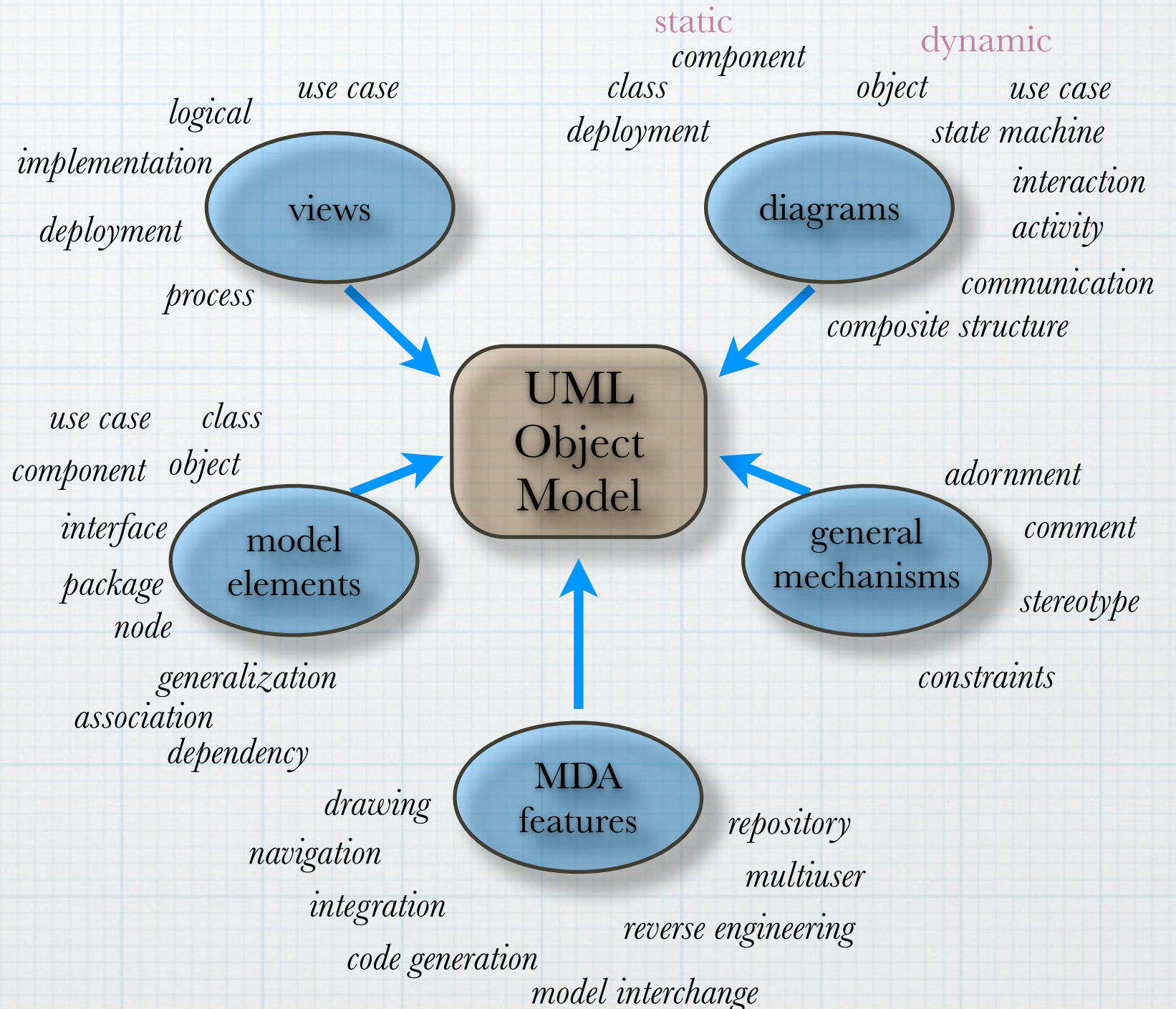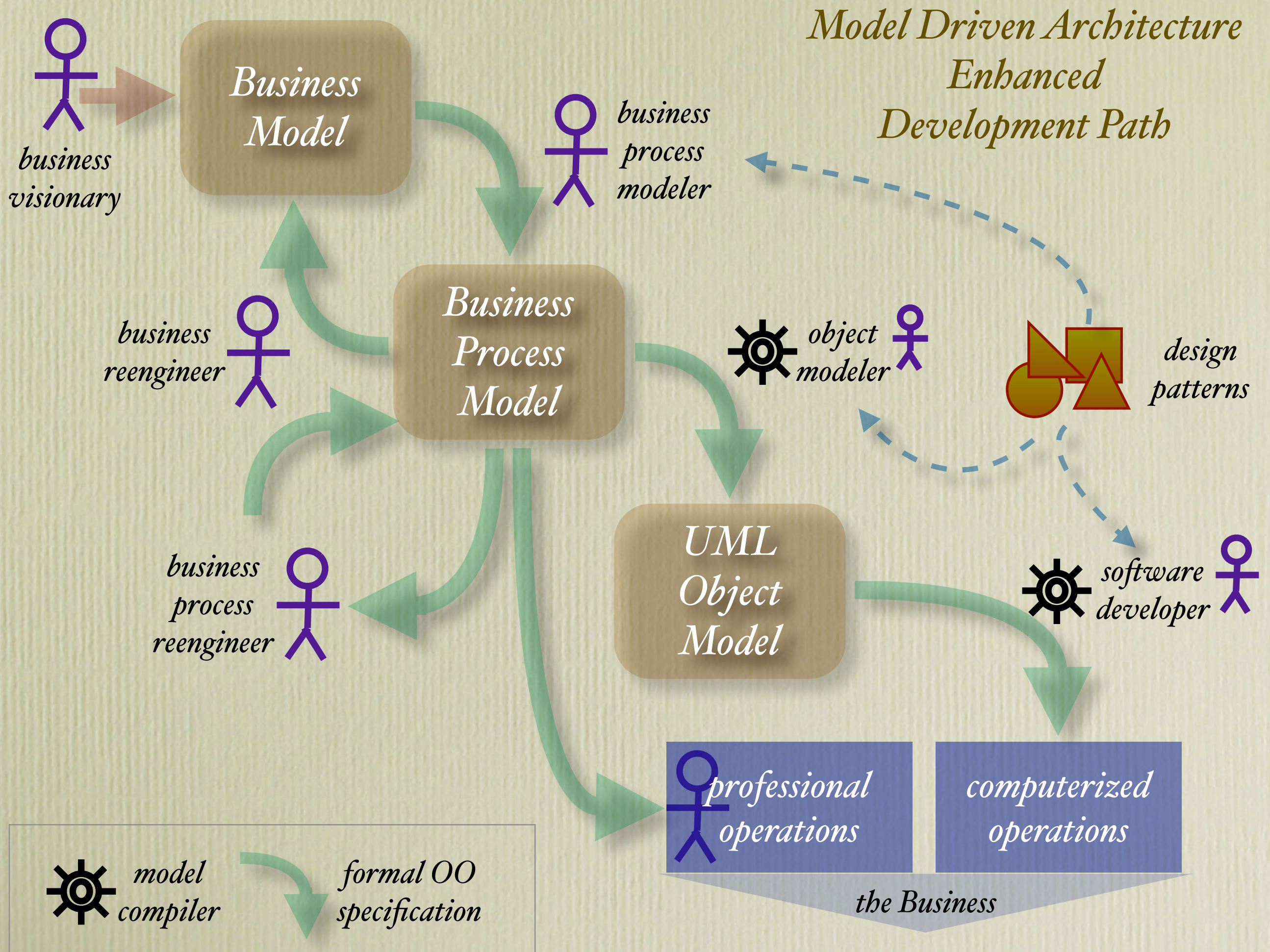* This example is based on the OO paradigm; different paradigms would focus on different characteristics

static

dynamic

component

class

deployment

object

use case

state machine

interaction

activity

communication

composite structure

logical   use case

implementation

deployment

process

views

diagrams

use case   class

component   object

interface

package   model elements

node

generalization

association

dependency

UML Object Model

adornment

comment

general mechanisms

stereotype

constraints

# Model Driven Architecture

* **OMG has established a vision of integrated tools and standards for object oriented development**

* **The MDA features provide standards and tool support for managing the system development process** - (another course)

static

dynamic

component

class

deployment

object

use case

state machine

interaction

activity

communication

composite structure

use case

logical

implementation

deployment

process

**views**

**diagrams**

use case    class

component    object

interface

package

node

generalization

association

dependency

**model elements**

**UML Object Model**

**general mechanisms**

adornment

comment

stereotype

constraints

drawing

navigation

integration

code generation

**MDA features**

repository

multiuser

reverse engineering

model interchange

Model Driven Architecture
Enhanced
Development Path

Business Model

business visionary

business process modeler

Business Process Model

business reengineer

object modeler

design patterns

business process reengineer

UML Object Model

software developer

professional operations

computerized operations

the Business

model compiler

formal OO specification

# System Task Scope & Risk

* **Migrate** - transferring functionality from one implementation technology to the next

* **Automate** - converting manual functionality to computerized implementation

* **Integrate** - combining or articulating information system function among two or more existing systems

* **Innovate** - implementing functionality by means of no previous experience or standards

* **Reengineer** - implementing functionality that represents a change in the business or business process models or both

* **Maintain** - extending, optimizing, or correcting existing system function

# Source & Level of Requirement Sensitivity

| Task\Source | Business Model | Business Process | Management | Users | Implementation Technology |
|---|---|---|---|---|---|
| **Migrate** | low | low | low | medium | high |
| **Automate** | low | medium | low | high | high |
| **Integrate** | medium | high | high | medium | medium |
| **Innovate** | medium | high | medium | medium | high |
| **Reengineer** | high | high | high | high | high |
| **Maintain** | low | low | low | medium | medium |

# 2. Requirements Engineering Actors

* domain expert

* end-user

* requirements engineer

* software engineer

* project manager

* client

# Domain Expert

* A **domain expert** or **subject matter expert** (SME) is a person with special knowledge or skills in a particular area. *Domain experts* are individuals who are both knowledgeable and extremely experienced with application domains.

Wikipedia

# End-User

* Economics and commerce define an **end-user** as the person who uses a product. The end-user may differ from the customer, who might buy the product, but doesn't necessarily use it; for example, with elephant food, a zookeeper might purchase commodities as a customer for an end-user - the elephant.

* In contracts, the term 'end-user' becomes a legal construct referring to a non-reseller. This definition characterizes the store the zookeeper bought food from as a non-end-user, but the zookeeper as an end-user.

Wikipedia

# Requirements Engineer

\* The requirements engineer is responsible for gathering, organizing and maintaining the corporate understanding of the problem and its anticipated solution by soliciting and facilitating the input of all stakeholders and preparing a formal document that serves to guide the development process and formalize the basis for agreement and decision making among all stakeholders.

# Software Engineer

* Software engineers "(1) apply a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software, that is, the application of engineering to software," and "(2) study approaches as in (1)." – IEEE Standard 610.12

# Project Manager

* A **Project Manager** is the person who has the overall responsibility for the successful planning and execution of any project. This title is used in the construction industry, architecture, software development and many different occupations that are based on production of a product or service.

* The Project Manager must possess a combination of skills including an ability to ask penetrating questions, detect unstated assumptions and resolve interpersonal conflicts as well as more systematic management skills.

* Key amongst his/her duties is the recognition that risk directly impacts the likelihood of success and that this risk must be both formally and informally measured throughout the lifetime of the project.

Wikipedia

# "Customer"

* A **customer** is someone who makes use of or receives the products or services of an individual or <u>organization</u>.

* The word historically derives from "custom," meaning "habit"; a customer was someone who frequented a particular shop, who made it a habit to purchase goods of the sort the shop sold there rather than elsewhere, and with whom the shopkeeper had to maintain a relationship to keep his or her "custom," meaning expected purchases in the future. The shopkeeper remembered the sizes and preferences of his or her customers, for example. The word did not refer to those who purchased things at a fair or bazaar, or from a street vendor.
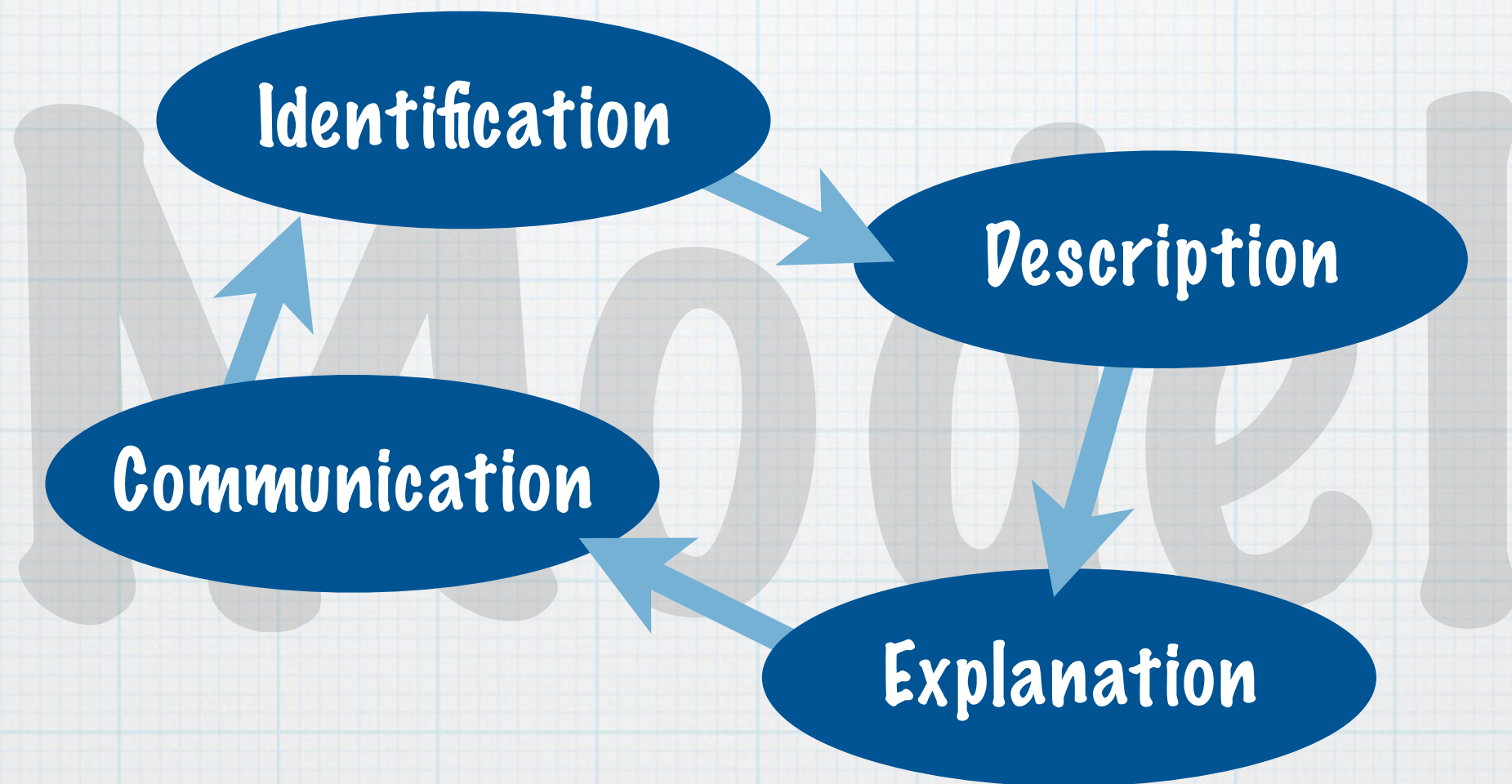
Wikipedia

# 3. Requirements Engineering & Modeling

**Identification**

**Description**

**Communication**

**Explanation**
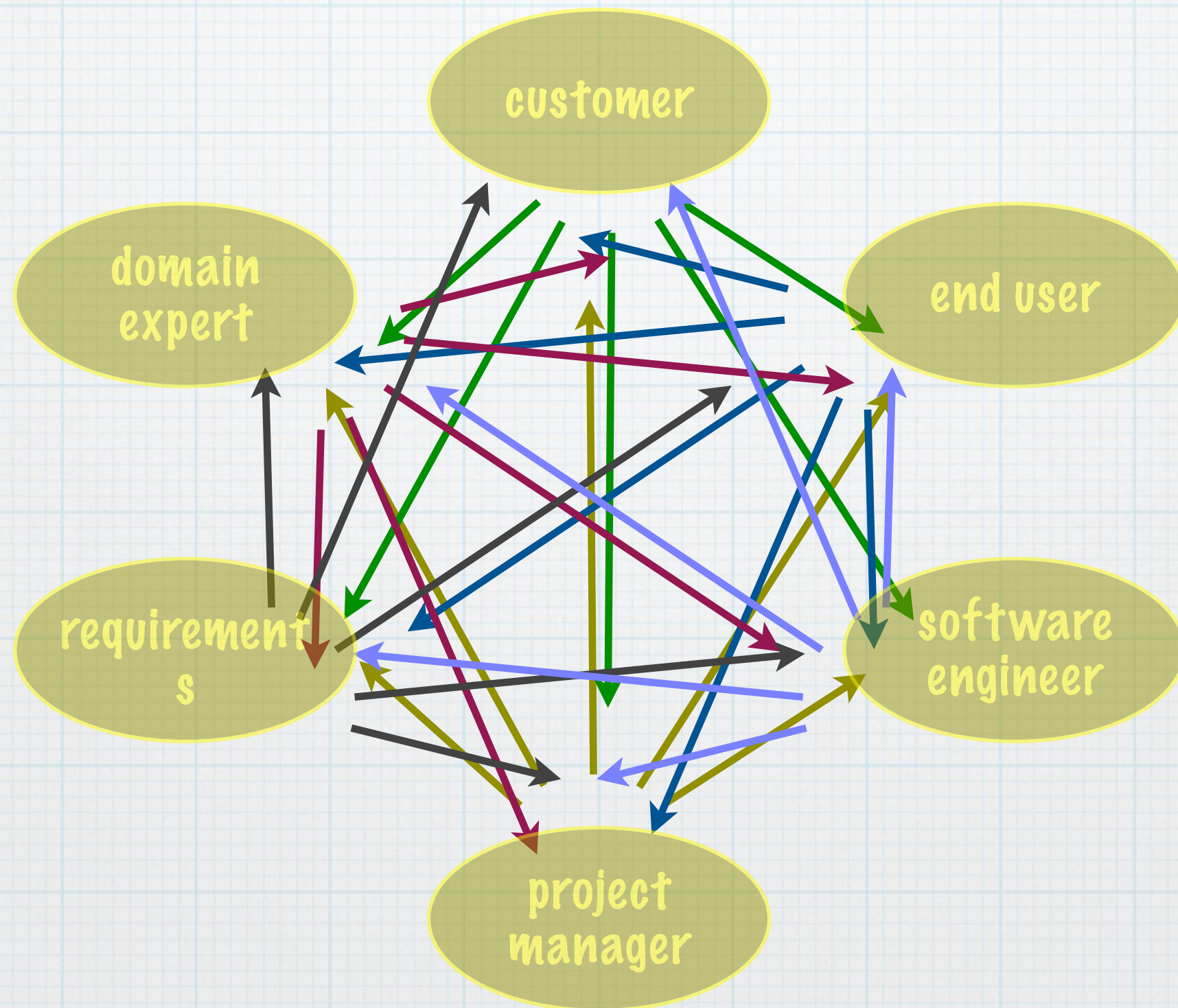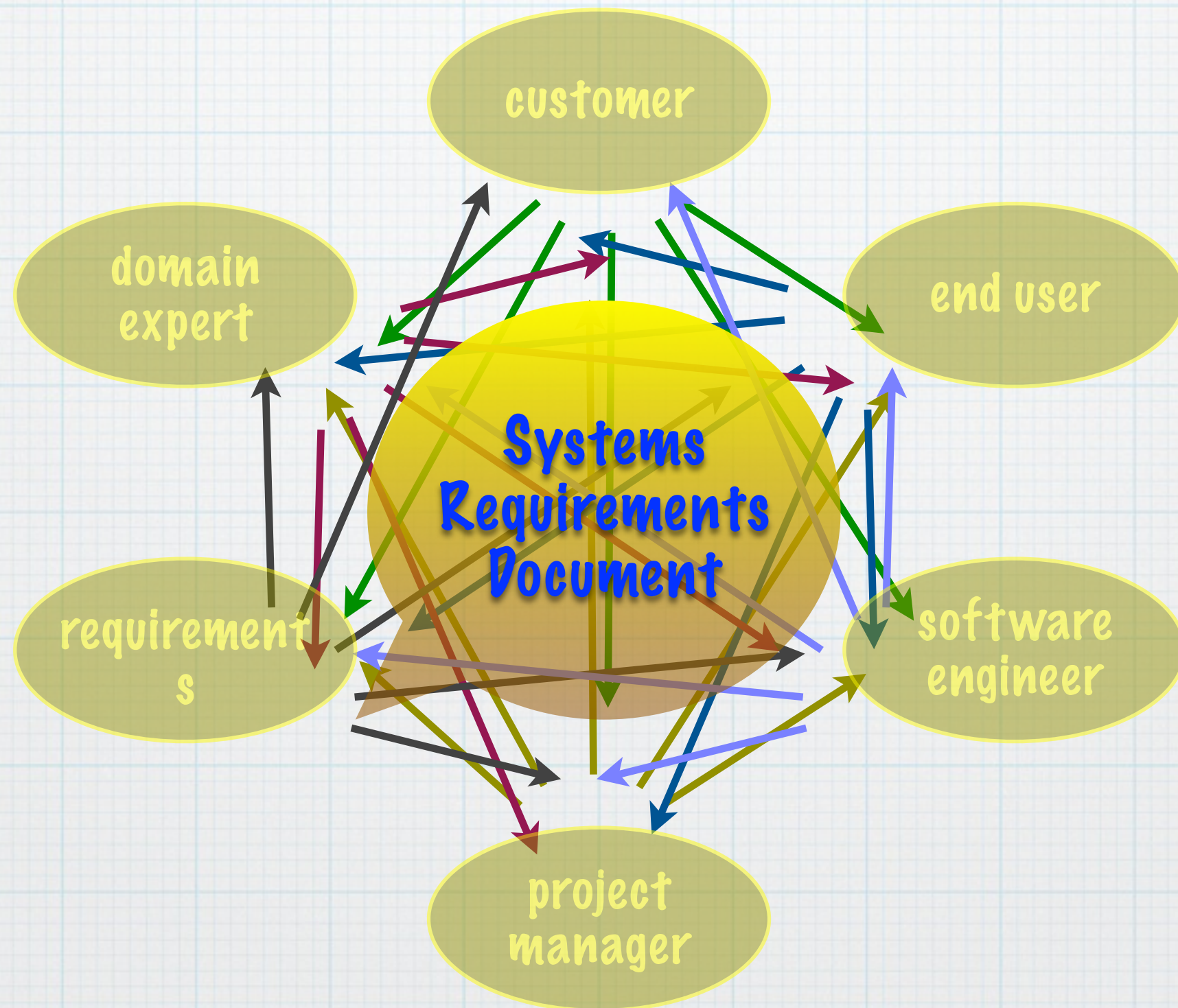
# *model

* n 1: a simplified description of a complex entity or process; "the computer program was based on a model of the circulatory and respiratory systems" [syn: theoretical account, framework] 2: a type of product; "his car was an old model" 3: a person who poses for a photographer or painter or sculptor; "the president didn't have time to be a model so the artist worked from photos" [syn: poser] 4: representation of something (sometimes on a smaller scale) [syn: simulation] 5: something to be imitated; "an exemplar of success"; "a model of clarity"; "he is the very model of a modern major general" [syn: exemplar, example, good example] 6: someone worthy of imitation; "every child needs a role model" [syn: role model] 7: a representative form or pattern; "I profited from his example" [syn: example] 8: a woman who wears clothes to display fashions; "she was too fat to be a mannequin" [syn: mannequin, manikin, mannikin, manakin, fashion model] 9: the act of representing something (usually on a smaller scale) [syn: modelling, modeling] v 1: plan or create according to a model or models [syn: pattern] 2: form in clay, wax, etc; "model a head with clay" [syn: mold, mould] 3: assume a posture as for artistic purposes; "We don't know the woman who posed for Leonardo so often" [syn: pose, sit, posture] 4: display (clothes) as a mannequin; "model the latest fashion" 5: create a representation or model of; "The pilots are trained in conditions simulating high-altitude flights" [syn: simulate] 6: construct a model of; "model an airplane" [syn: mock up]

# Modeling ::= Understanding

* Systems development is the process of understanding and acting upon that understanding
    * identification
    * description
    * explanation
    * communication
* Understanding is constructed from experience and analysis
    * abstraction
    * terminology
    * context
    * responsibility
    * clarity
    * fidelity
* The most effective tool for building understanding is the MODEL

# Managing Complexity

* **Managing complexity with ...**
    * Abstraction
        * procedural
        * data
    * Encapsulation
    * Inheritance
    * Association
    * Communication with Messages
    * Pervading methods of organization
        * objects and attributes
        * whole and parts
        * classes and members, and distinguishing between them
    * Scale
    * Categories of behavior
        * immediate causation
        * change over time
        * similarity of functions

# Abstraction

* **Abstraction**: the principle of ignoring those aspects of a subject that are not relevant to the current purpose in order to concentrate more fully on those that are. (Oxford, 1986).

    * When we use abstraction, we admit that what we are considering is complex; rather than try to comprehend the entire thing, we select parts of it.

* **Procedural abstraction**: the principle that any operation that achieves a well-defined effect can be treated by its users as a single entity, despite the fact that the operation may actually be achieved by some sequence of lower-level operations (ibid).

* **Data abstraction**: the principle of defining a data type in terms of the operations that apply to objects of the type, with the constraint that the values of such objects can be modified and observed only by the use of the operations. (ibid)

# Abstraction Level

* **High Level**
    * Coarse Grained - "A view from a thousand feet up."
    * Used for indicating context - overview
        * scope
        * constituency
        * range of effect
* **Low Level**
    * Fine Grained - "Each tree rather than the forest."
    * Used for indicating detail - specifics
        * data
        * transactions
        * interactions
* **Challenges -**
    * sufficient information without overload
    * consistent level of description / explanation for interaction

# What modelers do . . .

* modeling is a skill that is developed by building a set of knowledge resources to make the modeling easier . . .
    * domain knowledge
        * experience
            * history - formal education, work experience
            * exploration - experimentation, research
        * vocabulary - terminology, paradigms, methodologies
        * quality control - testing, work reviews, client interaction
    * communication
        * medium - analysts spend most of their time communicating
            * written - documentation becomes long term memory, resource, knowledge asset
            * oral - builds confidence and trust between analysts and with client
        * accuracy
            * perspective - "who is right?" often depends upon the viewing angle
            * quality control - "Assuming only makes an A__ out of You and Me!"
        * clarity
            * terminology - we all need to speak the same language, maybe a new one for us!
            * consistency - the parts need to fit from every angle, over and over again
            * relevance - the world is a big place, how much of it is needed in this problem?

# Pick a focus and model . . .

| Functional Decomposition | Data Flow | Information Modeling | Object-Oriented | | |
|---|---|---|---|---|---|
| | | | | 1 | Abstraction |
| X | X | | X | a | procedural |
| | | | X | b | data |
| | | | X | 2 | Encapsulation |
| | | | X | 3 | Inheritance |
| | | X | X | 4 | Association |
| | | | X | 5 | Communication with Messages |
| | | | | 6 | Pervading methods of organization |
| | | X | X | a | objects and attributes |
| | | X | X | b | whole and parts |
| | | X | X | c | classes and members, and distinguishing between them |
| | X | | X | 7 | Scale |
| | | | | 8 | Categories of behavior |
| | X | | X | a | immediate causation |
| | | | X | b | change over time |
| | | | X | c | similarity of functions |

# Wrap Up

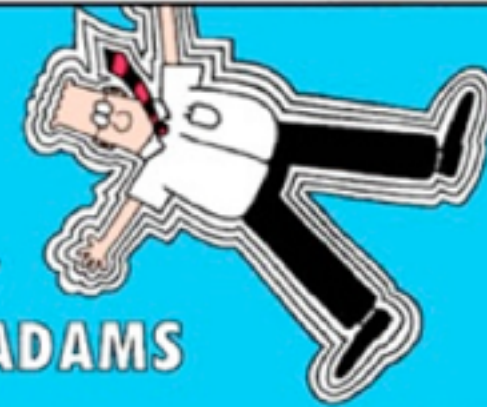1. **Scoping The Requirements Engineering Process:** understanding problem, users, and constraints

2. **Requirements Engineering Actors:** domain expert, end user, requirements engineering, software engineer, project manager, client

3. **Requirements Engineering & Modeling:** identification, description, communication, explanation