Chapter 6
System Engineering

- Computer-based system
- System engineering process
- “Business process” engineering
- Product engineering

(Source: Pressman, R. *Software Engineering: A Practitioner’s Approach*. McGraw-Hill, 2005)

Introduction

- Software engineering occurs as a consequence of system engineering
- System engineering may take on <u>two</u> different forms depending on the application domain
  - <u>“Business process” engineering</u> – conducted when the context of the work focuses on a business enterprise
  - <u>Product engineering</u> – conducted when the context of the work focuses on a product that is to be built
- Both forms bring order to the development of computer-based systems
- Both forms work to allocate a role for computer software and to establish the links that tie software to other elements of a computer-based system

System

- System (Webster)
  - A set or arrangement of things so related as to form a unity or organic whole
  - A set of facts, principles, rules. etc., … to show a logical plan linking the various parts
  - A method or plan of classification or arrangement
  - An established way of doing something such as a method or procedure

Computer-based System

- Defined: A set or arrangement of elements that are organized to accomplish some predefined goal by processing information
- The goal may be to support some business function or to develop a product that can be sold to generate business revenue
- A computer-based system makes use of system elements
- Elements constituting one system may represent one macro element of a still larger system
  - Examples
- The role of the system engineer is to define the elements of a specific computer-based system in the context of the overall hierarchy of systems

Computer-based System (continued)

- A computer-based system makes use of the following four system <u>elements</u> that combine in a variety of ways to transform information
  - **Software**: computer programs, data structures, and related work products that serve to effect the logical method, procedure, or control that is required
  - **Hardware**: electronic devices that provide computing capability, interconnectivity devices that enable flow of data, and electromechanical devices that provide external functions
  - **People**: Users and operators of hardware and software
  - **Database**: A large, organized collection of information that is accessed via software and persists over time
- The uses of these elements are described in the following:
  - **Documentation**: Descriptive information that portrays the use and operation of the system
  - **Procedures**: The steps that define the specific use of each system element or the procedural context in which the system resides

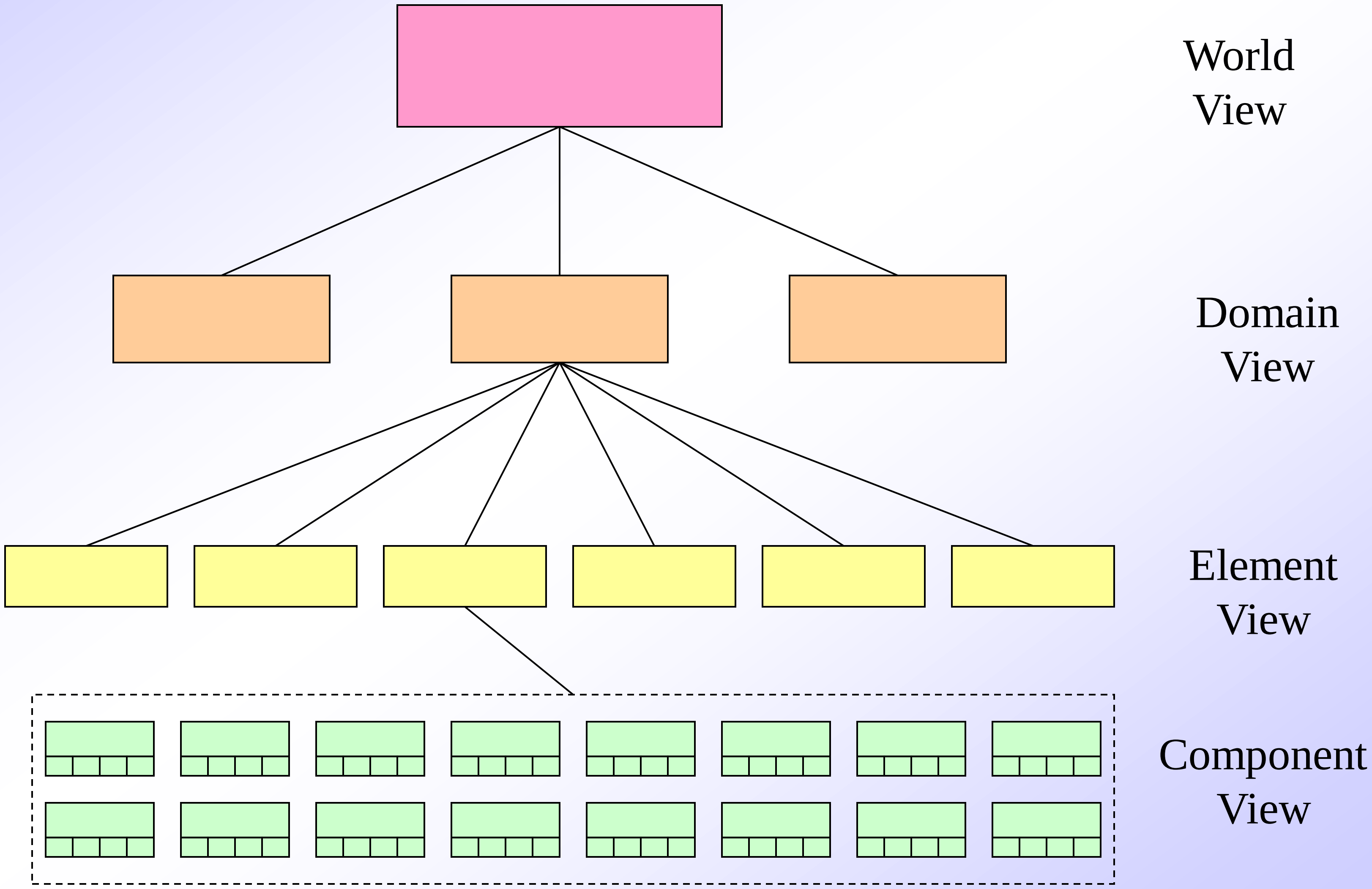
System Engineering Process

System Engineering Process

- The system engineering process begins with a world view; the business or product domain is examined to ensure that the proper business or technology context can be established
- The world view is refined to focus on a specific domain of interest
- Within a specific domain, the need for targeted system elements is analyzed
- Finally, the analysis, design, and construction of a targeted system element are initiated
- At the world view level, a very broad context is established
- At the bottom level, detailed technical activities are conducted by the relevant engineering discipline (e.g., software engineering)

"Always design a thing by considering it in its next larger context –
a chair in a room, a room in a house, a house in an environment,
and environment in a city plan"

System Engineering Hierarchy



System Modeling (at each view level)

- Defines the processes that serve the needs of the view under consideration
- Represents the behavior of the processes and the assumptions on which the behavior is based
- Explicitly defines intra-level and inter-level input that form links between entities in the model
- Represents all linkages (including output) that will enable the engineer to better understand the view
- May result in models that call for one of the following
  - Completely automated solution
  - A semi-automated solution
  - A non-automated (i.e., manual) approach

Factors to Consider when Constructing a Model

- Assumptions
  - These reduce the number of possible variations, thus enabling a model to reflect the problem in a reasonable manner
- Simplifications
  - These enable the model to be created in a timely manner
- Limitations
  - These help to bound the maximum and minimum values of the system
- Constraints
  - These guide the manner in which the model is created and the approach taken when the model is implemented
- Preferences
  - These indicate the preferred architecture for all data, functions, and behavior
  - They are driven by customer requirements

“Business Process” Engineering

“Business Process” Engineering

- The goal of BPE is to define architectures that will enable a business to use information effectively.
- Consists of Three different Architectures
  - Data Architecture
  - Application Architecture
  - Technology Infrastructure

BPE - Data Architecture

- Data Architecture: provides a framework for the information needs of a business or a business function
  - Data Objects: individual building blocks
  - Set of Attributes: some quality of data
  - Relationships: connection between objects

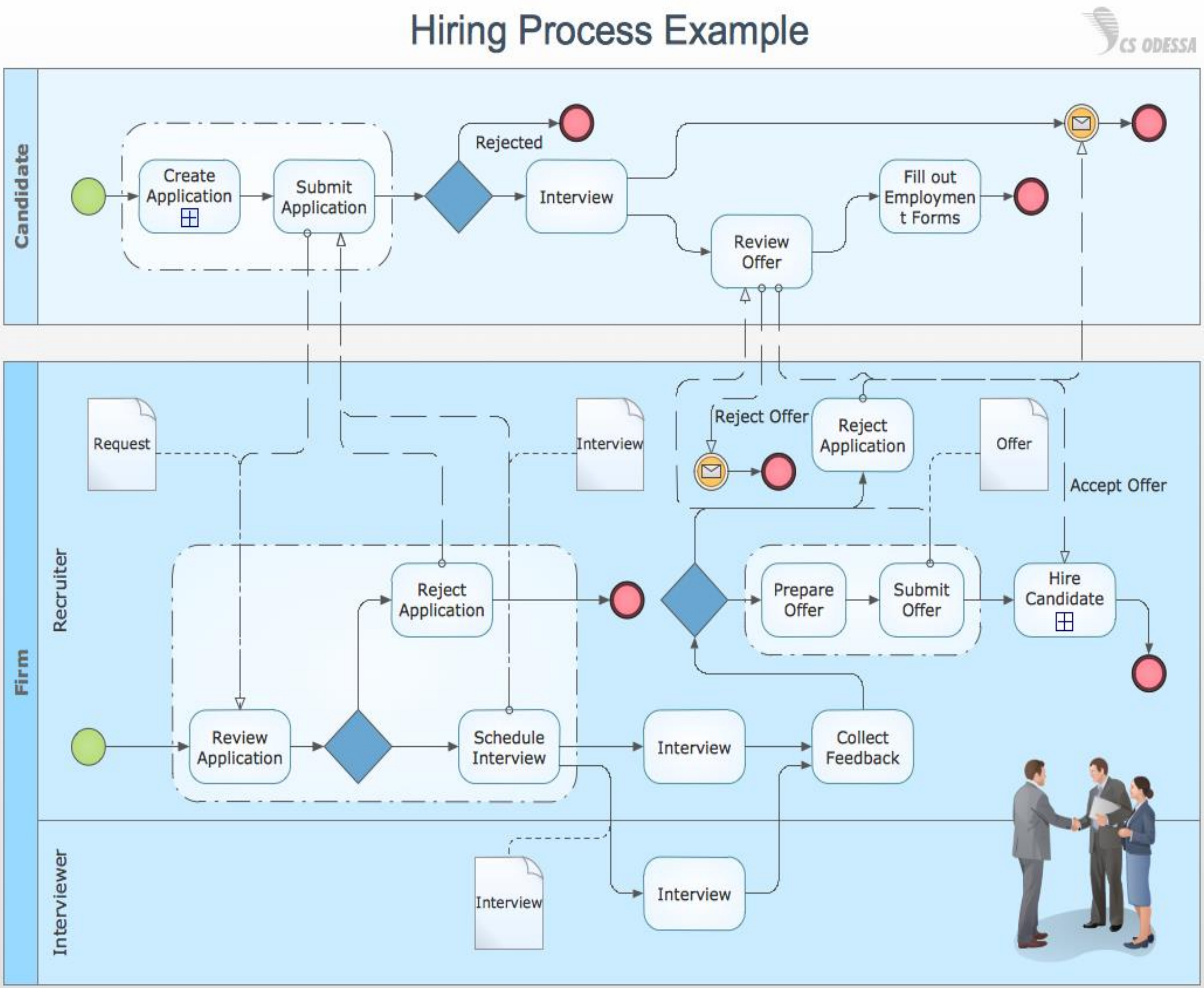
BPE- Application Architecture

- Encompasses those elements of a system that transform objects within the data architecture for some business purpose
- System of programs

BPE- Technology Infrastructure

- Provides foundation for data and application architectures
- Hardware and Software – supporting application and data
  - OS
  - NW
  - Storage
  - Servers

Hiring Process Example

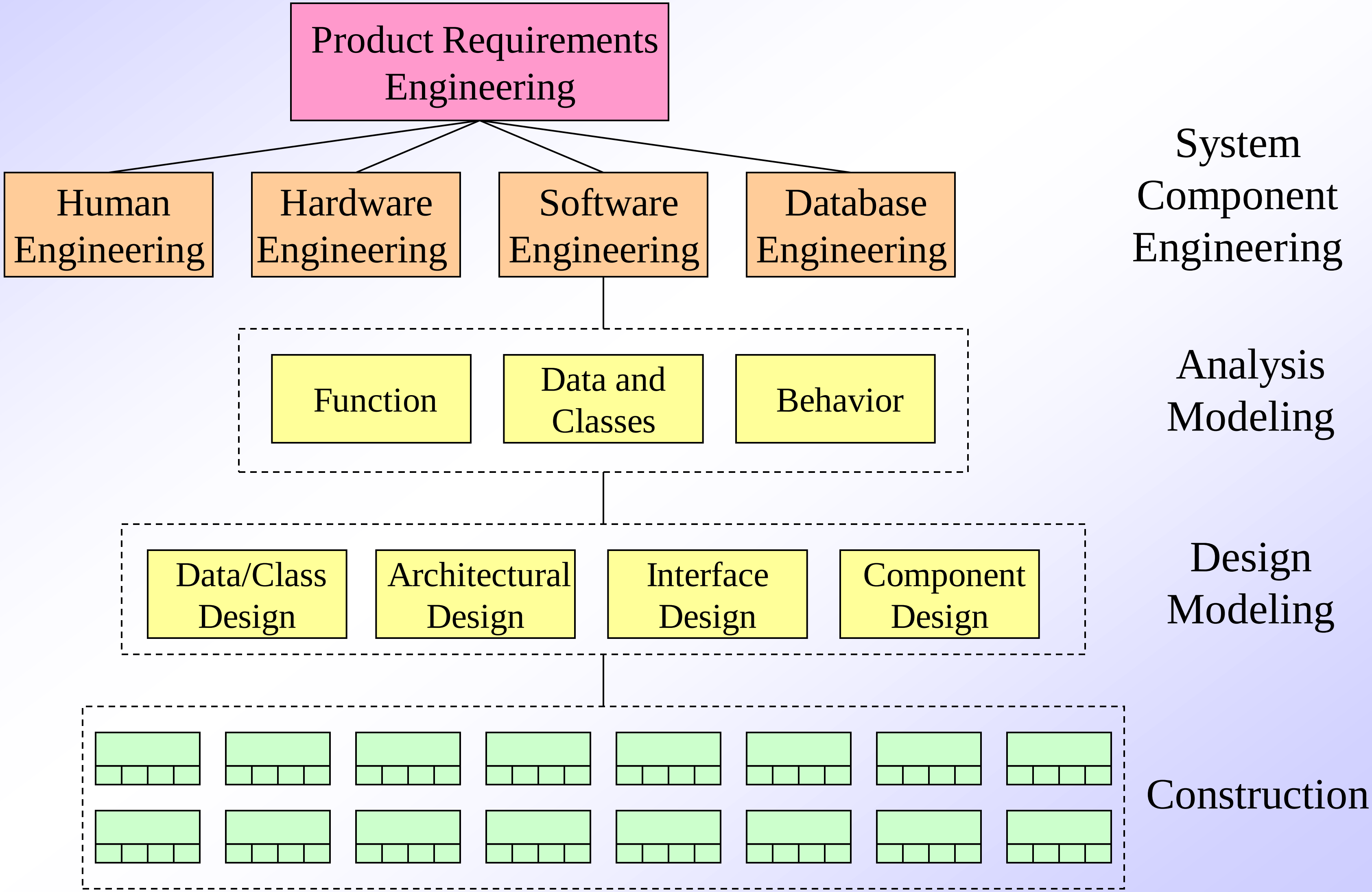


Product Engineering

Product Engineering

- Product engineering translates the customer's desire for a set of defined capabilities into a working product
- It achieves this goal by establishing a product architecture and a support infrastructure
  - Product architecture components consist of people, hardware, software, and data
  - Support infrastructure includes the technology required to tie the components together and the information to support the components
- Requirements engineering elicits the requirements from the customer and allocates function and behavior to each of the four components
- System component engineering happens next as a set of concurrent activities that address each of the components separately
  - Each component takes a domain-specific view but maintains communication with the other domains
  - The actual activities of the engineering discipline takes on an element view
- Analysis modeling allocates requirements into function, data, and behavior
- Design modeling maps the analysis model into data/class, architectural, interface, and component design

Product Engineering Hierarchy



Summary

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- System engineering process
- Business process engineering
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