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Initiating a systems development project and investigating system requirements

Topic 2

ICT284 Systems Analysis and Design

About this topic

In this topic we'll begin our coverage of the SDLC by looking first at how system development projects are initiated, and some techniques for problem identification.

Identifying the requirements of the new system is fundamental to being able to develop it successfully, and we'll look at discovering functional and non-functional requirements using the FURPS+ approach. We'll then consider various techniques for gathering requirements information, and what each of them can tell us.

Unit learning outcomes addressed in this topic

1. Explain how information systems are used within organisations to fulfil organisational needs
2. **Describe the phases and activities typically involved in the systems development life cycle**
3. Describe the professional roles, skills and ethical issues involved in systems analysis and design work
4. **Use a variety of techniques for analysing and defining business problems and opportunities and determining system requirements**
5. Model system requirements using UML, including use case diagrams and descriptions, activity diagrams and domain model class diagrams
6. Explain the activities involved in systems design, including designing the system environment, application components, user interfaces, database and software
7. Represent early system design using UML, including sequence diagrams, architectural diagrams and design class diagrams
8. Describe tools and techniques for planning, managing and evaluating systems development projects
9. Describe the key features of several different systems development methodologies
10. Present systems analysis and design documentation in an appropriate, consistent and professional manner

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Topic learning outcomes

After completing this topic you should be able to:

- Explain why and how system development projects are initiated
- Describe some techniques for problem identification
- Explain where requirements investigation fits in the SDLC
- Identify and distinguish between functional and non-functional system requirements
- Identify the stakeholders involved in IS development and their contributions to requirements definition
- Describe several information-gathering techniques and determine when each is best applied

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Resources for this topic

READING

- Satzinger, Jackson & Burd, Chapter 2. Omit p60-63 section 'Documenting Workflows with Activity Diagrams' for now
- Satzinger, Jackson & Burd, Chapter 11, p335-339, section 'Identify the Problem and Obtain Approval' up to 'The Estimated Time for Project Completion'

Except where otherwise referenced, all images in these slides are from those provided with the textbook: Satzinger, J., Jackson, R. and Burd, S. (2016) *Systems Analysis and Design in a Changing World*, 7th edition, Course Technology, Cengage Learning: Boston. ISBN-13 9781305117204

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Topic outline

- Initiating a systems development project
  - Problem definition
- Requirements
  - Functional and non-functional requirements
  - FURPS+
- Stakeholders
- Information-gathering techniques

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Core processes of the SDLC

Core processes
Identify the problem and obtain approval.
Plan and monitor the project.
Discover and understand details.
Design system components.
Build, test, and integrate system components.
Complete system tests and deploy the solution.

These are the core SDLC processes as described by the textbook – corresponding to the general phases of:

- Initiation
- Planning
- Analysis
- Design
- Construction
- Implementation

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In this topic …

Core processes
Identify the problem and obtain approval.
Plan and monitor the project.
Discover and understand details.
Design system components.
Build, test, and integrate system components.
Complete system tests and deploy the solution.

… we'll focus on the core processes of

identify the problem and obtain approval

and

discover and understand details

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Initiating a systems development project

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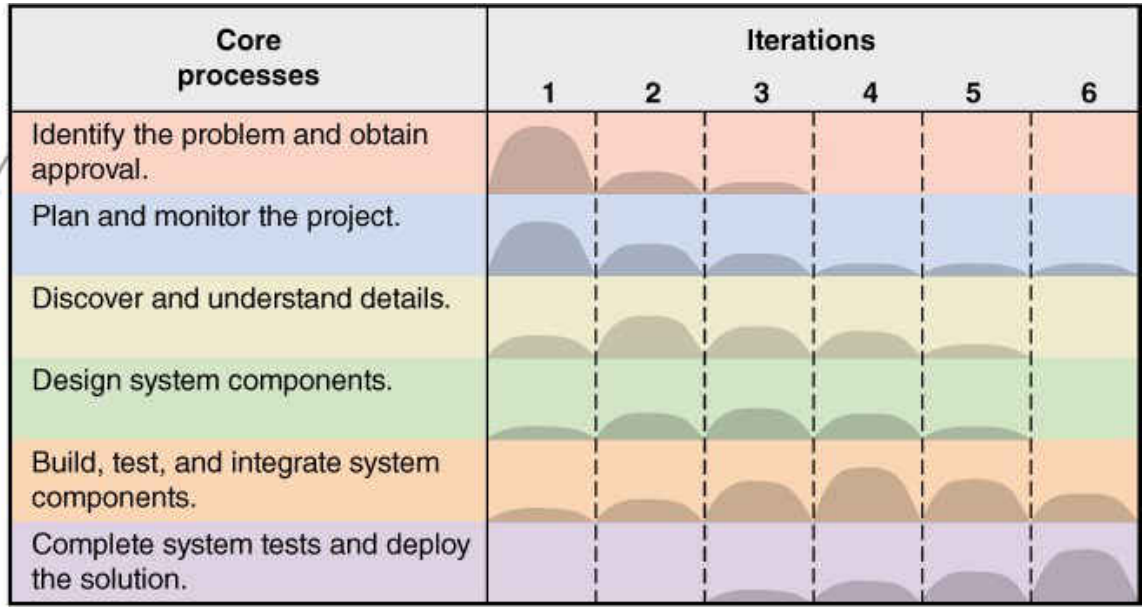
Getting started

Identify problem activities
Identify the problem. Quantify project approval factors. Perform risk and feasibility analysis. Review with the client and obtain approval.



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Project initiation

This phase answers the question 'is this project worth looking at?'

To do this it must:

- define the perceived problems, opportunities and directives that **triggered** the project
- define the **scope** of the project (what it will and won't do)
- Identify the business **benefits** that will accrue

These may be summarised in a System Vision document

Project triggers

System owners and users initiate most projects in response to some combination of:

- **Problems** - undesirable situations that prevent the organisation from fully achieving its purpose, goals, and/or objectives
- **Opportunities** - chances to improve the organisation even in the absence of specific problems
- **Directives** - new requirements that are imposed by management, government, or some external influence

Problem identification

- Care must be taken that the ‘real’ problem is being addressed, or the system will end up solving the wrong problem and be useless
- Need to ensure the symptom isn’t confused with the cause
- There are various tools and techniques to assist in problem identification and documentation – we’ll look at a few next

Techniques for identifying the problem

- **5 whys** – keep asking 'why' until the fundamental problem is revealed

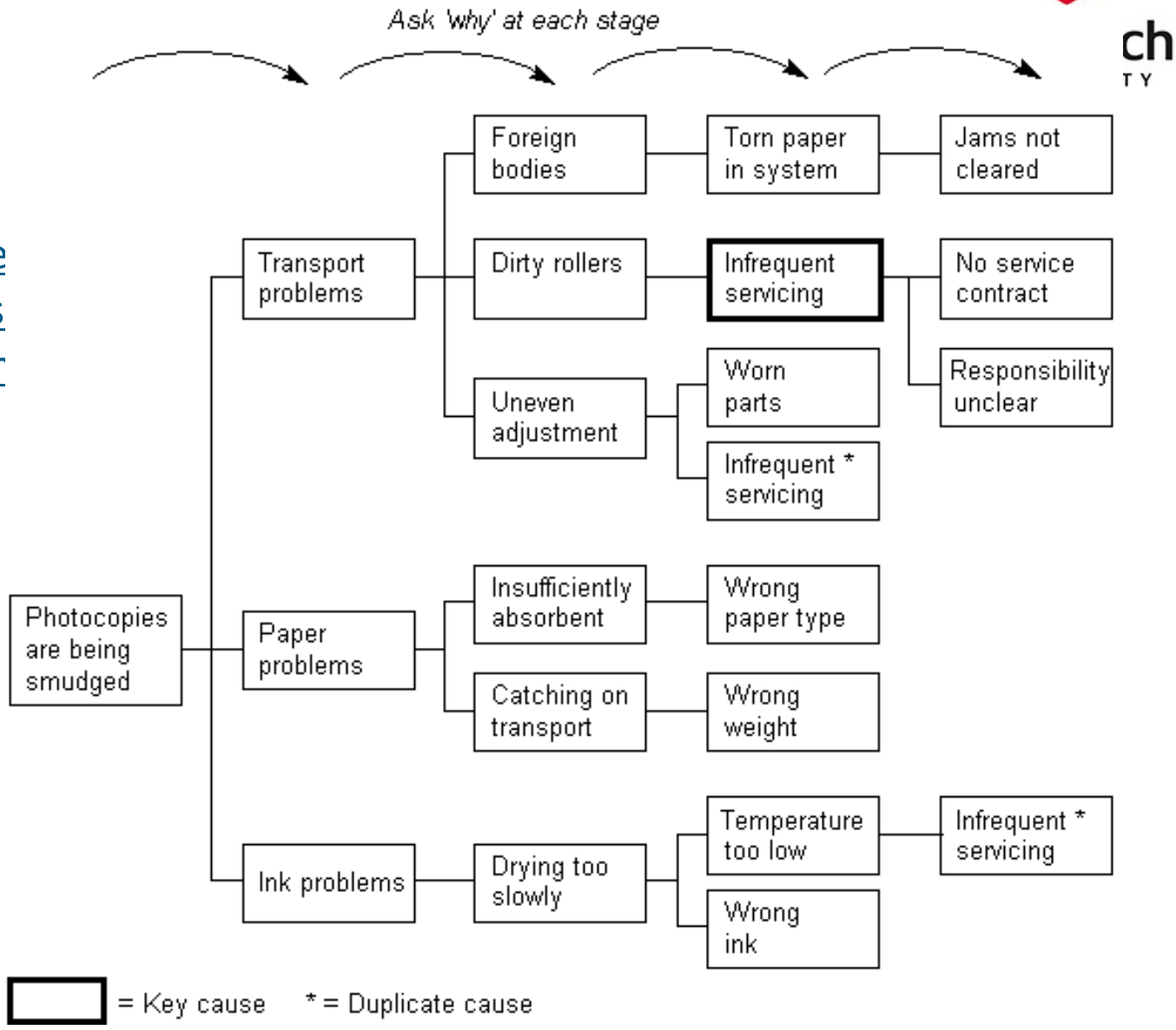
  e.g. The photocopier keeps smudging –

  WHY? (next slide)

- **Cause-Effect** or **Ishikawa** diagram – different causes and effects contribute to the stated problem

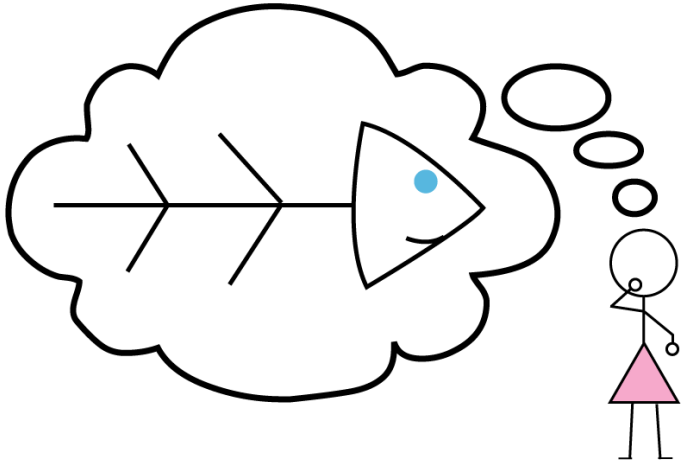
Example of a 'why-why' diagram

Image from http://www.syque.com/quality_tools/tools/Tools24.htm



Cause-effect (Ishikawa) diagram

A cause-effect diagram is a graphical tool used to identify, explore, and depict problems and the causes and effects of those problems. It is often referred to as a **Ishikawa diagram** or a **fishbone diagram**.



The basic concept is that the name of the **problem** is entered at the right of the diagram (head of fish). The possible **causes** of the problem are drawn as bones off the main backbone.

Image from http://www.bulsuk.com/2009/08/using-fishbone-diagram-to-perform-5-why.html

Example of a cause-effect diagram

The kinds of groups of problems are often similar within a particular domain/industry, so templates may be used.. ..

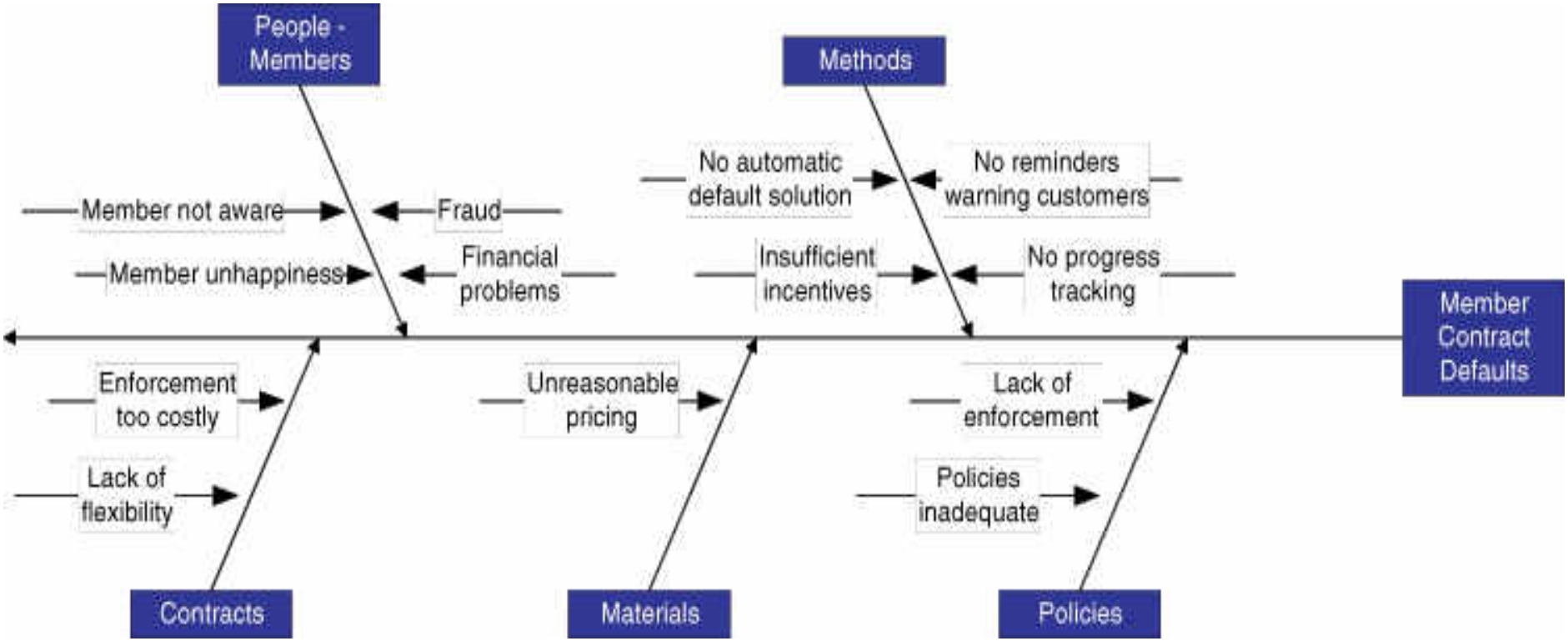


Image from Whitten, J.L., Bentley, L.D. & Dittman, K.C., (2001), Systems Analysis and Design Methods, 5th Edition, McGraw-Hill. Figure 6.3

Example of a cause-effect diagram

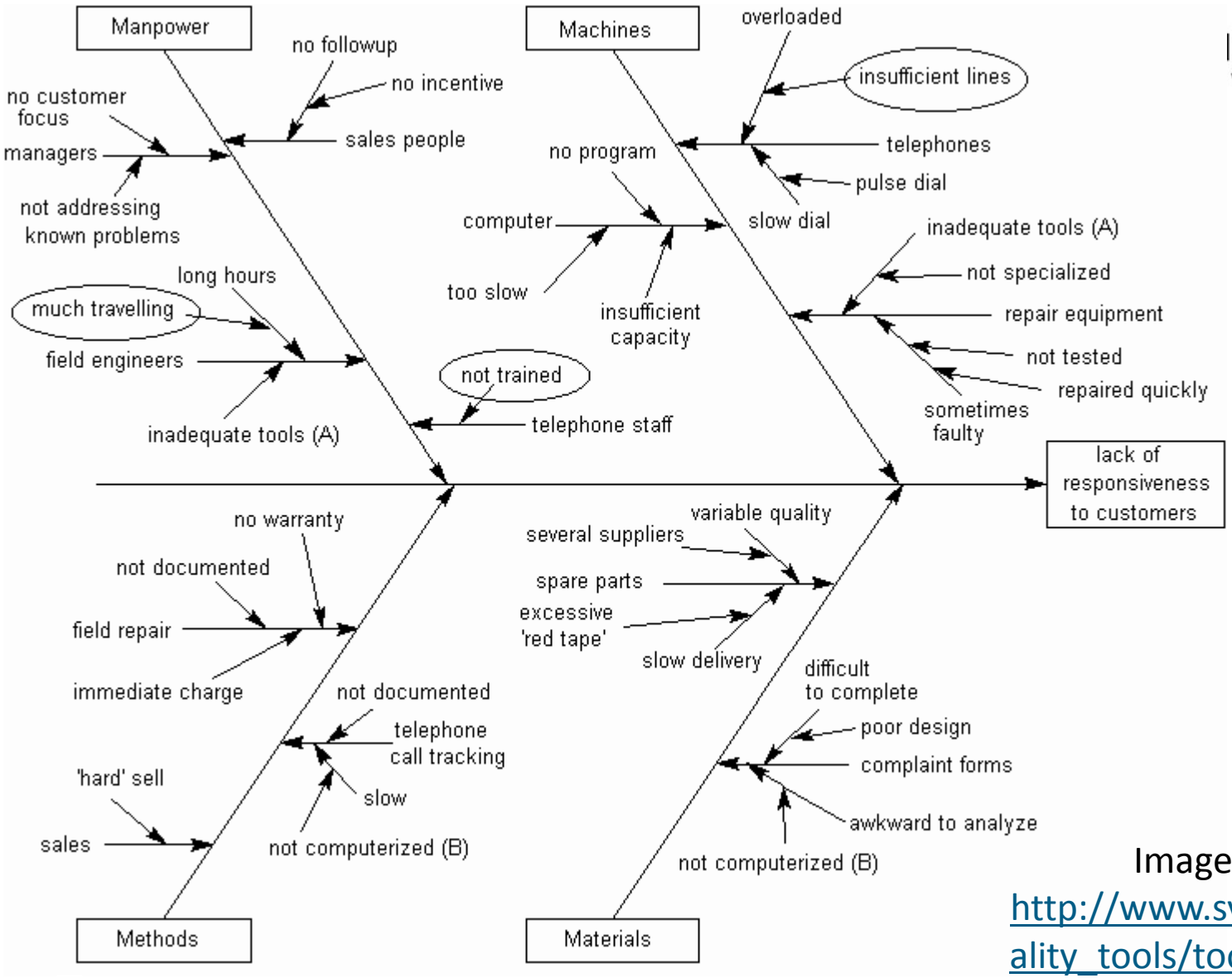


Image from http://www.syque.com/quality_tools/toolbook/cause-effect/example.htm

Opportunities

- Chances to improve the organisation even in the absence of specific problems
- Opportunities can arise out of short and long term strategic plans developed by organisations – these plans can identify potential projects that will then be prioritised and scheduled

Directives

- New requirements that are imposed by management, government, or some other external influence
- e.g. new or revised legislation such as tax requiring different reporting to be incorporated into systems

Project scope

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- Scope defines the boundaries of the project –
- Determines what's part of the system under consideration, **and** what's outside it
- Important to define scope of system clearly or it can lead to wrong problem being solved, or including too much within scope
- A Context (or Level 0) Data Flow Diagram is a model (traditional, not UML) often used to show 'the system' in its environment (next slide)

Image from Satzinger, J. Jackson, R. & Burd, S. Systems Analysis and Design in a Changing World, 2nd edition. Course Technology, Thomson Learning

Context data flow diagram

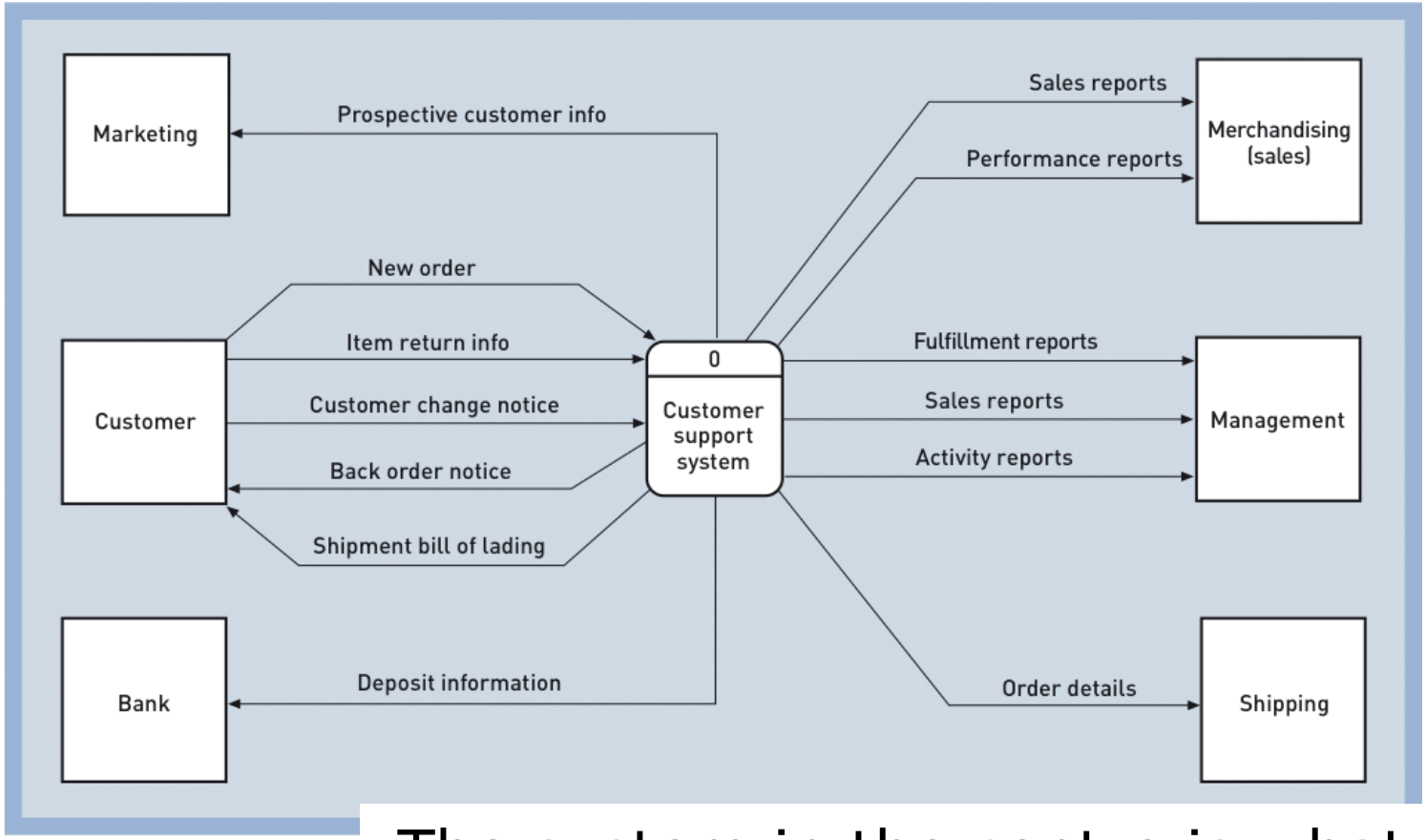


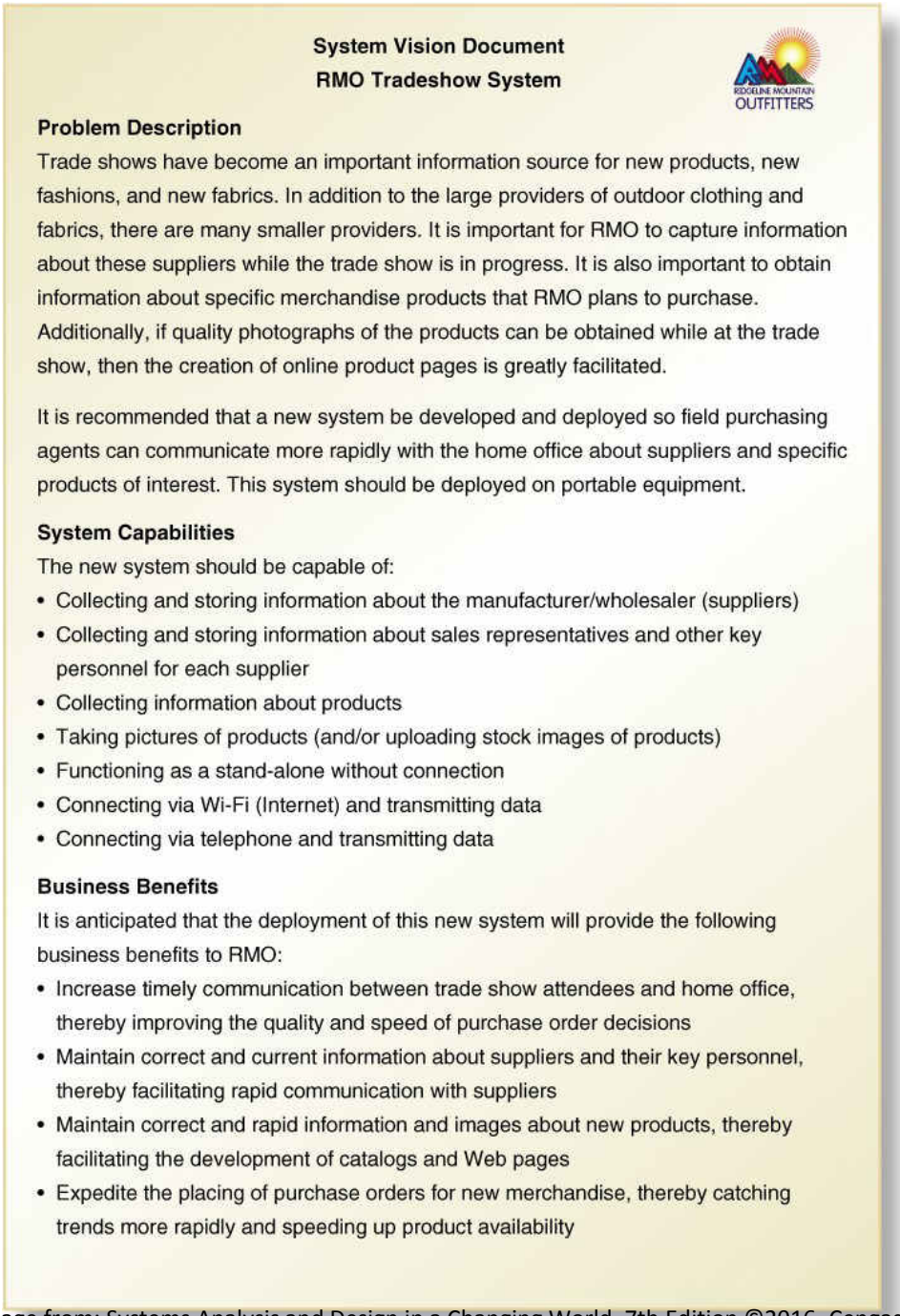
Figure 3-9

Context diagram for the customer support system

The system in the centre is what we are developing– all the rest is *outside the system scope*

Benefit

- The expected benefits to the organisation from the new system must be clearly articulated
- Benefits are generally described in terms of the *business* outcomes that will eventually lead to some improvement for the organisation
- - ideally describable in dollar terms such as increased revenue/decreased costs
- Both *tangible* and *intangible* benefits can accrue



System Vision Document
RMO Tradeshow System

RIDGELINE MOUNTAIN OUTFITTERS

Problem Description

Trade shows have become an important information source for new products, new fashions, and new fabrics. In addition to the large providers of outdoor clothing and fabrics, there are many smaller providers. It is important for RMO to capture information about these suppliers while the trade show is in progress. It is also important to obtain information about specific merchandise products that RMO plans to purchase. Additionally, if quality photographs of the products can be obtained while at the trade show, then the creation of online product pages is greatly facilitated.

It is recommended that a new system be developed and deployed so field purchasing agents can communicate more rapidly with the home office about suppliers and specific products of interest. This system should be deployed on portable equipment.

System Capabilities

The new system should be capable of:

- Collecting and storing information about the manufacturer/wholesaler (suppliers)
- Collecting and storing information about sales representatives and other key personnel for each supplier
- Collecting information about products
- Taking pictures of products (and/or uploading stock images of products)
- Functioning as a stand-alone without connection
- Connecting via Wi-Fi (Internet) and transmitting data
- Connecting via telephone and transmitting data

Business Benefits

It is anticipated that the deployment of this new system will provide the following business benefits to RMO:

- Increase timely communication between trade show attendees and home office, thereby improving the quality and speed of purchase order decisions
- Maintain correct and current information about suppliers and their key personnel, thereby facilitating rapid communication with suppliers
- Maintain correct and rapid information and images about new products, thereby facilitating the development of catalogs and Web pages
- Expedite the placing of purchase orders for new merchandise, thereby catching trends more rapidly and speeding up product availability

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Document the problem scope of solution and business benefits in a **System Vision Document**

Project approval

- The system vision document provides a high level document that identifies the need for a new system and sets out its scope and expected benefits
- This now needs to be defined more precisely so that approval can be obtained from the client to commence the project, using criteria such as:
  - Estimated time for completion
  - Estimated cost for project and system
  - Anticipated benefits
- We'll discuss these in more detail in a later topic

Summing up…

- The first stage/core process of the SDLC is to identify the problem and gain approval to continue
- This involves defining the perceived problems, opportunities and directives that triggered the project; defining the scope of the project (what it will and won't do); and identifying the business benefits that will accrue
- There are many techniques for identifying the root cause of a problem, including the 5 whys technique and cause-effect analysis
- It's important to define the scope of the system clearly or it can lead to wrong problem being solved, or including too much (or too little) within scope

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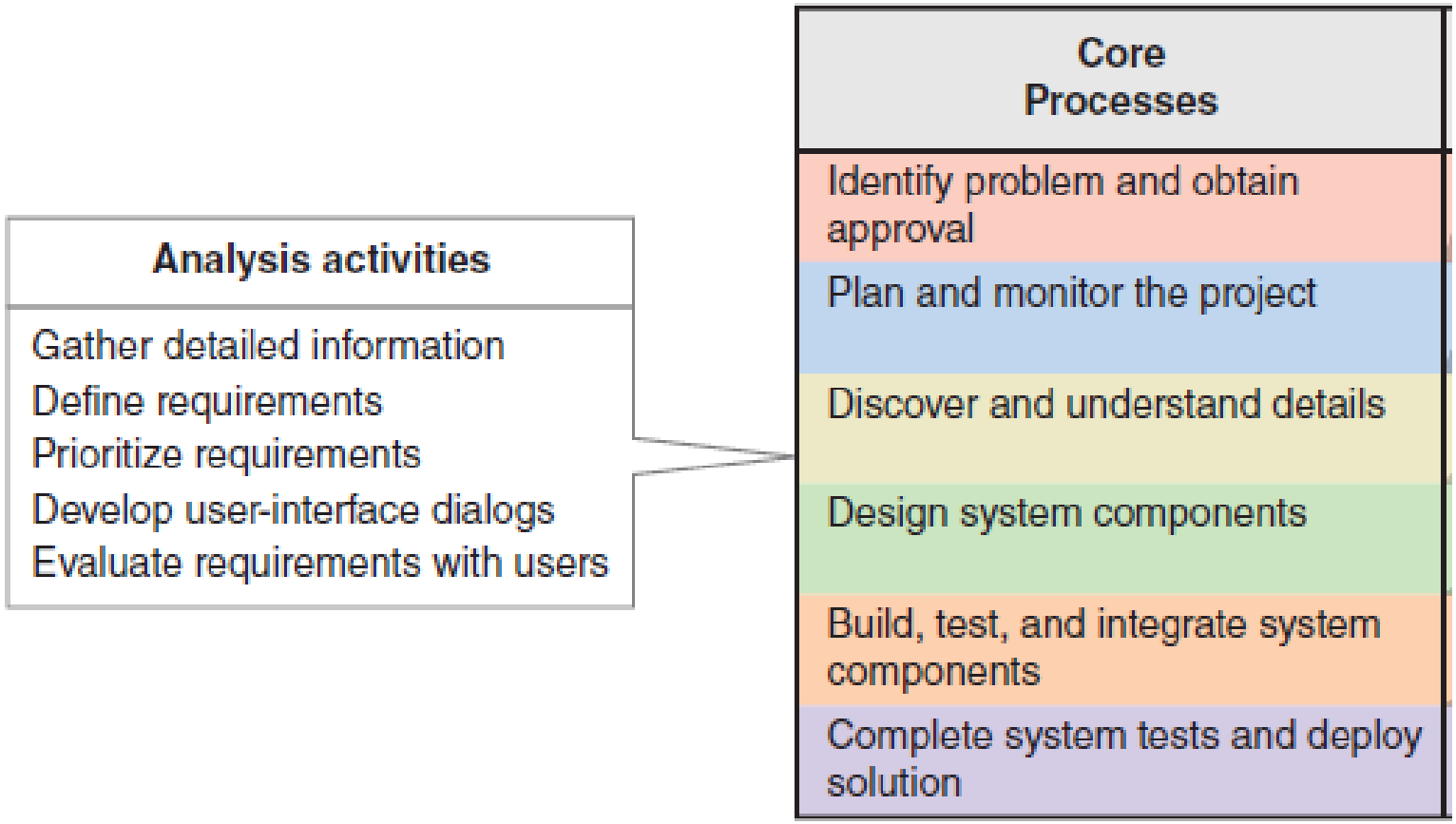
Systems analysis activities



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Systems analysis activities

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- Gather Detailed Information
  - Interviews, questionnaires, documents, observing business processes, researching vendors, comments and suggestions
- Define Requirements
  - Modeling functional and non-functional requirements
- Prioritize Requirements
  - Essential, important, vs. nice to have
- Develop User-Interface Dialogs
  - Flow of interaction between user and system
- Evaluate Requirements with Users
  - User involvement, feedback, adapt to changes

Requirements

Functional requirements

Non-functional requirements

FURPS+

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What are requirements?

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System Requirements =

- Functional requirements
- Non-functional requirements

Functional requirements – the activities the system must perform

- Business uses, functions the users carry out
- Use cases

Non-Functional requirements – other system characteristics

- Constraints and performance goals

FURPS requirements acronym

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Functional requirements

Usability requirements

Reliability requirements

Performance requirements

Security requirements

FURPS

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Requirement categories	FURPS + categories	Example requirements
Functional	Functions	Business rules and processes
Nonfunctional	Usability Reliability Performance Security	User interface, ease of use Failure rate, recovery methods Response time, throughput Access controls, encryption

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FURPS+ requirements acronym

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Functional requirements

Usability requirements

Reliability requirements

Performance requirements

Security requirements

+ even more categories…

FURPS+

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Requirement categories	FURPS + categories	Example requirements
Functional	Functions	Business rules and processes
Nonfunctional	Usability	User interface, ease of use
	Reliability	Failure rate, recovery methods
	Performance	Response time, throughput
	Security	Access controls, encryption
	+ Design constraints	Hardware and support software
	Implementation	Development tools, protocols
	Interface	Data interchange formats
	Physical	Size, weight, power consumption
	Support	Installation and updates

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The '+' in FURPS+
Additional requirements categories

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- Design constraints –

  Specific restrictions for hardware and software
- Implementation requirements

  Specific languages, tools, protocols, etc.
- Interface requirements

  Interface links to other systems
- Physical requirements

  Physical facilities and equipment constraints
- Supportability requirements

  Automatic updates and enhancement methods

Summing up…

- System **requirements** are made up of **functional** requirements – the activities the system must perform, and **non-functional** requirements – other system characteristics
- **FURPS+** acronym helps identify requirements:

  Functional requirements

  Usability requirements

  Reliability requirements

  Performance requirements

  Security requirements

  + design, implementation, interface, physical, supportability constraints,

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Stakeholders

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Stakeholders

Who do you involve and talk to?

Stakeholders– persons who have an interest in the successful implementation of the system

- **Internal Stakeholders**– persons within the organization
- **External stakeholders** – persons outside the organization
- **Operational stakeholders** – persons who regularly interact with the system
- **Executive stakeholders**– persons who don't directly interact, but use the information or have financial interest

Stakeholders

Who do you involve and talk to?

We can also identify

- **Clients** – who provide the funding for the systems development project
- **Technical and support staff** in the organisation

Each stakeholder group will have a slightly different view on what the system requirements should be

Examples of stakeholders

(Project is a comprehensive accounting system for public company)

Stakeholders for RMO CSMS project (Consolidated Sales and Marketing System)

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- Phone/mail sales order clerks
- Warehouse and shipping personnel
- Marketing personnel who maintain online catalog information
- Marketing, sales, accounting, and financial managers
- Senior executives
- Customers
- External shippers (e.g., UPS and FedEx)

Summing up…

- **Stakeholders** are all those persons who have an interest in the successful implementation of the system
- Can be internal to the organisation or external; operational (use the system) or executive
- Each type of stakeholder will have a slightly different perspective on what they want from the project –
- - so it is important to include representatives of all stakeholders when investigating the system requirements

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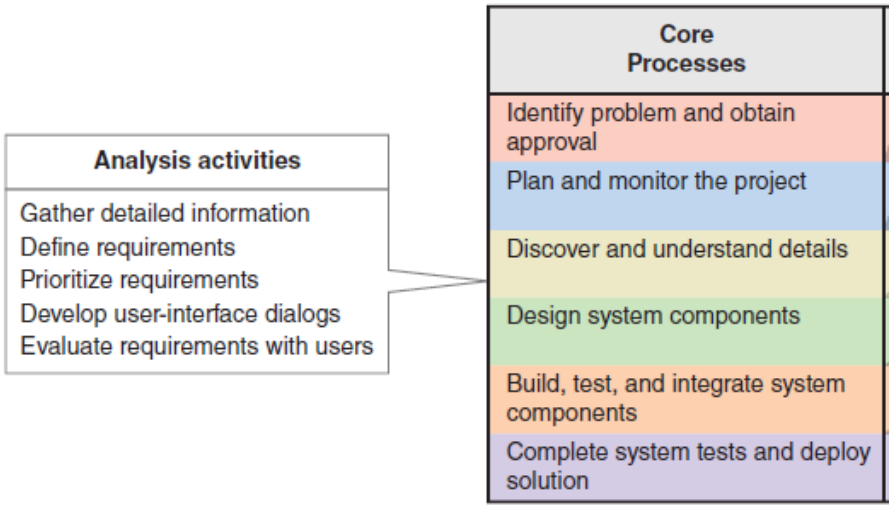
Information-gathering techniques



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Information-gathering techniques

- Interviewing users and other stakeholders
- Distributing and collecting questionnaires
- Reviewing inputs, outputs, and documentation
- Observing and documenting business procedures
- Researching vendor solutions
- Collecting active user comments and suggestions from testing

Interviews

Interviews are a fact-finding technique where the systems analysts collect information from individuals through face-to-face interaction

Advantages?

Disadvantages?

Interviewing involves…

- Preparing detailed questions
- Meeting with individuals or groups of users
- Obtaining and discuss answers to the questions
- Documenting the answers
- Following up as needed in future meetings or interviews

Types of interviews

Unstructured interviews are conducted with only a general goal or subject in mind and with few, if any, specific questions.

- Not usually practical for systems analysis

In **structured interviews** the interviewer has a specific set of questions to ask of the interviewee

Questions may be **open** or **closed**

Themes for interview questions

Theme	Questions to users
What are the business operations and processes?	What do you do?
How should those operations be performed?	How do you do it? What steps do you follow? How could they be done differently?
What information is needed to perform those operations?	What information do you use? What inputs do you use? What outputs do you produce?

Plan the interview – have an agenda

Discussion and Interview Agenda

Setting

Objective of Interview
Determine processing rules for sales commission rates

Date, Time, and Location
April 21, 2016, at 9:00 a.m. in William McDougal's office

User Participants (names and titles/positions)
William McDougal, vice president of marketing and sales, and several of his staff

Project Team Participants
Mary Ellen Green and Jim Williams

Interview/Discussion

1. *Who is eligible for sales commissions?*
2. *What is the basis for commissions? What rates are paid?*
3. *How is commission for returns handled?*
4. *Are there special incentives? Contests? Programs based on time?*
5. *Is there a variable scale for commissions? Are there quotas?*
6. *What are the exceptions?*

Follow-Up

Important decisions or answers to questions
See attached write-up on commission policies

Open items not resolved with assignments for solution
See Item numbers 2 and 3 on open items list

Date and time of next meeting or follow-up session
April 28, 2016, at 9:00 a.m.

Keep track of unresolved or outstanding questions using an Open Items list so they will be followed up

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ID	Issue title	Date identified	Target end date	Responsible project person	User contact	Comments
1	Partial shipments	6-12-2016	7-15-2016	Jim Williams	Jason Nadold	Ship partials or wait for full shipment?
2	Returns and commissions	7-01-2016	9-01-2016	Jim Williams	William McDougal	Are commissions recouped on returns?
3	Extra commissions	7-01-2016	8-01-2016	Mary Ellen Green	William McDougal	How to handle commissions on special promotions?

Questionnaires

Questionnaires are special purpose documents that allow the analyst to collect information and opinions from respondents.

Advantages?

Disadvantages?

Types of questions

Open ended questions offer the respondent greater latitude in the answer and are useful for explanations or examples

Closed ended questions only permit limited responses:

- Quantitative
- Multiple-choice
- Rating (Agree …. Disagree)
- Ranking (best to worst)

RMO Questionnaire

This questionnaire is being sent to all telephone-order sales personnel. As you know, RMO is developing a new customer support system for order taking and customer service.

The purpose of this questionnaire is to obtain preliminary information to assist in defining the requirements for the new system. Follow-up discussions will be held to permit everybody to elaborate on the system requirements.

Part I. Answer these questions based on a typical four-hour shift.

1. How many phone calls do you receive?_____
2. How many phone calls are necessary to place an order for a product?_____
3. How many phone calls are for information about RMO products, that is, questions only?_____
4. Estimate how many times during a shift customers request items that are out of stock._____
5. Of those out-of-stock requests, what percentage of the time does the customer desire to put the item on back order?_____%
6. How many times does a customer try to order from an expired catalog?_____
7. How many times does a customer cancel an order in the middle of the conversation?_____
8. How many times does an order get denied due to bad credit?_____

Part II. Circle the appropriate number on the scale from 1 to 7 based on how strongly you agree or disagree with the statement.

Question	Strongly Agree						Strongly Disagree
It would help me do my job better to have longer descriptions of products available while talking to a customer.	1	2	3	4	5	6	7
It would help me do my job better if I had the past purchase history of the customer available.	1	2	3	4	5	6	7
I could provide better service to the customer if I had information about accessories that were appropriate for the items ordered.	1	2	3	4	5	6	7
The computer response time is slow and causes difficulties in responding to customer requests.	1	2	3	4	5	6	7

Part III. Please enter your opinions and comments.

Please briefly identify the problems with the current system that you would like to see resolved in a new system.

_____
_____
_____

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How many types of questions can you identify in this questionnaire?

Review existing documentation

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From **inside** the organisation:

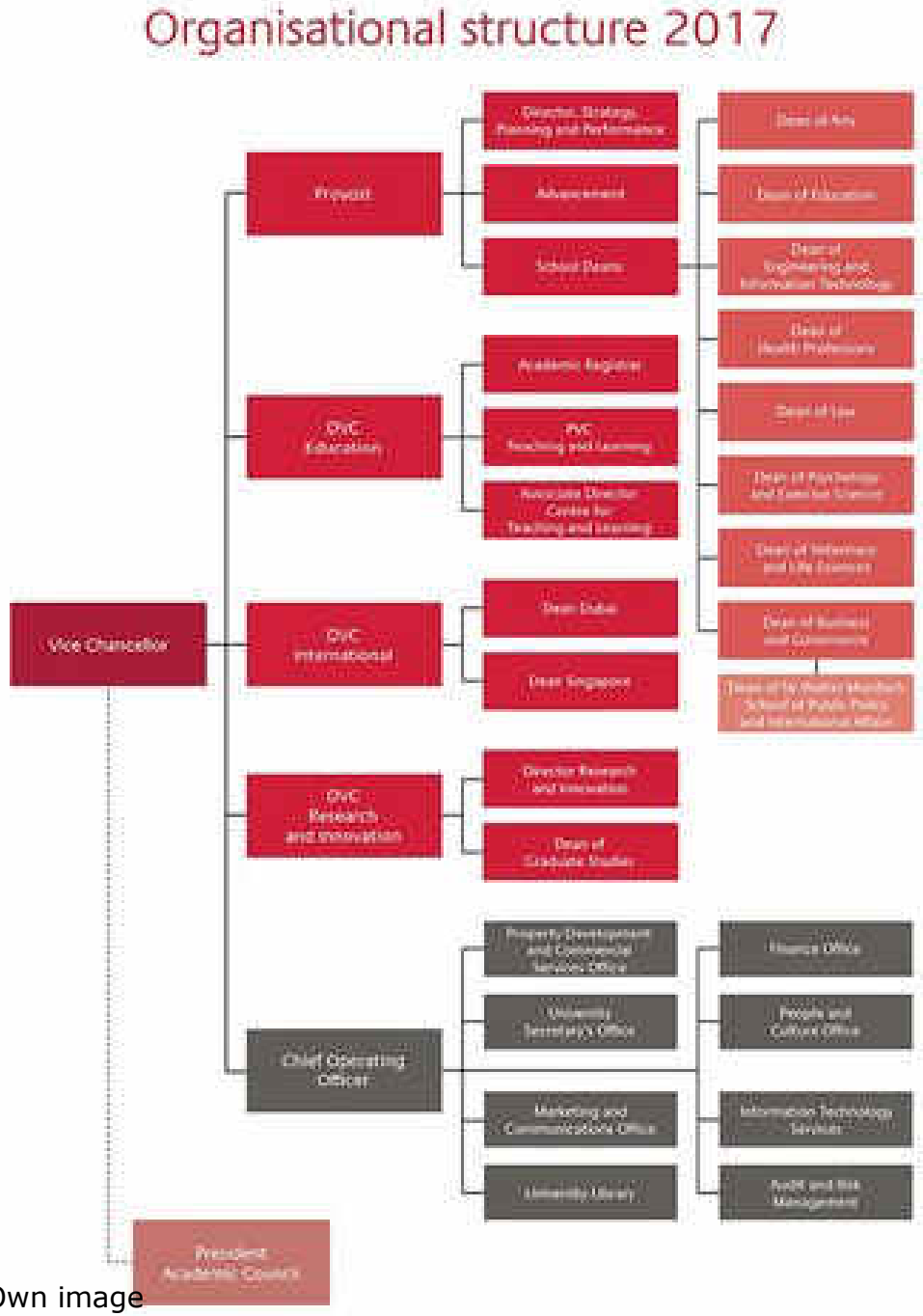
- Organisational charts
- Policy and procedures documents
- Documents describing the problem
- Documents describing the business function being investigated (forms, screens, samples of database records, reports)
- Previous system documentation

Sources **outside** the organisation may provide useful information, e.g. on industry best practice

Things you can find out from documents

- Symptoms and causes of problems
- Persons in organization who have understanding of problem
- Business functions that are supported by the present system
- Type of data to be collected and reported by the system
- Questions that need to be covered in interviews

Murdoch University's Organisational Structure



Example - Organisational chart

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Example – RMO customer order form

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Ridgeline Mountain Outfitters—Customer Order Form

RIDGELINE MOUNTAIN OUTFITTERS

Name and address of person placing order.
(Please verify your mailing address and make correction below.)
Order Date ___/___/___

Name

Address Apt. No

City State Zip

Phone: Day ( ) Evening ( )

Gift Order or Ship To: (Use only if different from address at left.)

Name

Address Apt. No

City State Zip

Gift ☐ Address for this Shipment Only ☐ Permanent Change of Address ☐

Gift Card Message

Delivery Phone ( )

	Item No.	Description	Style	Color	Size	Sleeve Length	Qty	Monogram	Style	Price Each	Total

MERCHANDISE TOTAL

Regular FedEx shipping $4.50 per U.S. delivery address
(Items are sent within 24 hours for delivery in 2 to 4 days)

Please add $4.50 per each additional U.S. delivery address

FedEx Standard Overnight Service

Any additional freight charges

International Shipping (see shipping information on back)

Method of Payment

Check/Money Order ☐ Gift Certificate(s) ☐ AMOUNT ENCLOSED $ ____

American Express ☐ MasterCard ☐ VISA ☐ Other ☐

Account Number

MO YR
___/___
Expiration Date

Signature

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Sample completed rather than blank forms

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Can determine what the data for each field should look like:

- Type of data
- Size of data
- Whether mandatory
- Relationships among data

Can also find out how people *really* use the form

Observation

Observation is a fact-finding technique where the systems analyst either participates in or watches a person perform activities to learn about the system.

Advantages?

Disadvantages?

Observation guidelines

- Determine the who, what, where, when, why, and how of the observation
- Obtain permission from appropriate supervisors or managers
- Inform those who will be observed of the purpose of the observation
- Keep a low profile
- Take notes during or immediately following observation
- Review observation notes with appropriate individuals
- Don't interrupt the individuals at work
- Don't focus heavily on trivial activities
- Don't make assumptions

Research vendor solutions

Most problems are not completely unique, so have probably been solved before (at least in part)

Researching existing solutions can help generate new ideas, or even provide an off-the-shelf solution

- Can contact organisations that have previously experienced similar problems. They may share valuable information
- White papers, vendor literature, competitors

Collect user comments and suggestions

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- User feedback from testing early iterations or prototypes
- “I’ll know it when I see it”
- Users often cannot completely or accurately state their requirements until they can interact with a live system that implements those requirements

Other techniques - Prototyping

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Discovery prototyping is the act of building a small-scale, representative or working model of the users' requirements in order to discover or verify those requirements.

Advantages?

Disadvantages?

Putting it together : need a Fact-Finding Strategy

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Need a fact-finding strategy. For example:

1. Learn all you can from existing documents, forms, reports, and files
2. If appropriate, observe the system in action
3. Given all the facts that you've already collected, design and distribute questionnaires to clear up things you don't fully understand
4. Conduct your interviews (or group work sessions)
5. (Optional). Build discovery prototypes for any functional requirements that are not understood or if requirements need to be validated
6. Follow up

Summing up…

- There are many **information-gathering techniques** that can be used in the analysis phase, including:

  Interviewing users and other stakeholders

  Distributing and collecting **questionnaires**

  Reviewing inputs, outputs, and **documentation**

  Observing and documenting business procedures

  Researching vendor solutions

  Collecting active **user comments** and suggestions from testing

  .. and others

- It is important to plan your **fact-finding strategy** to collect information in the most efficient way and make the most of your time with the stakeholders

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The importance of requirements

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The importance of getting the requirements right…

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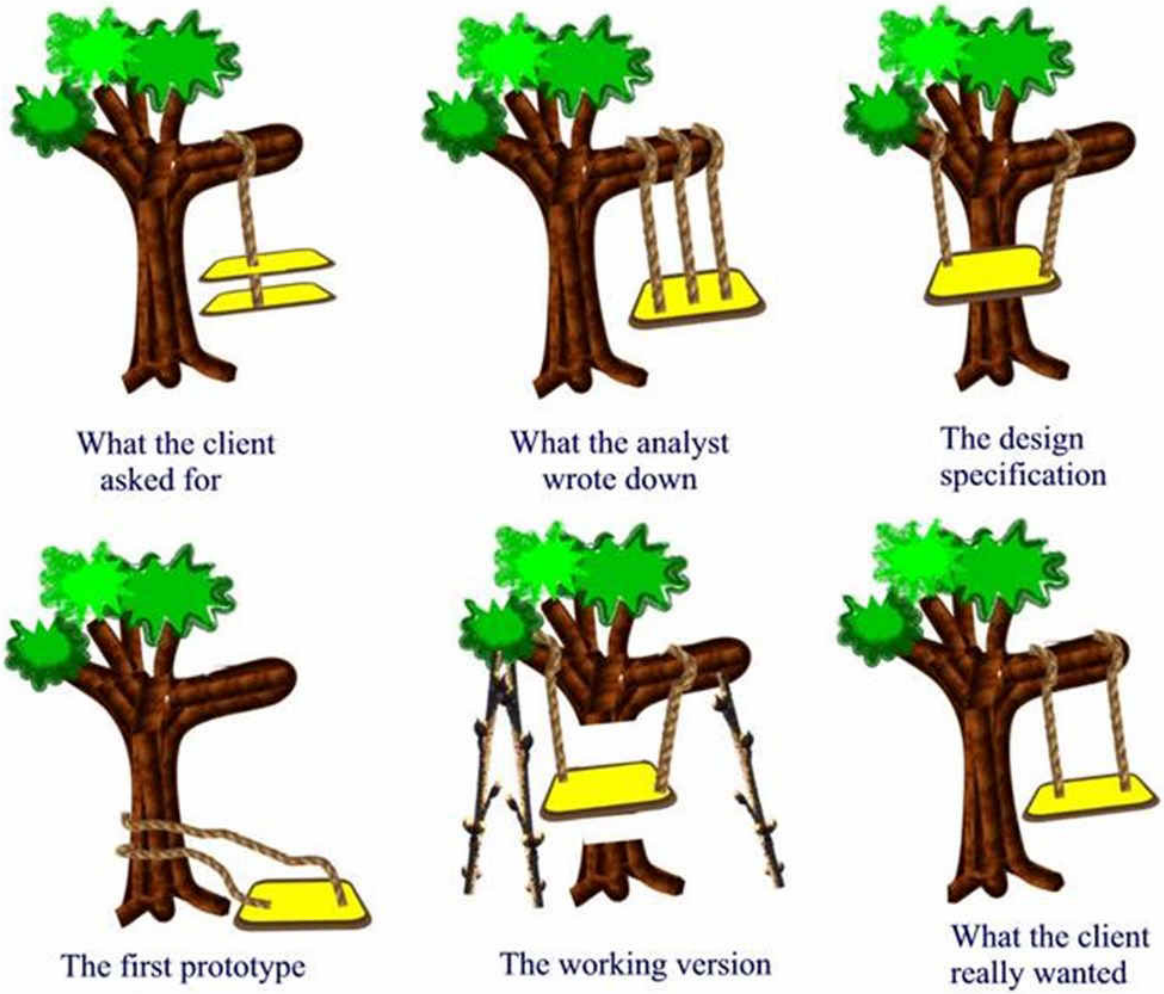

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If the requirements are incorrect:

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- The system may **cost more** than projected
- The system may be **delivered later** than promised
- The system may **not meet the users' expectations** and that dissatisfaction may cause them not to use it
- Once in production, the **costs of maintaining** and enhancing the system may be excessively high
- The system may be **unreliable** and prone to errors and downtime
- The **reputation** of the IT staff on the team is tarnished because any failure, regardless of who is at fault, will be perceived as a mistake by the team

Relative cost to fix an error

Phase in Which Found	Cost Ratio
Requirements	1
Design	3-6
Coding	10
Development Testing	15-40
Acceptance Testing	30-70
Operation	40-1000

Image from: Systems Analysis and Design in a Changing World, 7th Edition ©2016. Cengage Learning

Requirements management

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The process of managing **change** to requirements

- Over the lifetime of the project it is very common for new requirements to emerge and existing requirements to change
  - Studies have shown that over the life of a project as much as 50 percent or more of the requirements will change before the system is put into production!
- **Requirements management** specifies such things as:
  - how a change request should be submitted, how it is analyzed for impact to scope, schedule, and cost, how it's approved or rejected, and how the change is implemented if approved
- Continues throughout the project

Summing up…

- Defining and managing requirements is crucial to successful system development
- If requirements are not defined correctly the system may be over time, over budget, or not do what it is meant to do
- If errors are found early, in the requirements phase, they are orders of magnitude easier to fix than if they are discovered late
- Almost inevitably, requirements will change over the course of the project and **requirements management** - managing changes and new requests - is an important skill of the project manager

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Topic learning outcomes revisited

After completing this topic you should be able to:

- Explain why and how system development projects are initiated
- Explain where requirements investigation fits in the SDLC
- Describe some techniques for problem identification
- Identify and distinguish between functional and non-functional system requirements
- Identify the stakeholders involved in IS development and their contributions to requirements definition
- Describe several information-gathering techniques and determine when each is best applied

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What’s next?

In this topic, we introduced the concept of functional requirements – those activities that are essential for the new system to fulfil its purpose. In the next topic, we’ll examine how use case modelling is used to identify and represent the functional requirements of the new system.

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