ICT158

Introduction to Information Systems

Topic 8

Developing information systems

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Learning objectives

After completing this topic you should be able to:

- Explain the business benefits associated with successful software development
- Discuss the different strategies for acquiring information systems
- Describe the phases of the systems development life cycle (SDLC)
- Summarise different software development methodologies
- Discuss the different perspectives identified as hard and soft systems approaches in relation to systems development
- Discuss project management fundamentals.

Key Concepts

Software development life cycle

Hard and soft systems approach

Waterfall, object and agile-based development methodologies

Systems procurement

Project Management fundamentals

Readings

Bidgoli, H. (2014). *MIS4*: Cengage Learning. Ch 6 [in MyUnitReadings]

Overview

Organisational dependence on information systems

- Strategies for acquiring information systems

The SDLC

- Software development methodologies

Procuring information systems

Project management

8.1 Organisational dependence on information systems

8.1.1 Strategic significance of IS

8.1.2 IS failure

Organisational dependence on information systems

Contemporary organisations depend heavily on information systems and the underlying information for everyday operation

Over time, information systems migrated from back room functions to 'front office' and have *strategic* significance in an organisation

What this means is that without effective IS, organisations cannot maintain competitive advantage in their industry

So, as an organisation's reliance on information systems grows, so does the business consequence of IS success or failure

Impact of IS failure

IT failures may stop us doing everyday things – using an ATM, having bills paid automatically, catching the correct train, handing in an assignment on time

A failure may also be more serious, resulting in loss of life or serious damage to infrastructure or large financial loss.

Are failures just a fact of life?

Consequences of IS success/failure

Increase or decrease revenues—Organisations have the ability to directly increase profits by implementing successful IT systems. Organisations can also lose millions when software fails or key information is stolen or compromised.

Nike's poorly designed supply chain management software delayed orders, increased excess inventories and caused earnings to fall 24 per cent below expectations.

Repair or damage brand reputation—Technologies such as customer relationship management (CRM) software can directly enhance a company's brand reputation. Software can also severely damage a company's reputation if it fails to work as advertised or has security vulnerabilities that affect its customers' trust.

H&R Block customers in the US were furious when the company accidentally placed its customers' passwords and social security numbers on its website.

Prevent or incur liabilities—Technology such as CAT scans, MRIs and mammograms can save lives. Faulty technology used in aeroplanes, motor vehicles, pacemakers or nuclear reactors can cause significant damage, injury or death.

A primary care-based hepatitis B screening program in New Zealand almost collapsed due to the near failure of an IT system. Multiple incorrect assumptions were made about participants, primary care workflows and IT capacity, software vendor user knowledge and the health IT infrastructure, resulting in risking lives and reduced care.[4]

Increase or decrease productivity—CRM and supply chain management (SCM) software can directly increase a company's productivity. Large losses in productivity can also occur when software malfunctions or crashes.

The Standish Group estimates that defective software code accounted for 45 per cent of computer-system downtime and cost US companies US$100 billion in lost productivity in 2003 alone.

Source: Baltzan (2013) p 249

History of failures

Australia has a rich history of system failures, although US events usually dominate the media

Failures may be categorised as

- *annoying* – occur almost daily and are accepted as part of daily life. On a personal basis – Windows or Microsoft crashes; on a national level, delays to flights or trains

- *damaging* to reputation (eg TRELIS in WA; ABS census)

  Gartner said IBM will "bounce back".

  The brand will suffer initially in the Australian marketplace ... particularly in state and federal government.

  Source: http://www.abc.net.au/news/2016-08-16/census-failure-will-have-far-reaching-consequences/7749446

- lead to *demise of organisation* (eg One.Tel)

- *critical* to life (Therac-25)

Reasons for failure

- Having unclear or missing business requirements
- Skipping SDLC phases
- Changing technology
- Cost of finding errors

We will look at what these mean in terms of acquiring successful IS

Improvements to software success

The Standish group's data over thousands of ICT project suggest some improvement in the success of software projects

Successful = delivered on time, on budget, with required features and functions

Failed = cancelled prior to completion or delivered and never used

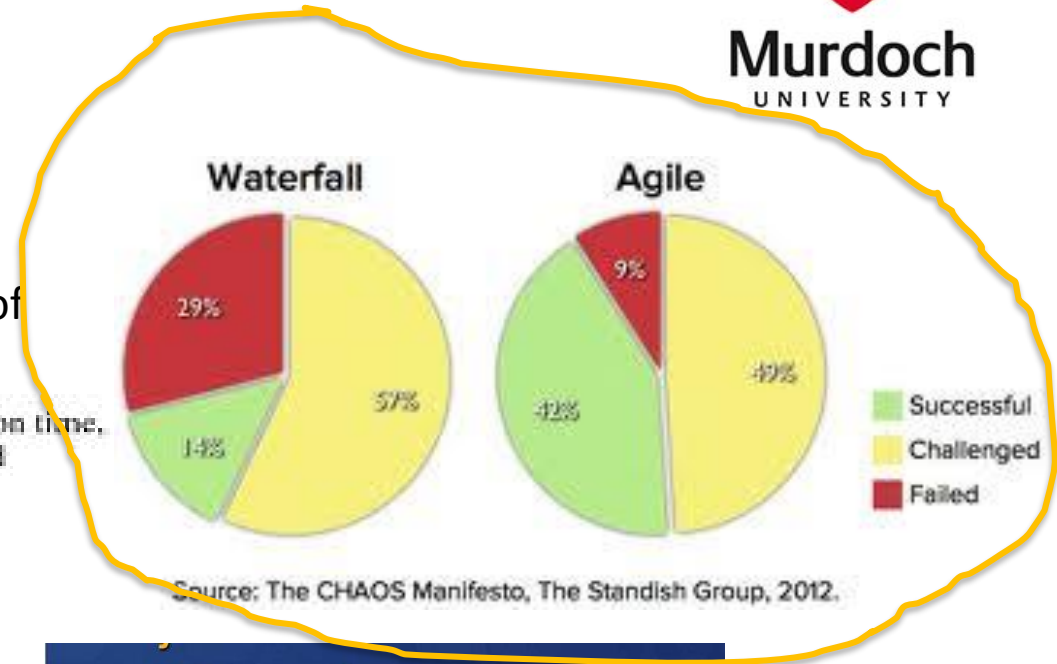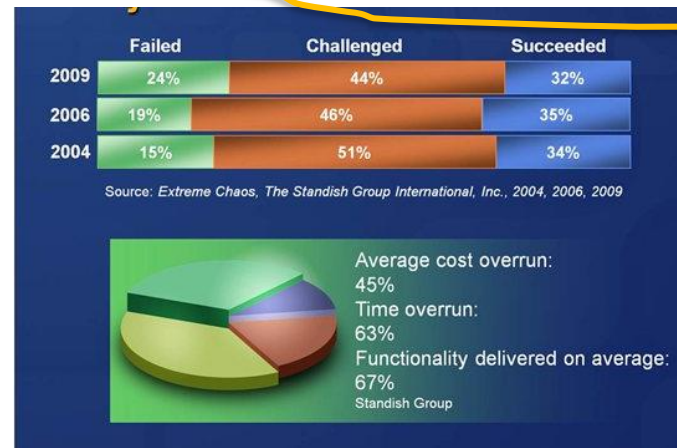Challenged = late, overbudget, and/or withless than the required features and functions

Waterfall

Agile

29%
57%
14%

9%
49%
42%

Successful
Challenged
Failed

Source: The CHAOS Manifesto, The Standish Group, 2012.

1994
Success 16%
Failure 31%
Challenged 53%

	Failed	Challenged	Succeeded
2009	24%	44%	32%
2006	19%	46%	35%
2004	15%	51%	34%

Source: Extreme Chaos, The Standish Group International, Inc., 2004, 2006, 2009

Average cost overrun: 45%
Time overrun: 63%
Functionality delivered on average: 67%
Standish Group

Source: Standish Chaos reports

Organisations are dependant on their information systems.

Their success of failure helps determine the success of the organisation as a whole.

8.2 Acquiring IS

8.2.1 Strategies to consider

Acquiring information systems

The advantages to the organisation of successful information systems should ensure they are acquired carefully.

In order to do that organisations need to deal with a number of strategic issues, eg :

- What technologies and systems best support our core business processes?

- What hardware, software, or services do we buy, build, or have managed by an outside service provider?

Strategies for acquiring IS

- *Purchase (procure) a pre-written application*
- Customise a pre-written application
- Lease
- Use software-as-a-service providers
- Use open source systems
- Outsource and/or off-shore
- *Custom develop*

Components of an information system

Hardware

Procedures

Procedures

People

Repository

Information System

Procedures

Procedures

Software

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Network

There are numerous strategies to acquiring information systems, from TurnKey procurement to custom development. The strategy chosen should align with the needs of the organisation

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8.3 the SDLC

8.3.1 Planning

8.3.2 Defining

8.3.3 Designing
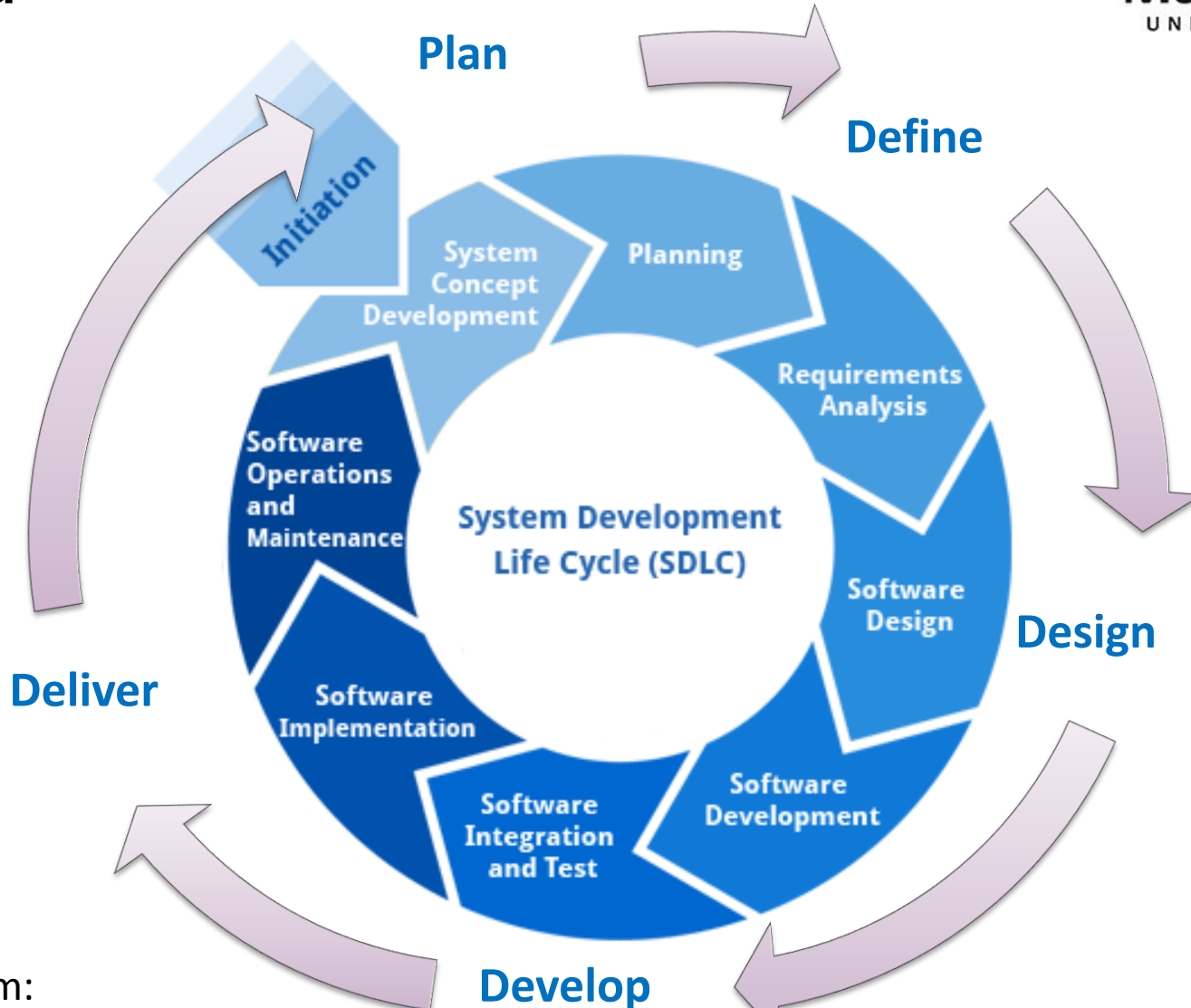
8.3.4 Developing

8.3.5 Delivering

SDLC

The Software Development Life Cycle (SDLC) is the overall process for developing information systems

The SDLC is the foundation for all systems development methodologies

SDLC - begins with a business need

Plan

Define

Design

Develop

Deliver

Initiation

System Concept Development

Planning

Requirements Analysis

Software Design

Software Development

Software Integration and Test

Software Implementation

Software Operations and Maintenance

System Development Life Cycle (SDLC)

Adapted from:
http://www.offbeatsoftwaresolutions.com/Our_Methodology_Images/Sdlc.png

SDLC - planning

A new information system is a solution to a problem the organisation identifies.

The **Plan** phase involves establishing the reasons for the system:

- defining the problem and its causes
- the goals of the system and
- setting up the project

Plan

Initiation

Planning

Software Concept Development

System Development Life Cycle (SDLC)
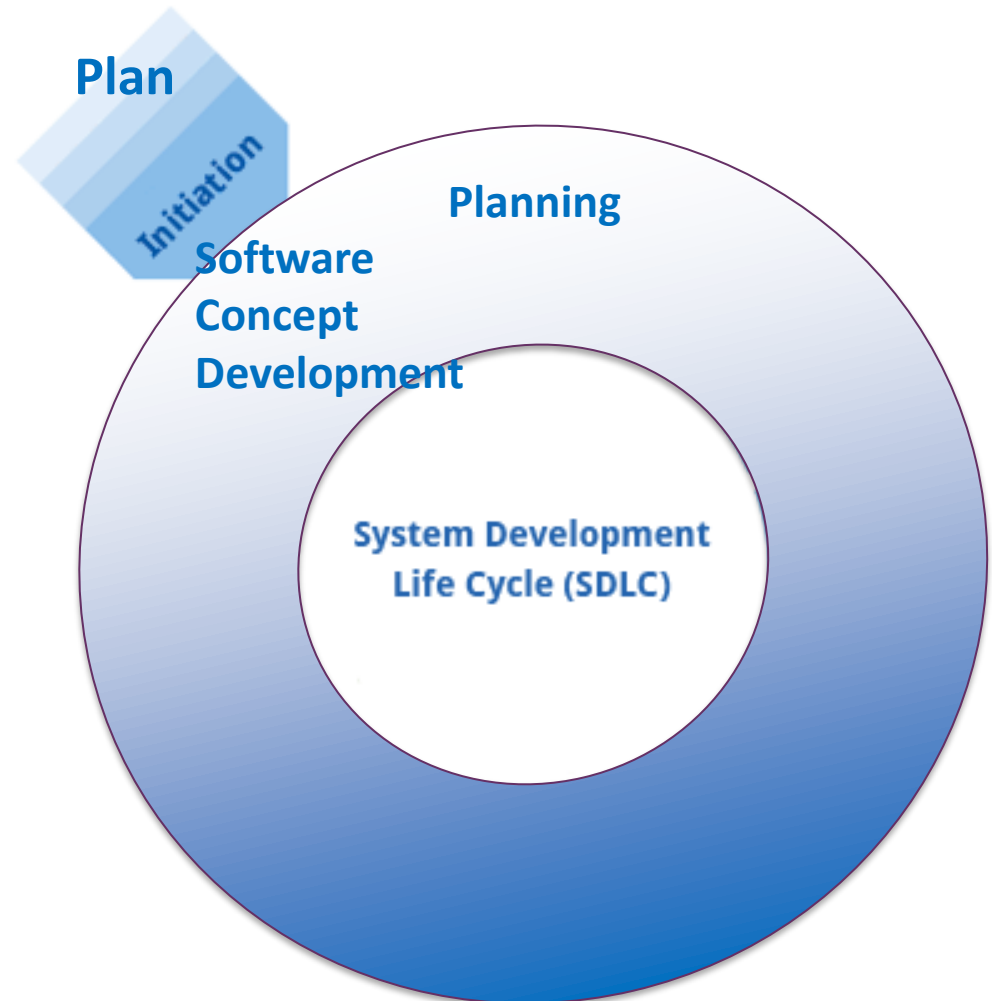
SDLC - defining

The **Define** phase involves determining the stakeholders' needs and requirements of the system.

The business requirements are the detailed set of features the system must support.

Requirements Analysis is the most critical phase of a system development project.

Define

Requirements Analysis

System Development Life Cycle (SDLC)
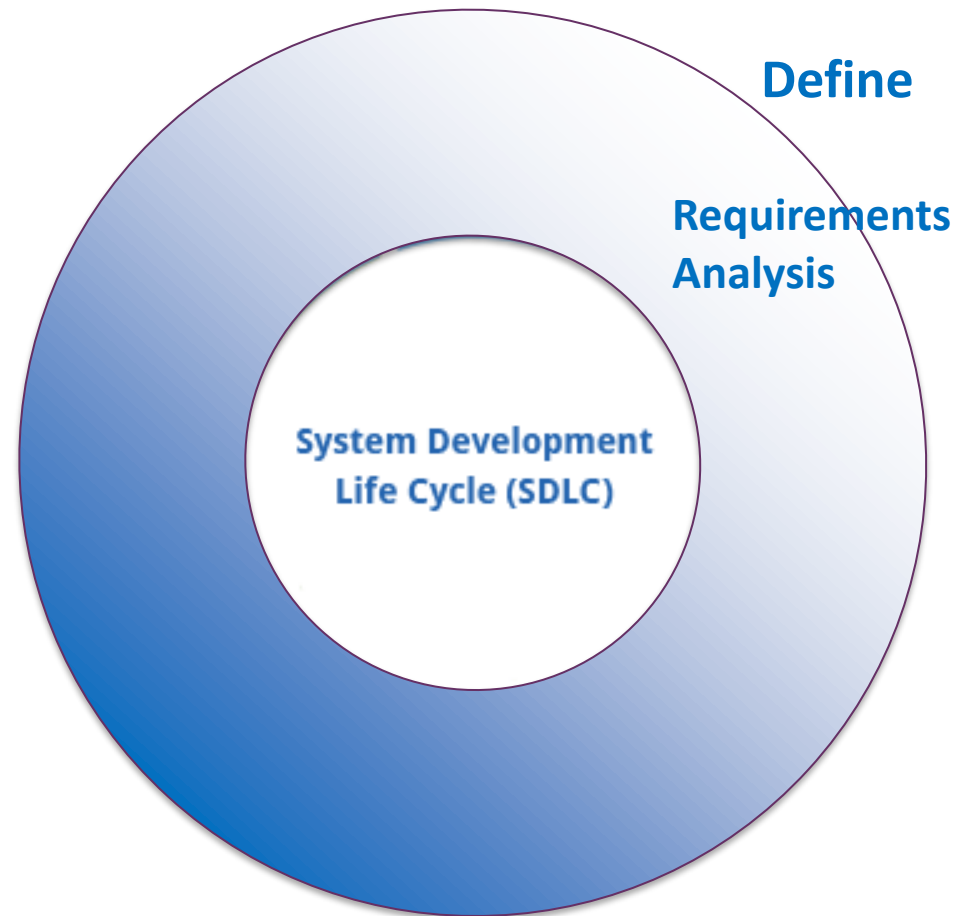
SDLC - designing

The **Design** phase describes how the system will fulfil the objectives identified during the Define phase.

The design of an information system is the overall plan or model of that system. Like a blueprint for a building, it gives the system its form and structure

Design

Software Design

System Development
Life Cycle (SDLC)
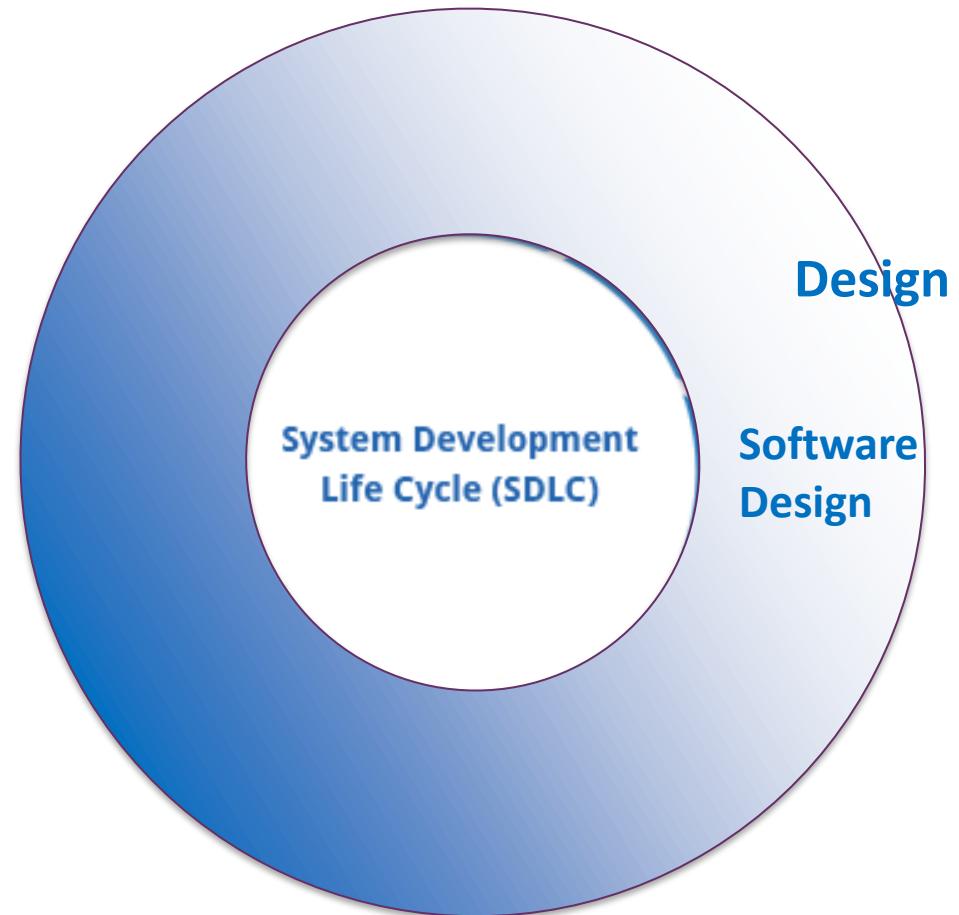
SDLC - developing

The **Develop** phase translates the solution specification established in the Define and Design phases into a fully operational information system. Programming and then testing to check the system meets all the business requirements help ensure the success of the system
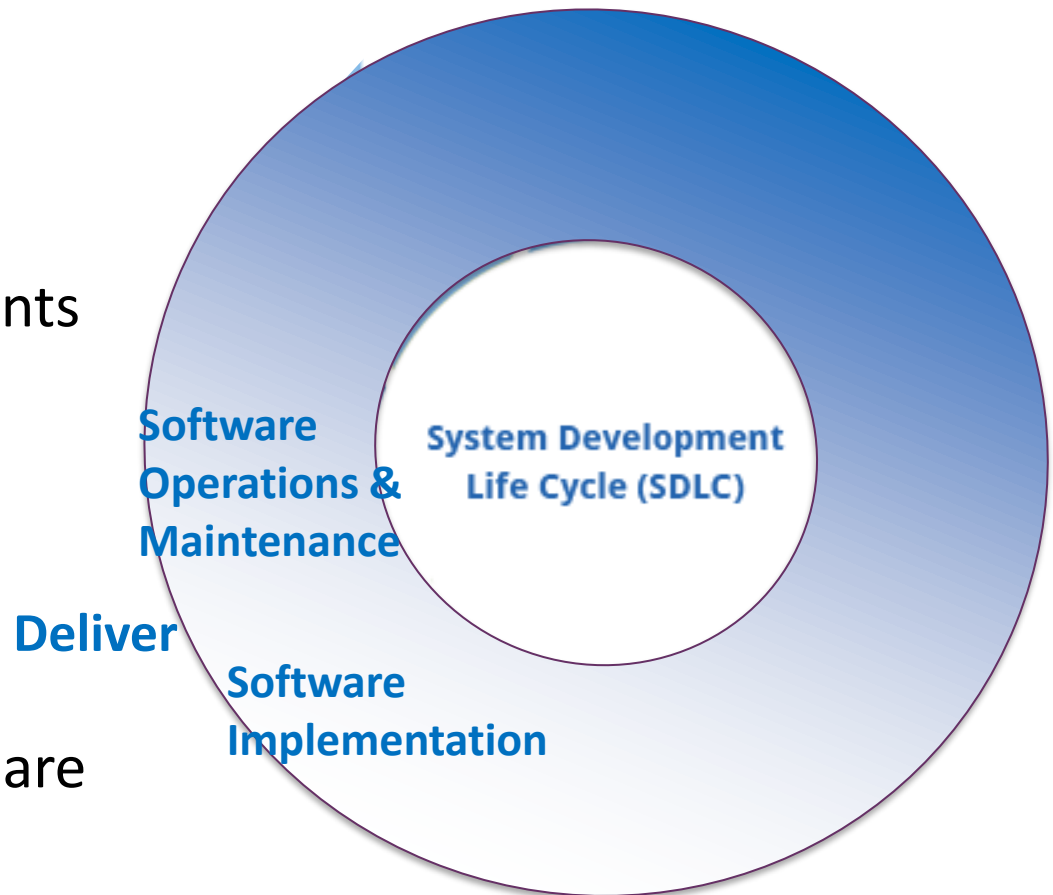
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System Development
Life Cycle (SDLC)

Software
Development

Software
Integration
& Testing

Develop
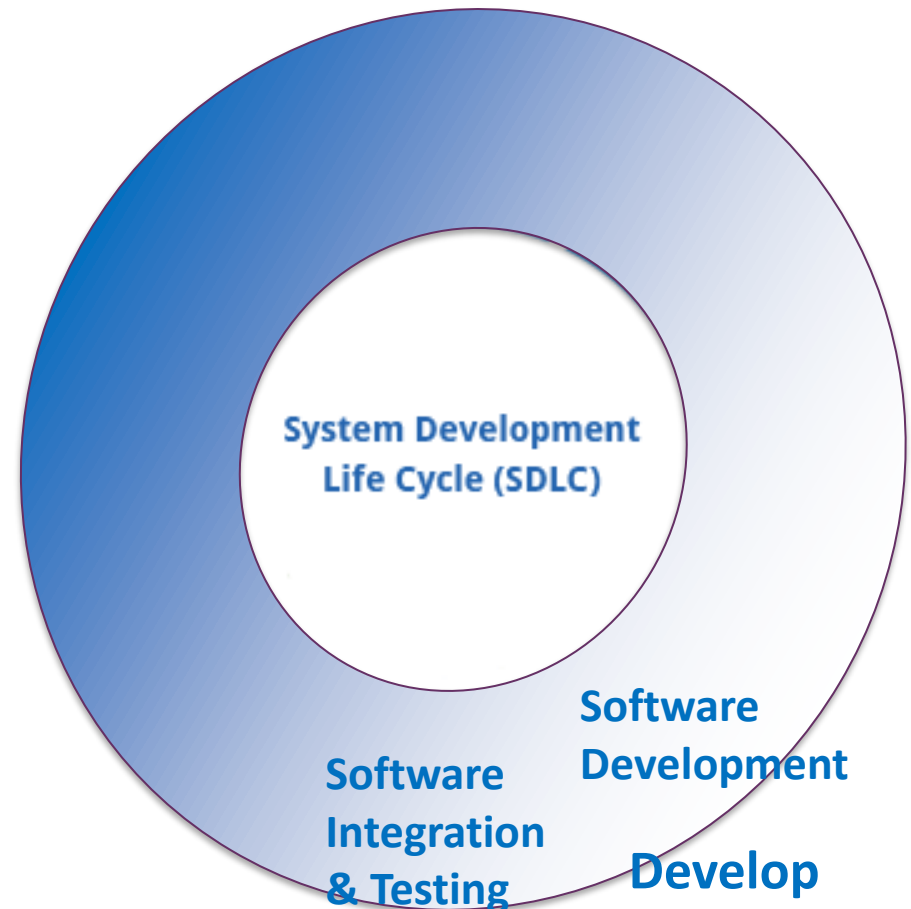
SDLC - delivering

Once the system is installed, it begins its operational life.
It must be maintained throughout that time to:

- correct any errors
- meet changing requirements or
- improve processing efficiency.

Maintenance problems are reduced if the requirements are captured well.

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Software Operations & Maintenance

System Development Life Cycle (SDLC)

Deliver

Software Implementation

Recap

The Software Development Life Cycle identifies an overall

process for developing an information system.

The SDLC acts as a foundation for systems development

methodologies.

All organisations need to follow some SDLC for the creation,

maintenance and evolution of their software-intensive

information systems.

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8.4 SDLC methodologies

8.4.1 Approaches to IS development

- Waterfall
- SSADM
- O-O
- Agile
- End-user

System development methodologies

These refer to the framework that is used to *structure*, *plan*, and *control* the process of developing an information system

Each of the available methodologies is best suited to specific kinds of projects, based on various technical, organisational, project and team considerations

System development methodologies

There are alternate ways for modelling and designing information systems. These include:

- **Waterfall** and **structured** – view the information system from a functional or process-oriented perspective

- **Object-oriented** - combines data and processes into single entities called objects

- **Agile** – focus on short development iterations

How do we choose which methodology suits?

We can apply Systems Thinking

System thinking

An approach to problem solving that views problems as parts of an overall system

A set of practices that is based on the belief that the component parts of a system can best be understood in the context of relationships with each other and with other systems, rather than in isolation

Depending on the type of systems approach taken, different processes are put into place to develop the system, and improve the organisation

Waterfall

This is a sequential development process. This means that as each of the phases is completed, the developers move on to the next step, and can't (usually) go back to a previous step
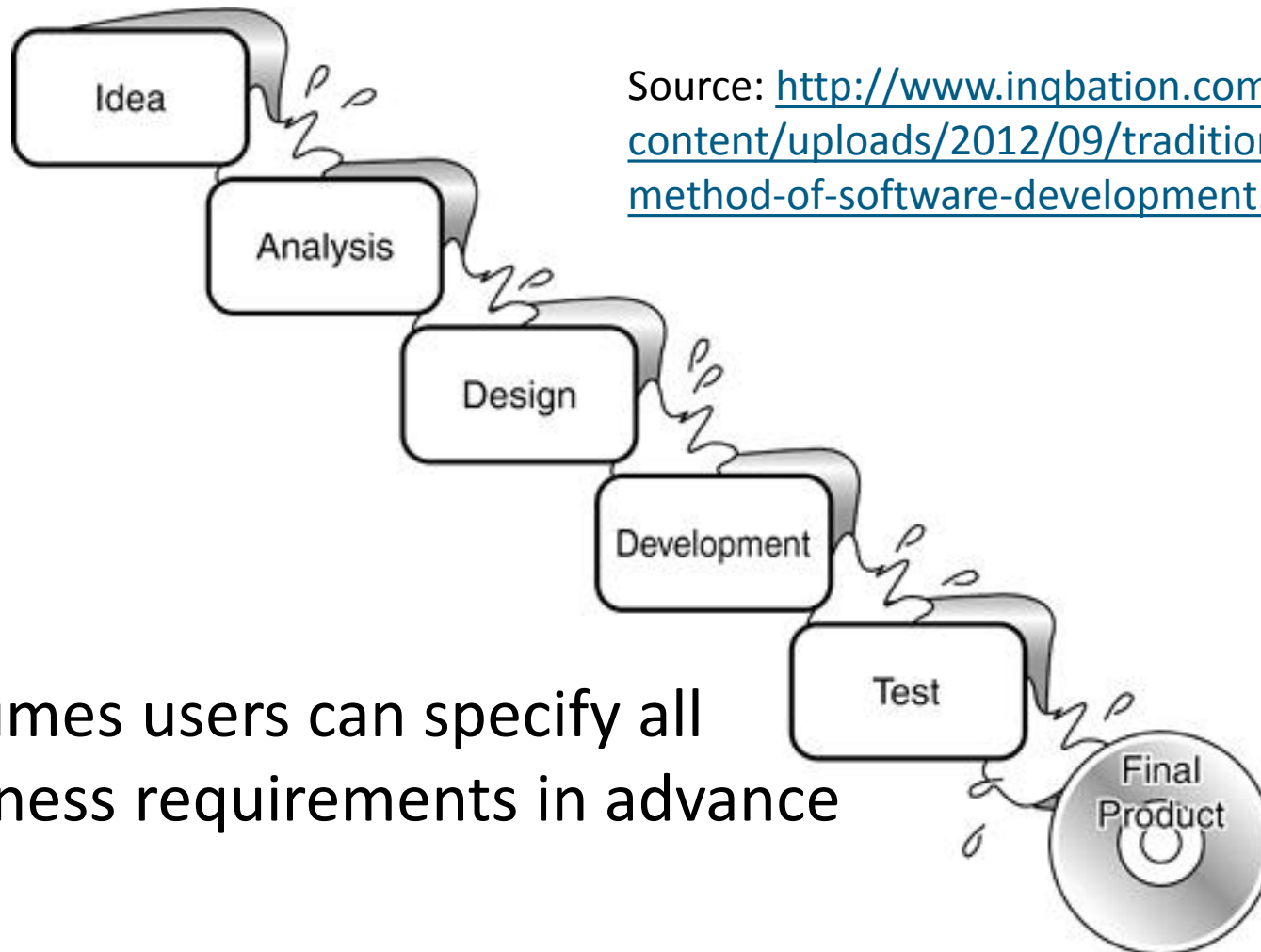
Waterfall

- is activity-based (with rigid adherence to sequence)
- stresses documentation
- is inflexible
- flaws flow onwards
- **but** gives the client an idea of estimated cost, time & size

Waterfall

Source: http://www.inqbation.com/wp-content/uploads/2012/09/traditional-waterfall-method-of-software-development.gif

Idea → Analysis → Design → Development → Test → Final Product

Assumes users can specify all business requirements in advance

Structured systems analysis and design method (SSADM)

The SSADM is an open methodology based on the waterfall model.

It features intensive user involvement – they sign off each phase assuring that requirements are met

SSADM applies a variety of techniques (eg data flow modelling, entity behaviour)

Characteristics of SSADM:

- Dividing a project into small modules with well defined objectives
- Performing activities in a sequence
- Diagrammatic representation and other useful modelling techniques
- Simple and easily understood by clients and developers

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SSADM in the SDLC

Source: http://www.tattoopins.com/606
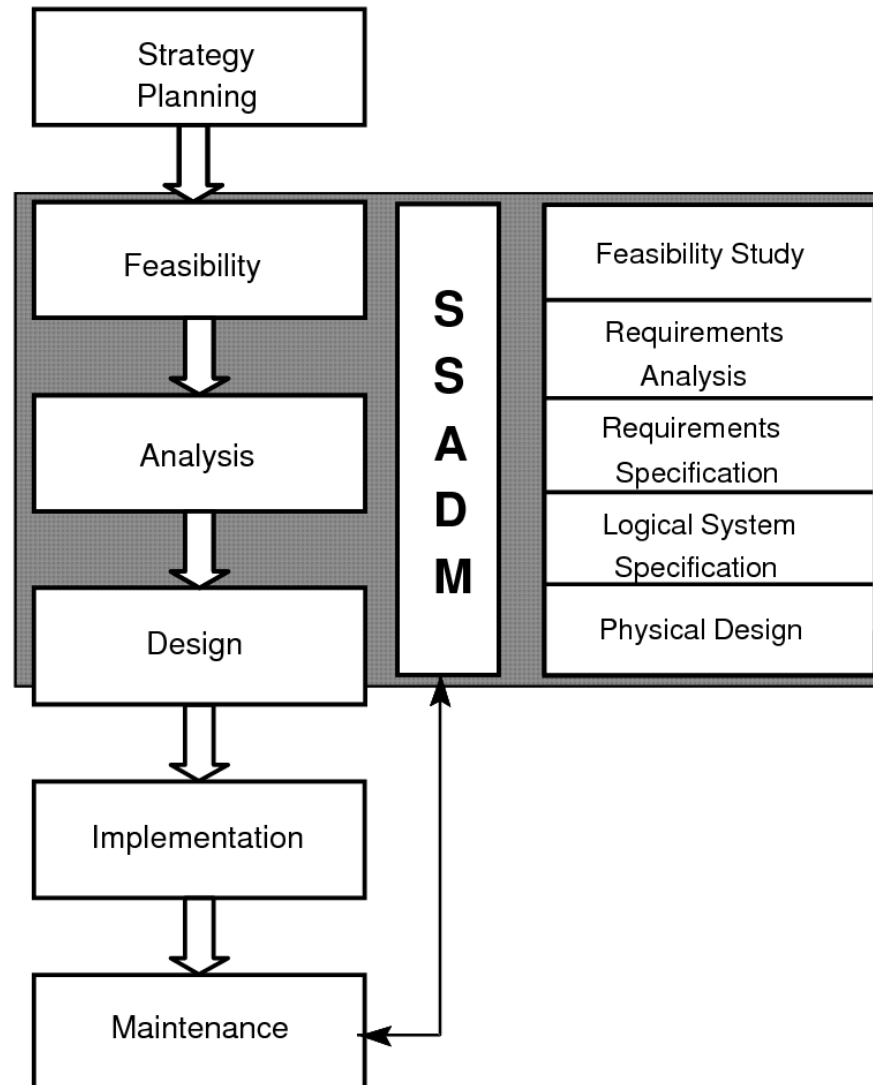
O-O development

Object Oriented Development (OOD) is a software development method based around identifying the objects required to satisfy the requirements of the system

The properties of an object are discussed in detail
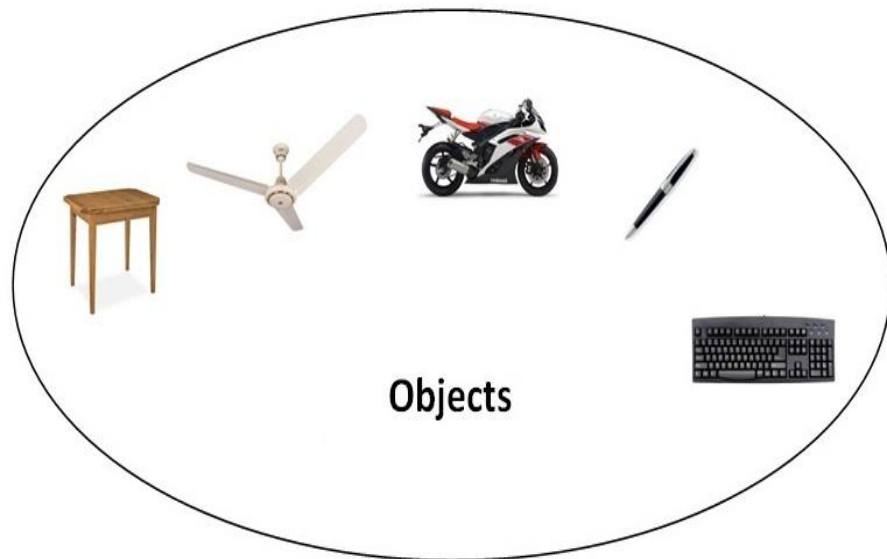
Object-orientation encourages and facilitates re-use of software components

Objects

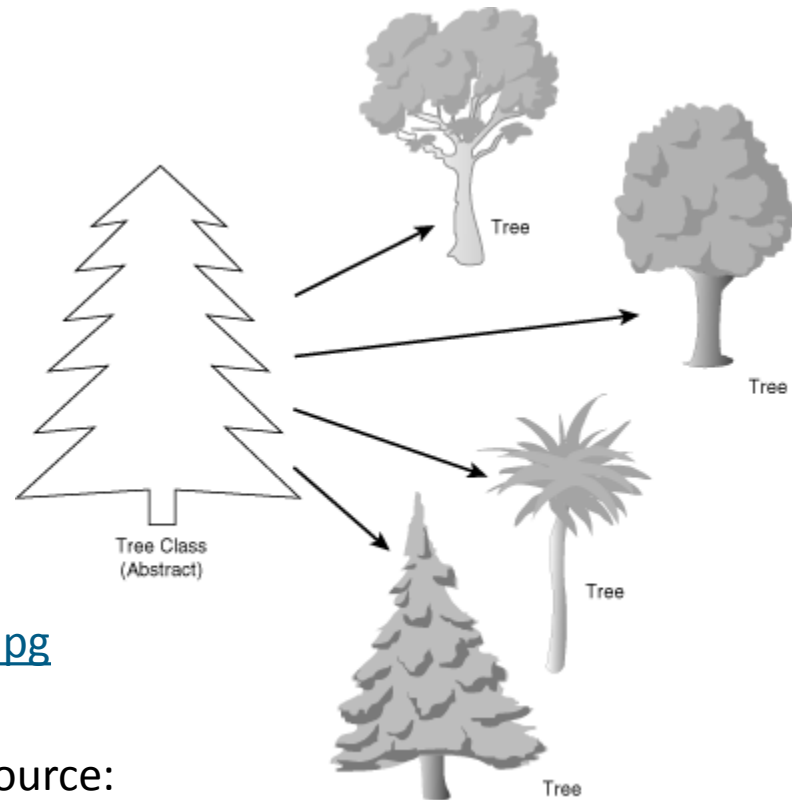O-O allows us to define abstract classes of objects that share common characteristics

Objects

Source:
http://www.javatpoint.com/images/objects.jpg

Tree Class
(Abstract)

Tree

Tree

Tree

Tree

Source:
http://www.webbasedprogramming.com/Java-Unleashed-Second-Edition/f2-1.gif

Agile development

Provides a 'solution' to the problems of waterfall

Based on an incremental approach over a short time (eg month) addressing 'bare minimum' requirements

Client feedback helps determine the priority for the next module to be developed

As the initial project doesn't have a definitive plan, the final product can be grossly different than what was initially intended

Agile

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Source: http://www.stagrp.com/wp-content/uploads/Agile-Development-Diagram.jpg
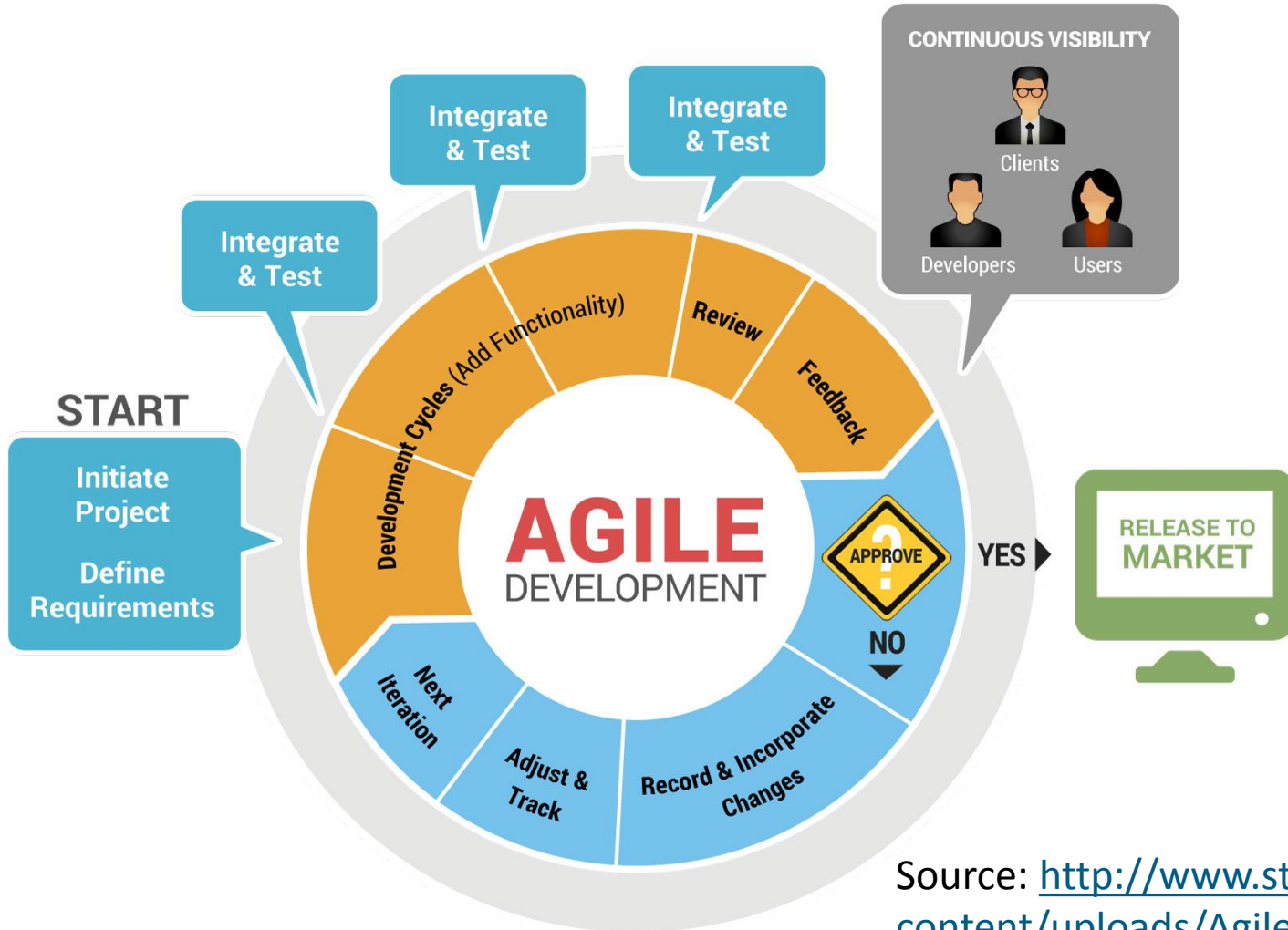
End user development

An approach in which the users develop their own applications with little/no help from IT

Advantages:

- Bypasses IT department
- User controls the application
- Directly meets user requirements
- User acceptance is high
- Frees up IT resources for high priority projects

Disadvantages:

- Lower quality systems
- Inadequate documentation
- Poor quality control
- Inadequate interfaces to existing systems

Methodologies refer to the framework that is

used to structure, plan, and control the

process of developing an information system.

Hundreds of methodologies exist to support the

software development process. The most

common fit into 'families' based on their

underlying characteristics.

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8.5 System thinking

8.5.1 Hard

8.5.2 Soft

Which development approach is the 'right one' ?

There is no universal answer:

- it depends on the priorities that have been identified for the system

- It depends on the type of systems thinking the development team (or project manager) follows

System priorities

What is most important to identify this system as successful?

- Excellent performance

- Ease of use

- Reliability/quality

- Cost

- etc

Hard systems approach

Hard systems approaches (eg waterfall, systems engineering, operations research) assume:

- objective reality of systems in the world
- *well-defined problem to be solved*
- technical factors foremost
- scientific approach to problem-solving
- *one correct solution*

Waterfall

Situations where <u>most</u> appropriate:

1. Project is for development of a mainframe-based or transaction-oriented batch system.
2. Project is large, expensive, and complicated
3. Project has clear objectives and solution
4. Project requirements are stable or unchanging during the system development life cycle
5. User community is fully knowledgeable in the business and application
6. Strict requirement exists for formal approvals at designated milestones.

Situations where <u>least</u> appropriate:

1. Large projects where the requirements are not well understood or are changing for any reasons such as external changes, changing expectations, budget changes or rapidly changing technology
2. Web Information Systems primarily due to the pressure of implementing a WIS project quickly; the continual evolution of the project requirements; the need for experienced, flexible team members drawn from multiple disciplines; and the inability to make assumptions regarding the users' knowledge level
3. Real-time systems
4. Leading-edge applications

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Soft Systems approach

Motivation for new approach:

True problems (and therefore solution objectives) usually cannot be stated precisely. Therefore hard systems approaches are modelling artificial systems and problems, and solutions are premature

Problem analysis phase should be about building a rich picture and not coming up with a concrete systems model

Analysis should come up with multiple alternatives "human activity systems"

These human activity systems are the basis for debate about change, and not blue-prints for designs

Soft Systems approach

Soft systems approaches (Soft Systems Methodology, soft OR) assume:

- organisational problems are 'messy' (Ackoff), poorly defined
- stakeholders interpret problems differently (no objective reality)
- human factors important
- creative, intuitive approach to problem-solving
- outcomes are learning, better understanding, rather than a 'solution'

There is no 'right' methodology for developing

an information system. Depending on the

culture of the organisation, its needs and

those of the stakeholders involved, some

methodologies may be more appropriate

than others, based on their characteristics

8.6 Procurement

8.6.1 Key processes

8.6.2 Selection criteria

Procuring an information system

Acquiring an information system 'complete' outside the organisation

Processes include:

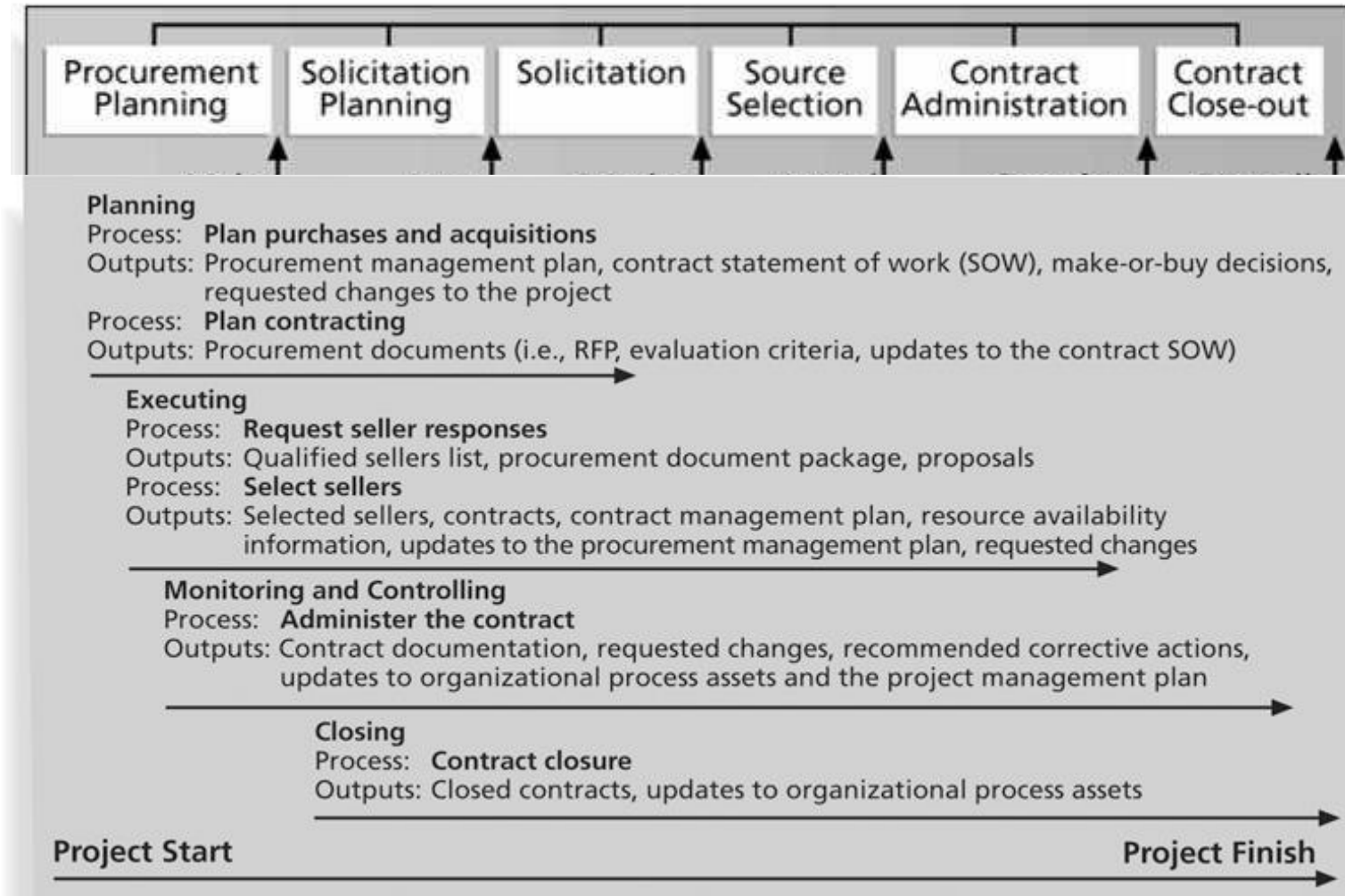**Planning procurements**: determining what to procure, when, and how

Conducting procurements: obtaining seller responses, selecting sellers, and awarding contracts

Administering procurements: managing relationships with sellers, monitoring contract performance, and making changes as needed

Closing procurements: completing and settling each contract, including resolving of any open items

Key processes

Procurement Planning | Solicitation Planning | Solicitation | Source Selection | Contract Administration | Contract Close-out

Planning
Process: **Plan purchases and acquisitions**
Outputs: Procurement management plan, contract statement of work (SOW), make-or-buy decisions, requested changes to the project
Process: **Plan contracting**
Outputs: Procurement documents (i.e., RFP, evaluation criteria, updates to the contract SOW)

Executing
Process: **Request seller responses**
Outputs: Qualified sellers list, procurement document package, proposals
Process: **Select sellers**
Outputs: Selected sellers, contracts, contract management plan, resource availability information, updates to the procurement management plan, requested changes

Monitoring and Controlling
Process: **Administer the contract**
Outputs: Contract documentation, requested changes, recommended corrective actions, updates to organizational process assets and the project management plan

Closing
Process: **Contract closure**
Outputs: Closed contracts, updates to organizational process assets

Project Start   **Project Finish**

Source: Schwalbe (2014) Ch 12

Selection criteria

It's important to prepare some form of evaluation criteria, preferably before issuing a formal RFP or RFQ

Beware of proposals that look good on paper; be sure to evaluate factors, such as past performance and management approach

Organisations can advertise to procure goods and services in several ways

- Approaching the preferred vendor
- Approaching several potential vendors
- Advertising to anyone interested

Sample evaluation sheet

E.G.

Criteria	Weight	Proposal 1		Proposal 2		Proposal 3	
		Rating	Score	Rating	Score	Rating	Score
Technical Approach	30%						
Management Approach	30%						
Past Performance	20%						
Price	20%						
Total Score	100%						

Recap

Information systems do not need to be custom developed. There are many other ways of acquiring them. However, the process must be managed to achieve the goals identified.

8.7 Project management

8.7.1 Improving project performance in IS projects
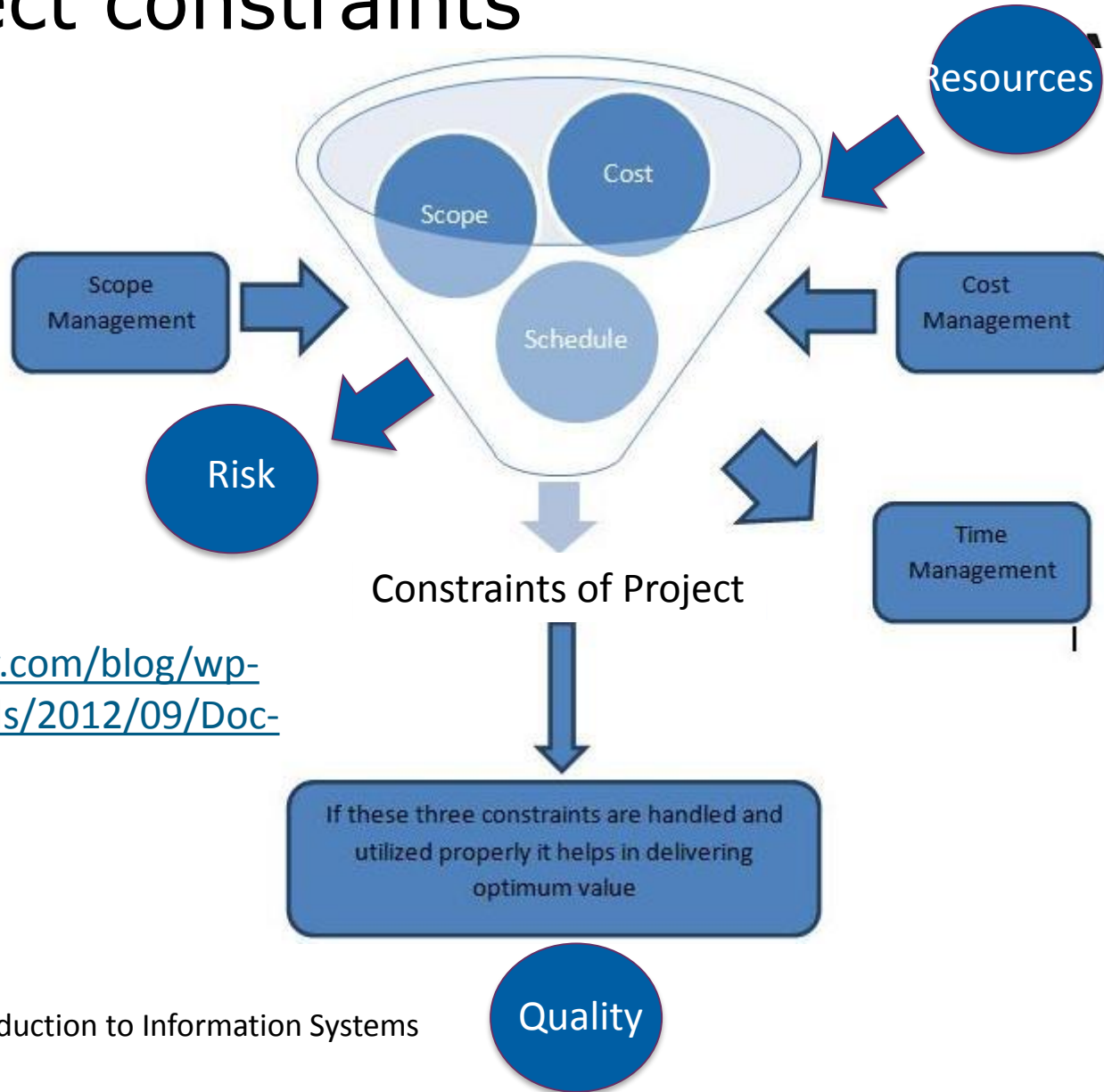
Managing IS projects

Project management offers a framework for coordinating the activities required to acquire an information system (or, in fact, manage any other project)

PMs work with:

- Project deliverables – any measurable outcome produced as part of the project (eg design documents, testing scripts, plans)

- Project milestones – key dates when groups of activities must be performed (eg completing the planning phase)

Project constraints

Source:
http://pmstudy.com/blog/wp-content/uploads/2012/09/Doc-image.jpg
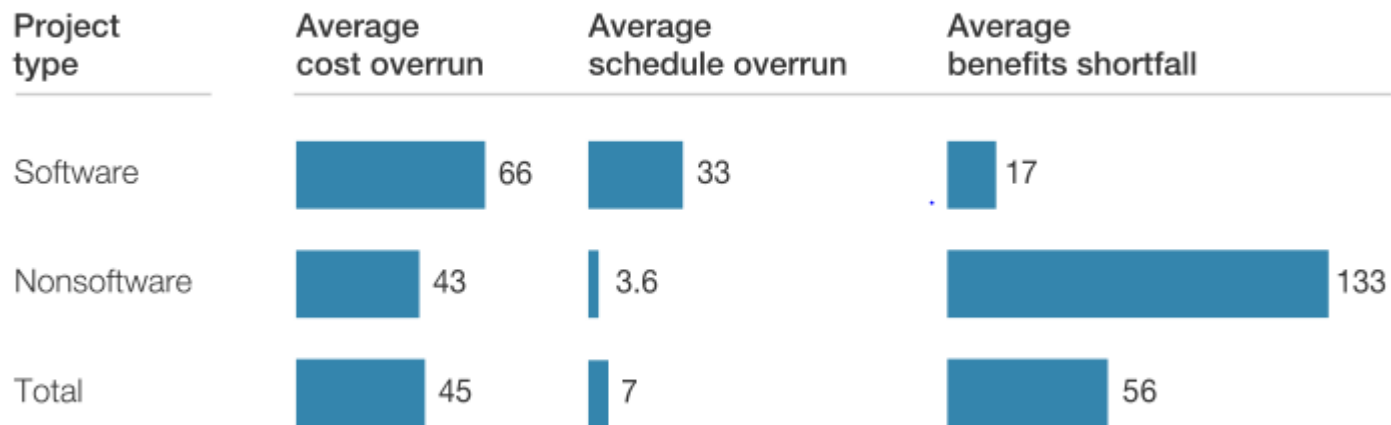
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Interrelationships

Research has shown that the failure rate of IT projects is much higher in an organisation that does not exercise disciplined project management

% of IT projects with given issue (for those with budgets >$15 million in 2010 dollars)

Project type	Average cost overrun	Average schedule overrun	Average benefits shortfall
Software	66	33	17
Nonsoftware	43	3.6	133
Total	45	7	56

Source: http://www.mckinsey.com/insights/business_technology/delivering_large-scale_it_projects_on_time_on_budget_and_on_value

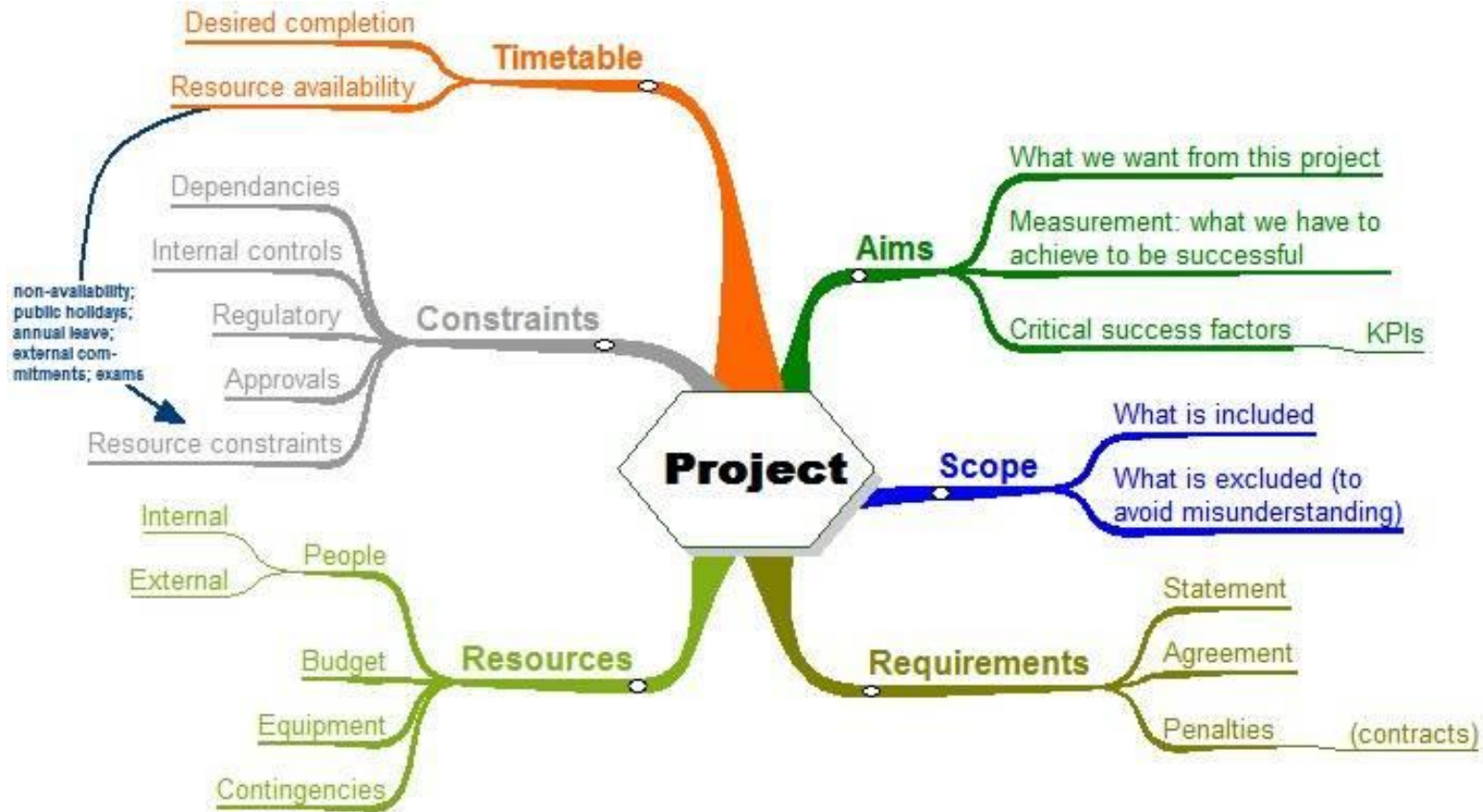# Improving project performance

So how do companies maximise the chances that their IT projects deliver the expected value on time and within budget?

- focusing on managing *strategy* and *stakeholders* instead of only concentrating on budget and scheduling

- having the right people who can master the technology and project content

- building effective teams which work with the overall goals of projects

- excelling at core project-management practices and quality checks
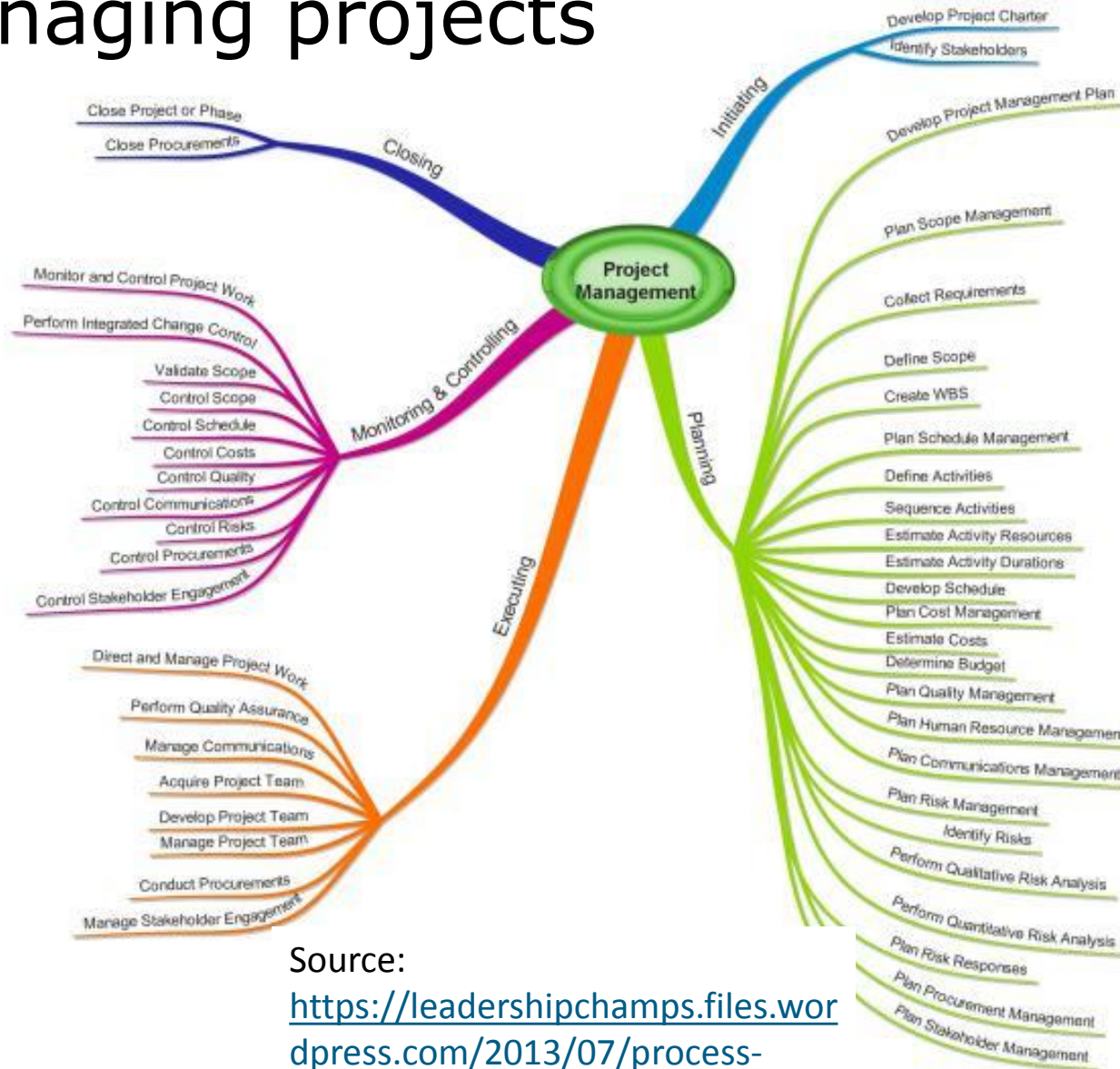
Planning projects

Source: http://www.topicscape.com/images/article/mindmapping-for-project-planning2.jpg

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Managing projects

Source: https://leadershipchamps.files.wordpress.com/2013/07/process-maps2.jpg?w=562&h=534

Project management provides a framework for the activities involved in acquiring an information system.

Planning and managing projects helps to achieve successful IS.

Summary

Organisations use information systems to support their business goals

They apply a number of strategies to acquire an information system

We focussed on *custom development*, applying a variety of methodologies, and *procurement*

Nevertheless, all approaches address a number of phases, and tend to follow a SDLC

In addition, good project management practice enhances the potential for the IS system to succeed

Resources used in this topic

Baltzan, P, Lynch, K, & Blakey, P. (2013). *Business Driven Information Systems* (2nd Ed.). North Ryde NSW: McGraw-Hill Australia Pty Ltd. Ch 6

Schwalbe, K. (2014). *Information Technology Project Management.* Cengage Learning. 7e Ch 12