Fundamentals of Software Engineering

Introduction

Fundamentals

CS vs SWE

* CS – Computer Science
  * Fundamentals of how computers and programs work
* SWE – Software Engineering
  * design and build software in teams

What is Software?

* Software
  * Computer programs
  * Associated documentation
    * requirements
    * design models
    * user & system manuals
    * test results

Coding/Programming


```
1  <!DOCTYPE html PUBLIC "-//W3C//DTD
   XHTML 1.0 Transitional//EN"
2  "http://www.w3.org/TR/xhtml1/DTD/
   xhtml1-transitional.dtd">
3
4  <html xmlns="http://www.w3.org/1999/
   xhtml">
5      <head>
6          <meta http-equiv="Content-
   Type" content=
7          "text/html; charset=us-
   ascii" />
8          <script type="text/
   javascript">
9              function reDo() {top.
   location.reload();}
10             if (navigator.appName ==
   'Netscape') {top.onresize = reDo;}
11             dom=document.
   getElementById;
12         </script>
13     </head>
14     <body>
15     </body>
16 </html>
```

```
setOfNumbers = []

print("How many random numbers do you want to generate?")
max = int(input())

for i in range (max):
    setOfNumbers.append(random.randrange(1,101,1))
setOfNumbers.sort()
print(setOfNumbers)

print("Which number do you want to find in the set of random
searchNumber = int(input())

firstPos = 0
lastPos = max-1
found = False

while (not found and firstPos <= lastPos):
    midPos = int((firstPos + lastPos)/2)

    if (searchNumber == setOfNumbers[midPos]) :
        found = True
    else :
        if (searchNumber < setOfNumbers[midPos]):
            lastPos = midPos - 1
        else :
            firstPos = midPos + 1


if (found) :
    print("Your item is in the list")
else :
    print("Your item is not in the list")
```

```
sub clean_line() {
    ($ligne) = @_ ;
    chomp $ligne;
    if ( $origin_LANG eq "nl" ) {                                    # nl
        if ( $ligne =~ m/<\/div>/ ) { return ""; }
        if ( $ligne =~ m/\{\{Wikipedia.*\// ) { return ""; }
        $ligne =~ s/===/==/g ;
    } elsif ( $origin_LANG eq "en" ) {                               # en
        $ligne =~ s/\{\{.*\|(.*)\}\}/$1/ ;
    } elsif ( $origin_LANG eq "it" ) {                               # it
        if ( $ligne =~ m/^\[\[Immagine:.*$/ ||
             $ligne =~ m/^\[\[Image:.*$/ ) { return ""; }
    }

    $ligne =~ s/\|.*\]\]/\]\]/g ; #lien interne renommé
    $ligne =~ s/#[^\]]*//g ; #ancre
    if ( $ligne =~ m/^\{\|/ || $ligne =~ m/\|\}/ ) { return ""; } #tableau
    if ( $ligne =~ m/^\|/ ) { return ""; } #<tr> / <td>

    if ( $ligne =~ m/<?[A-Za-z0-9]*>/ ) {
        die ("Erreur : balise html à la ligne $. :\n$ligne\n");
    }
    if ( $ligne =~ m/==.*==/ ) {
        return $ligne;
    } elsif ( $ligne =~ m/\[\[(.*)\]\]/ ) {
```

Software Engineering

All aspects of developing a software **product**

* Processes
* Methods and practices
* Tools and technologies
* Team work
* Communication

Why Software Engineering?

Avoid errors! Some major Failures

* 1983, Soviet nuclear early warning system malfunctioned
* 2012, Knight Capital Group Lost $440 million on trades in approx 30 minutes due to buggin trading algorithm
* 2003, Saint Mary Mercy hospital inaccurately reported patients dead: patient management system, notified social Security, patient insurance companies, and the patients themselves of their death

More failures?

* **2005, World Of Warcraft Creates virus:** Hakkar, the god of Blood. “Corrupted-Blood” virus that had the ability to instantly kill off weaker character. It was supposed to be limited to his kingdom. Many geeks were very upset.

Still More failures?

* 2012, Apple maps, total disaster. Towns missing, incorrect location. Labeled as least usable software ever released by Apple.

* 2005, .Michigan Dept. of Corrections Grants Prisoners Early Release

* 1998, Mars Climate Orbiter: The $327 Million Disaster. Due to miscalculation it went missing 286 days later by entering the Mars atmosphere at the wrong entry point and disintegrated :(

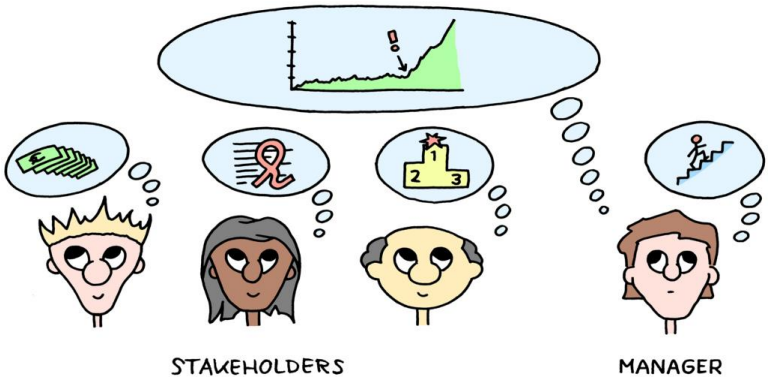
Project

A project is a **temporary** endeavor undertaken to **create** a unique **product** or **service**

PMI: Project Management Institute

Properties

* Unique purpose
* Temporary
* Requires **resources**
* Has a sponsor and/or customer
* Has **stakeholders**

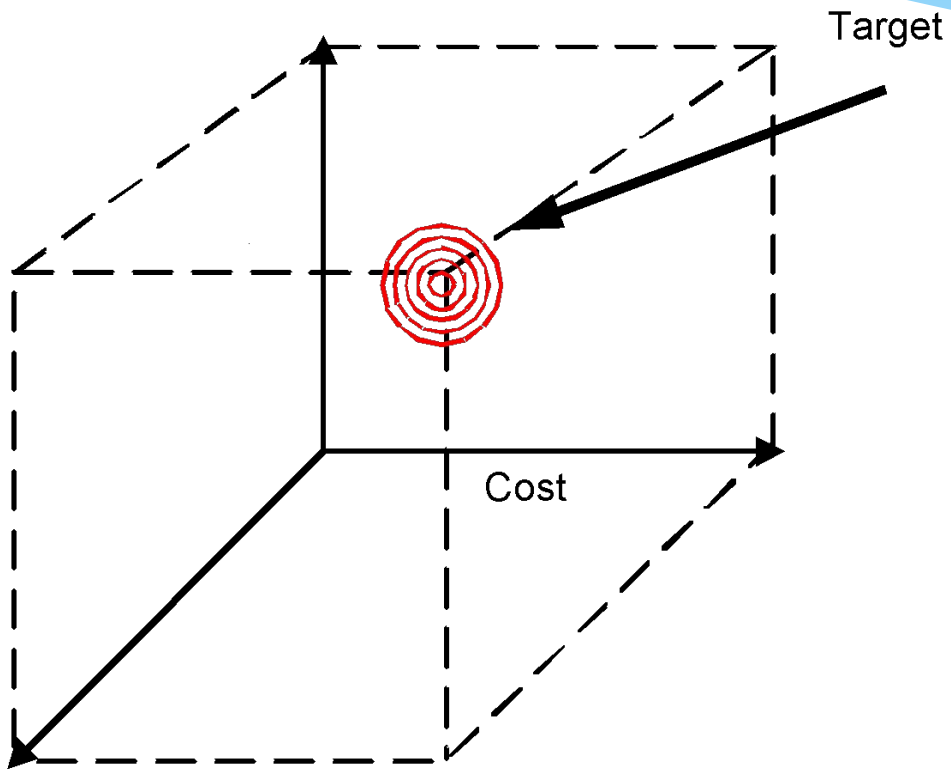


Project Management

The application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements.

PMI*, Project Management Body of Knowledge

Target of Project Management



The project manager aims to meet 3 goals

* Time
* Cost
* Scope

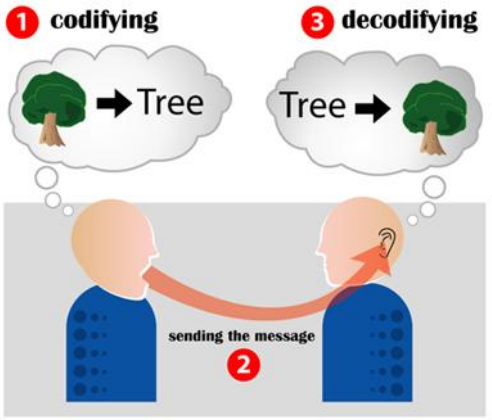
Thus, satisfy customer.

Four Project Dimensions

* People
* Process
* Product
* Technology

People Issues

* Matching people to tasks
* Balance
  * individual and team
* Clear communication
  * Expectations
* Authority with responsibility
* Career development



Process

* Development fundamentals
* Quality assurance
* Risk management
* Lifecycle planning
* Customer orientation
* Process maturity improvement
* Rework avoidance

Product

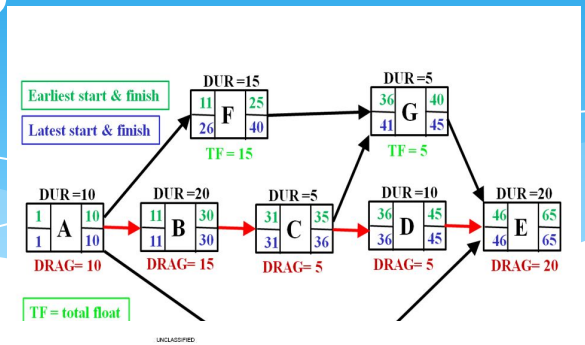
* Size management
* Product
  * characteristics
  * requirements
* Feature creep management
  * What is it?
  * Why does it happen?
  * How and when to stop it?

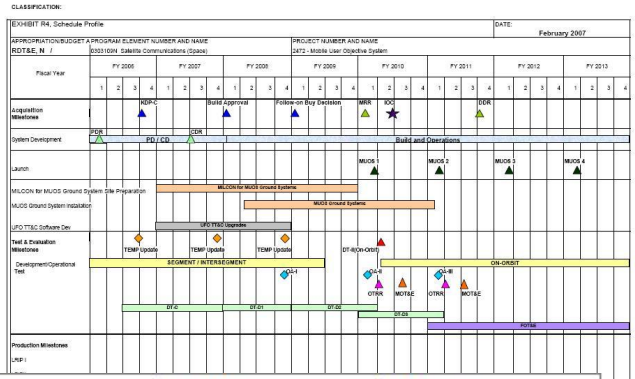
Technology

* Language
  * Which programming languages
* Tool selection
  * IDE
  * Repository
  * Version Management
  * Database
  * ....

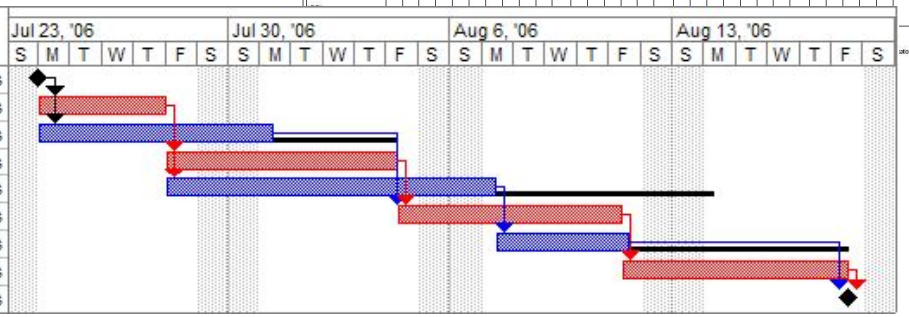
Planning

* Determine
  * requirements
  * resources
  * product features
* Select lifecycle model





ID	Task Name	Predecessors	Duration
1	Start		0 days
2	a	1	4 days
3	b	1	5.33 days
4	c	2	5.17 days
5	d	2	6.33 days
6	e	3,4	5.17 days
7	f	5	4.5 days
8	g	6	5.17 days
9	Finish	7,8	0 days



Value of Planning

Plans are nothing; planning is everything.

Dwight D. Eisenhower

Tracking

* Track
  * Cost
  * Effort
  * Schedule
* Tracking is comparing
  * Planned vs. Actual
* How to handle when things go off plan?

Software Failures

MODERN RESOLUTION FOR ALL PROJECTS

	2011	2012	2013	2014	2015
SUCCESSFUL	29%	27%	31%	28%	29%
CHALLENGED	49%	56%	50%	55%	52%
FAILED	22%	17%	19%	17%	19%

The Modern Resolution (OnTime, OnBudget, with a satisfactory result) of all software projects from FY2011–2015 within the new CHAOS database. Please note that for the rest of this report CHAOS Resolution will refer to the Modern Resolution definition not the Traditional Resolution definition.

Standish Group 2015 Chaos Report

CHAOS RESOLUTION BY PROJECT SIZE

	SUCCESSFUL	CHALLENGED	FAILED
Grand	2%	7%	17%
Large	6%	17%	24%
Medium	9%	26%	31%
Moderate	21%	32%	17%
Small	62%	16%	11%
TOTAL	100%	100%	100%

The resolution of all software projects by size from FY2011–2015 within the new CHAOS database.

CHAOS RESOLUTION BY AGILE VERSUS WATERFALL

SIZE	METHOD	SUCCESSFUL	CHALLENGED	FAILED
All Size Projects	Agile	39%	52%	9%
	Waterfall	11%	60%	29%
Large Size Projects	Agile	18%	59%	23%
	Waterfall	3%	55%	42%
Medium Size Projects	Agile	27%	62%	11%
	Waterfall	7%	68%	25%
Small Size Projects	Agile	58%	38%	4%
	Waterfall	44%	45%	11%

The resolution of all software projects from FY2011–2015 within the new CHAOS database, segmented by the agile process and waterfall method. The total number of software projects is over 10,000.

CHAOS FACTORS OF SUCCESS

FACTORS OF SUCCESS	POINTS	INVESTMENT
Executive Sponsorship	15	15%
Emotional Maturity	15	15%
User Involvement	15	15%
Optimization	15	15%
Skilled Resources	10	10%
Standard Architecture	8	8%
Agile Process	7	7%
Modest Execution	6	6%
Project Management Expertise	5	5%
Clear Business Objectives	4	4%

Software Hall of Shame

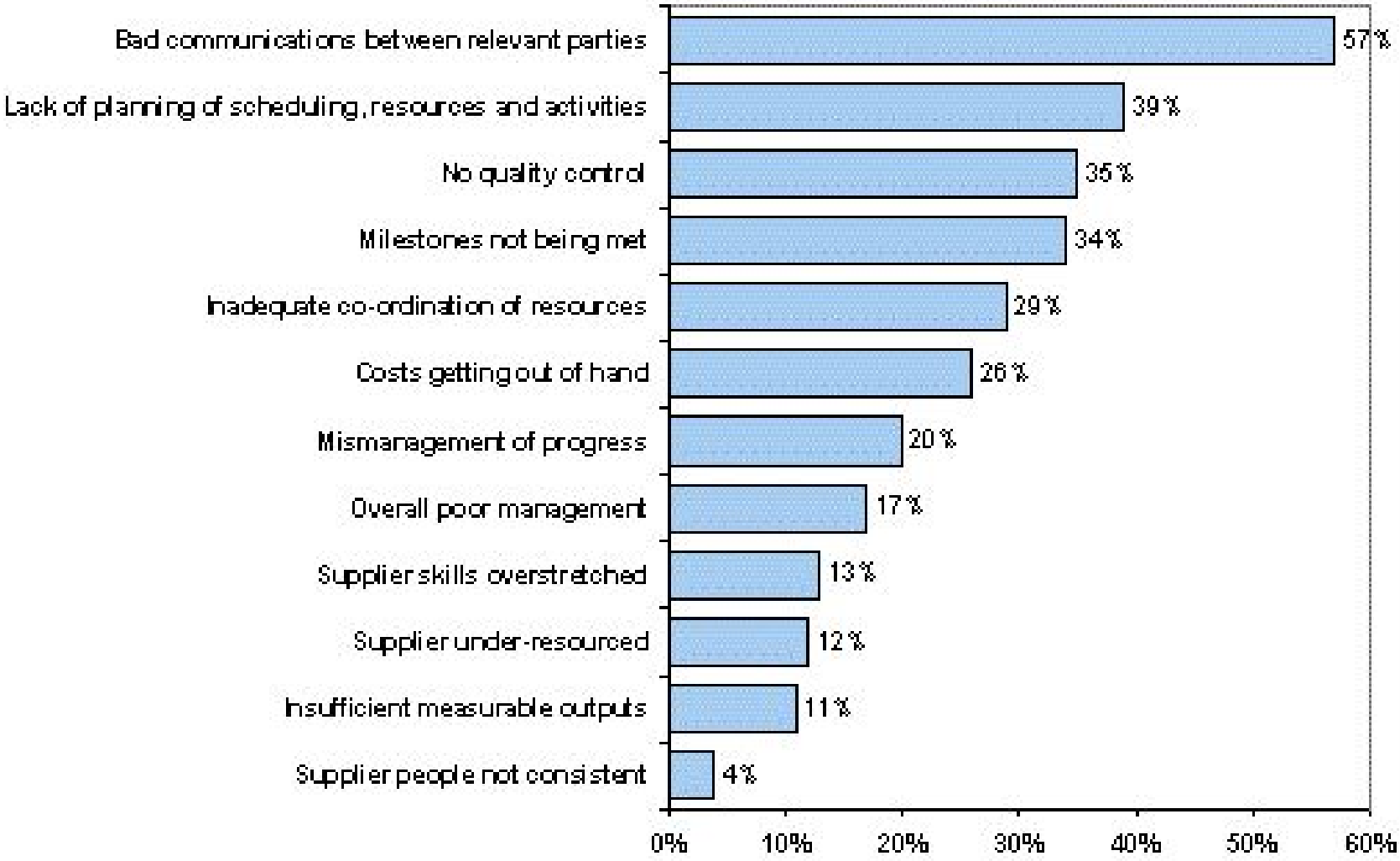
* http://spectrum.ieee.org/computing/software/why-software-fails

UK Inland Revenue		Software errors contribute to $3.45 billion* tax-credit overpayment.
Avis Europe PLC [UK]		Enterprise resource planning (ERP) system canceled after $54.5 million† is spent.
Ford Motor Co.		Purchasing system abandoned after deployment costing approximately $400 million.
J Sainsbury PLC [UK]		Supply-chain management system abandoned after deployment costing $527 million.†
Hewlett-Packard Co.		Problems with ERP system contribute to $160 million loss.
AT&T Wireless		Customer relations management (CRM) upgrade problems lead to revenue loss of $100 millio
2004	Avis Europe PLC [UK]	Enterprise resource planning (ERP) system canceled after $54.5 million† is spent.
2004	Ford Motor Co.	Purchasing system abandoned after deployment costing approximately $400 million.
2004	J Sainsbury PLC [UK]	Supply-chain management system abandoned after deployment costing $527 million.†
2004	Hewlett-Packard Co.	Problems with ERP system contribute to $160 million loss.
2003–04	AT&T Wireless	Customer relations management (CRM) upgrade problems lead to revenue loss of $100 million.
2002	McDonald's Corp.	The Innovate information-purchasing system canceled after $170 million is spent.
2002	Sydney Water Corp. [Australia]	Billing system canceled after $33.2 million† is spent.
2002	CIGNA Corp.	Problems with CRM system contribute to $445 million loss.
2001	Nike Inc.	Problems with supply-chain management system contribute to $100 million loss.
2001	Kmart Corp.	Supply-chain management system canceled after $130 million is spent.
2000	Washington, D.C.	City payroll system abandoned after deployment costing $25 million.
1999	United Way	Administrative processing system canceled after $12 million is spent.
1999	State of Mississippi	Tax system canceled after $11.2 million is spent; state receives $185 million damages.
1999	Hershey Foods Corp.	Problems with ERP system contribute to $151 million loss.
1998	Snap-on Inc.	Problems with order-entry system contribute to revenue loss of $50 million.
1997	U.S. Internal Revenue Service	Tax modernization effort canceled after $4 billion is spent.
1997	State of Washington	Department of Motor Vehicle (DMV) system canceled after $40 million is spent.
1997	Oxford Health Plans Inc.	Billing and claims system problems contribute to quarterly loss; stock plummets

Project Failure

* Why do projects Fail?

Major Causes Of Project Failure



Professional Organizations

* Project Reference
  http://www.projectreference.com/ (table of references)
* Software Engineering Institute (SEI)
  http://www.sei.cmu.edu/
* Project Management Institute (PMI)
  http://www.pmi.org
* The International Association of Project and Program Management
  http://www.iappm.org

Learnings

* Differences between writing code and developing software products
* Concerns of software development
* Why project fail

References

* Images from clipartfest.com and wikimedia were used in this presentation
* 2015 report on software success https://www.infoq.com/articles/standish-chaos-2015