Successes and challenges experienced in implementing a measurement program in small software organizations

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- Case study no.2: concerned with applying best practices
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Introduction

- Software companies, large or small
  - Managers need information for decision making
- Large organizations
  - Dedicated personnel for measurement program
- Small organizations
  - Measurement program handled by manager/owner
- 2 case studies of small software organizations
  - Both include functional size measurement using COSMIC-FFP
  - Many similarities
  - Different issues => different approaches

Characteristics of the two small software organizations

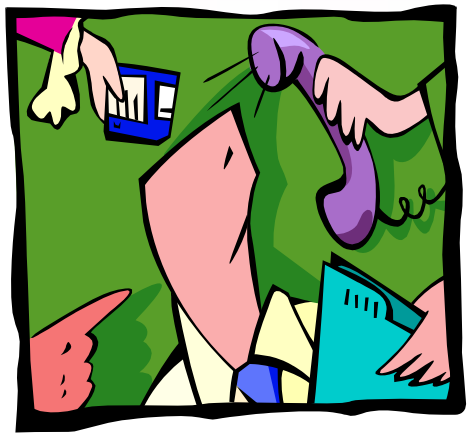
Characteristics	Case study no.1	Case study no.2
Product type	Manufacturing management system	Asset loans management system
Number of users	260	300
Product architecture	Client-server	Client-server
Team size	9 dev / 12 employees	12 dev
Years of existence	19	20
Most important projects issue	Quality: increasing costs to manage	Delivery dates: missing too often
Motivation	Control the cost of fixing defects	Applying best practices to increase productivity

Their projects

- A project = one or several related features
  - New or modified modules
- Similar in size in both cases
  - Average 150 hours
  - Biggest project approximately 800 hours
- Cost overruns in half of their projects
- Project documentation = spreadsheet for:
  - Requirements, UI Prototypes, Planning Data, Design, Test Cases
- Project backlog = 6 months of work for the whole team

Their manager's working schedule

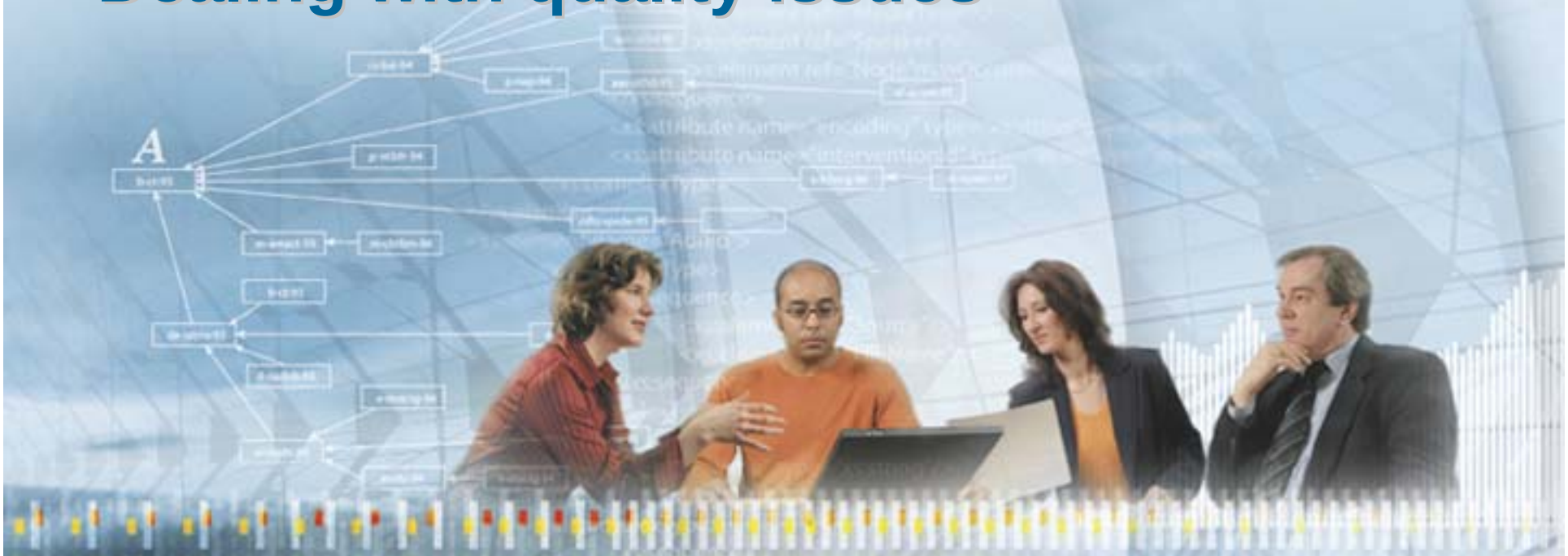
- Company owner
  - Work between 60 and 90 hours per week
  - Act as project manager to deliver quality software to their customer, plus they handle…
    - Daily operations
    - Financing and accounting
    - Marketing and sales
    - Human resources and training
    - Growth
  - Need an efficient measurement program to support fast decision making



Requirements for a measurement program

- Fulfil the manager's information needs
- Low cost/effort to sustain
  - Effort saved for decision making > measurement program cost

Case study no.1:
Dealing with quality issues



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Case study no.1: Dealing with quality issues

- Half-day mini-assessment of the software process
  - Process is fuzzy
  - Poor in quality control activities
- Several hundred defects per release
  - Few insights available into defects
  - Difficult to prioritize
- Team size has grown significantly over the last 3 years
  - Unknown productivity

Case study no.1: The solution approach

- Based on the Personal Software Process (PSP) and the IDEAL^{sm} model
- Step 1: Stabilize the software process
  - 15 phases defined, applied, and measured
  - 12 categories for defects defined and applied
    - Plus: process phase where detected and injected
- Step 2: Introduce functional size measurement
- Step 3: Do a Pareto analysis of defects found
  - Improve process, quality, and productivity

IDEAL^{SM} is a service mark of the Carnegie-Mellon University

Case study no.1: Process phases

No.	Process phases	Description
1	PAEX	Analysis of customer requirements (Phase Analyse des EXigences)
2	PAFO	Functional analysis (Phase Analyse FOnctionnelle)
3	PATE	Technical analysis (Phase Analyse TEchnique)
4	PRAN	Analysis review (Phase Revue de l'ANalyse)
5	PDES	Design (Phase DESign)
6	PRDE	Design review (Phase Revue de DEsign)
7	PEST	Estimation (Phase d'ESTimation)
8	PRES	Estimation review (Phase Revue de l'EStimation)
9	PCTU	Construction and unit testing (Phase Code et Tests Unitaires)
10	PRCO	Code review (Phase Revue de COde)
11	PTBB	White-box testing (Phase Test Boîte Blanche)
12	PTBN	Black-box testing (Phase Test Boîte Noire)
13	PVTE	Tests verification (Phase Vérification des TEsts)
14	PDUS	User documentation (Phase Documentation USager)
15	PFIN	Project finalized (Phase de FINalisation)

Case study no.1: Defect categories

Cat.	Description	Example
1	Missing	Missing items in a phase (e.g., PAEX, etc.)
2	Irrelevant	Irrelevant items in a phase
3	Incorrect	Incorrect or imprecise items in a phase
10	Documentation	Comments, messages, manual, etc.
20	Security	Locking errors, user management, access permission
30	Packaging	Configuration management, build, etc.
40	Assignment	Declaration statements, duplicates, objects or variables initialization, freeing memory, range (array), boundaries (variables), scope, etc.
50	Interface	Procedure call, references (parameters), files, display, printing, communication, formats, contents, etc.
60	Checking	Error messages, inadequate conditions, exceptions not handled, etc.
70	Data	Structures, contents, etc.
80	Function	Pointers, loops (off-by-one, increments, recursivity), algorithms, calculations, etc.
90	System	Performance (speed), memory usage, etc.

Case study no.1: Functional size

- Objectives:
  - Estimation in a “firm fixed price” context
  - Project comparison
  - Predictable process
- Using COSMIC-FFP
  - Only 1-day training required
  - Measurement manual is free
  - Previous attempts with IFPUG abandoned
    - Team considered it too costly to sustain
- Effort and functional size measured for the first 25 projects
  - Correlation of effort and size into an estimation model was not satisfying

Case study no.1: Issues of functional size measurement

- Different individuals = different size
  - Developers have a clear tendency to measure from a developer point of view instead of a user point of view
  - 2 analysts were measuring with less than 2% difference
- Project size varies from initial analysis to final phase due to requirement changes
  - Measurement is performed twice: initial size and final size
- 1 single point for data movements on large data groups made no sense to them for estimation purposes
  - Team added 1 point for every set of 12 attributes in a large data group for “exit” and “read” data movement types
  - They adjusted project sizes
  - Correlation between effort and size became more than 0.90
  - But: size is bigger than the standard measurement method

Case study no.1: Defect statistics since 2003

Number of defects injected by phase, per defect category

		Defect categories															
		nil	blank	1	2	3	10	20	30	40	50	60	70	80	90	**All**	%
Phases	PAEX	1	0	6	1	4	0	0	2	0	1	0	1	0	0	**16**	1%
	PAFO	6	0	29	1	19	0	1	1	1	2	3	1	6	1	**71**	3%
	PATE	18	0	9	0	3	0	2	2	2	4	1	5	2	4	**52**	2%
	PDES	13	1	74	8	4	0	2	3	23	291	10	12	5	0	**446**	18%
	PEST	0	0	5	0	0	0	0	0	0	0	0	0	0	0	**5**	0%
	PCTU	216	14	60	10	8	26	45	5	198	600	321	110	275	27	**1915**	76%
	All	**254**	**15**	**183**	**20**	**38**	**26**	**50**	**13**	**224**	**898**	**335**	**129**	**288**	**32**	**2505**	100%
	%	10%	1%	7%	1%	2%	1%	2%	1%	9%	36%	13%	5%	11%	1%	100%	

Effort to fix defects by phase, per defect category (hours)

		Defect categories															
		nil	blank	1	2	3	10	20	30	40	50	60	70	80	90	**All**	%
Phases	PTBB	1	0	10	2	1	0	0	0	12	1	4	3	2	0	**35**	1%
	PTBN	13	0	8	0	0	0	0	0	4	11	0	2	1	2	**41**	1%
	PVTE	133	15	20	0	0	4	60	8	63	376	138	51	136	29	**1031**	28%
	PFIN	126	41	222	8	100	18	109	36	232	395	378	179	641	64	**2546**	70%
	All	**273**	**55**	**259**	**10**	**101**	**22**	**168**	**44**	**311**	**782**	**520**	**234**	**779**	**95**	**3652**	100%
	%	7%	2%	7%	0%	3%	1%	5%	1%	9%	21%	14%	6%	21%	3%	100%	

Case study no.1: Initial measurement results

Performance data for the first 25 projects:

	Projects 1 to 25
Overall productivity	1.94 hours/Cfsu
Programming productivity	1.12 hours/Cfsu
Rework density	0.33 hours/Cfsu

- **Decision to introduce peer reviews**
- **Quality objectives defined:**
  - **Increase overall productivity by 10%**
  - **Decrease the number of defects by 20%**

Case study no.1: Results

Performance data for the first 36 projects

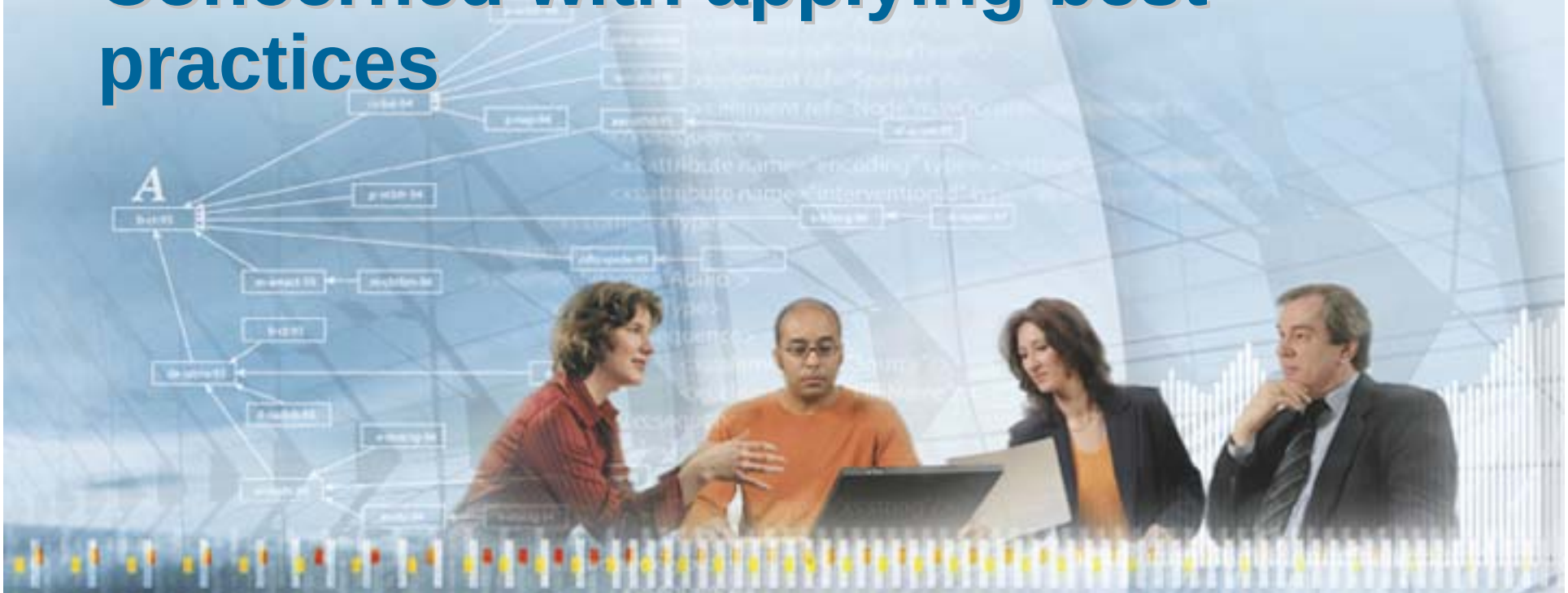
	Subset of projects			Improvement
	1 to 25	26 to 36	1 to 36	
Overall productivity	1.94	1.73	1.82	11%
Programming productivity	1.12	0.91	1.04	19%
Rework density	0.33	0.13	0.26	61%

- **6 project indicators:**
  - **Defect density**
  - **Rework density**
  - **Overall productivity**
  - **Schedule delivery**
  - **Completeness of requirements**
  - **Accuracy of estimates**
- **They now rarely have cost overruns**
- **Process is predictable**

Case study no.1: Challenges

- Resistance to change
  - Measure projects, not people
  - Communicate
  - Provide process insights through measures
- Rigour required to sustain measurement
  - Lack of rigour results in project deviations from standard process performances
- Be able to compare their productivity with other organizations (e.g., ISBSG projects)
  - Obtain 2 functional size measures: standard and local

Case study no.2: Concerned with applying best practices



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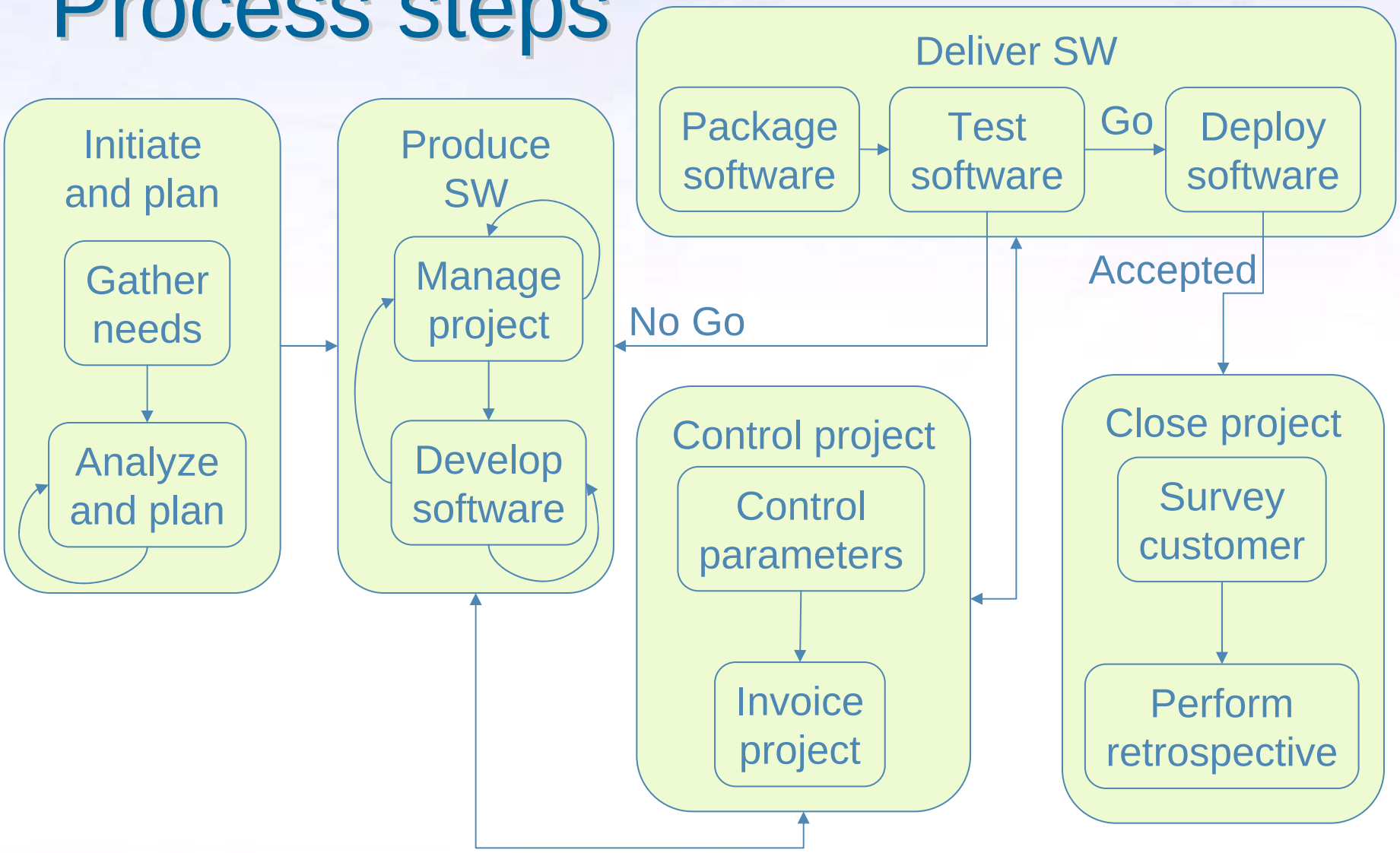
Case study no.2: Concerned with applying best practices

- Stable but undocumented process
  - Quality delivered
    - Between 0 and 2 defects per monthly release, fixed within half a day
- Lost potential projects to Indian outsourcing firms in 2001-2002
- Wanted to learn about the CMMI, then…
  - Assess their practices
  - Improve process on a continuous basis
  - Objectives
    - Improve quality in general and quality of life
    - Manage growth through a consistent and repeatable process
    - Delegate some management tasks to team members

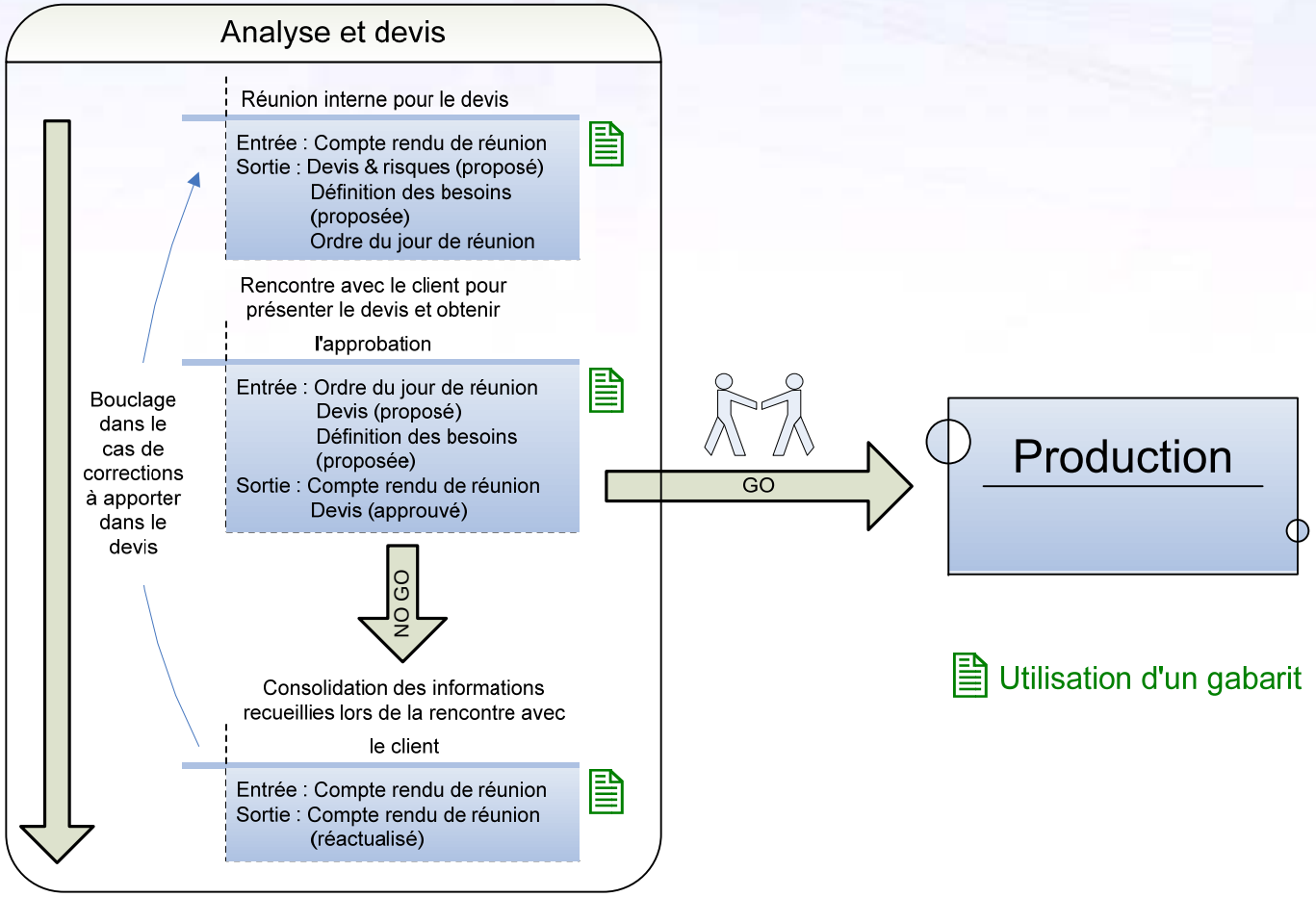
Case study no.2: The solution approach

- Based on the CMMI, without seeking a level
- Step 1: Document and start improving the software process
  - Graphical representation on 5 pages only
  - Templates for every work product
- Step 2: Provide training on best practices
- Step 3: Improve existing measurement program
  - Introduce functional size with COSMIC-FFP

Case study no.2: Process steps

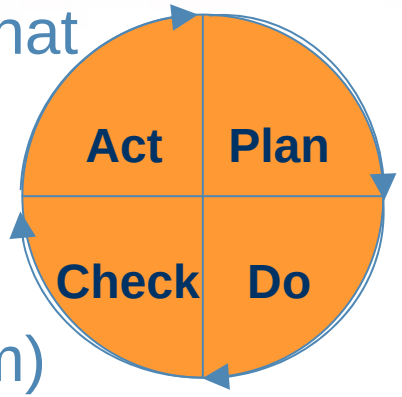


Case study no.2: Example of a process step



Case study no.2: Applying best practices

- Training provided on selected CMMI process areas:
  - Half-day sessions every other week
  - 1 process area covered in-depth each time
  - Assessment of current practices related to that process area
  - Actions defined to improve process
- In between sessions:
  - Actions performed (e.g. peer reviews, Scrum)
- Beginning of next session:
  - Retrospective on improvements and adjustments

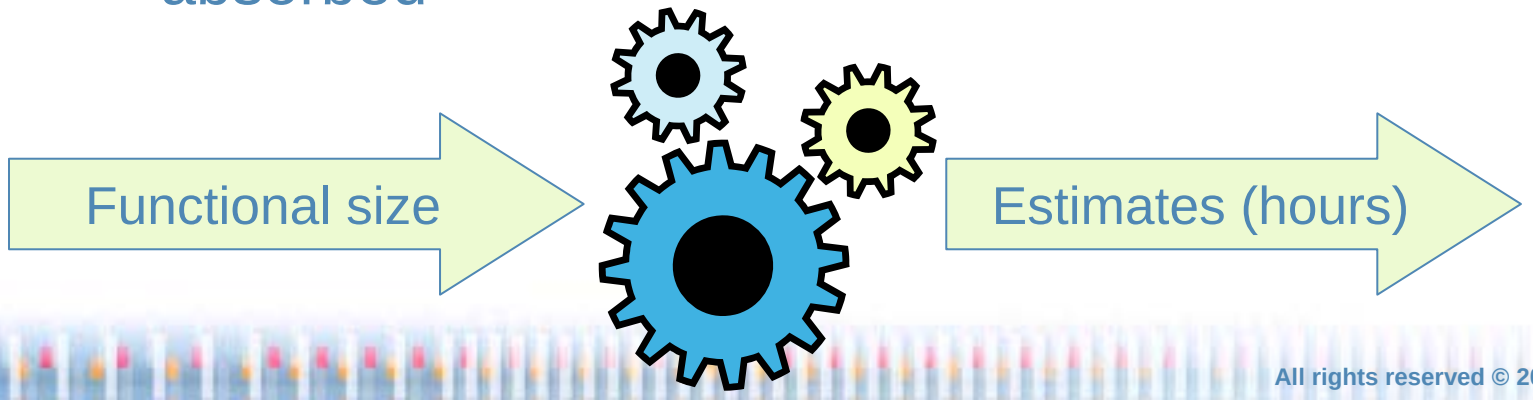


Case study no.2: Improve existing measurement program

- Program included measurement of:
  - Estimated and actual effort per project phase
  - Start and end dates
- Business model: “Not to exceed”, invoicing actual effort
  - Motivation: improve predictability of process performance
- Functional size measurement added
  - COSMIC-FFP chosen
- Estimation/productivity model developed
  - Refinements defined per functionality type for maintenance projects
  - Automated with macros in a spreadsheet

Case study no.2: Results

- Functional size measurement is applied on every new project
  - To compare with traditional estimation results
  - Part of their project definition template
  - Productivity model monitored and maintained
    - 2.5 hours/Cfsu for VFP projects
    - 4.5 hours/Cfsu for C# projects, once learning curve absorbed



Case study no.2: Challenges

- Sustaining growth due to increased customer demands
  - Lack of time to perform FSM
  - Faster ways to measure were tried and adopted
- Rigour required to sustain measurement
  - New analyst trained on FSM with COSMIC-FFP
- Improve measurement usage to manage and take decisions
  - E.g.: an “expected benefit” was added for every Change Request calculated on transaction volumes, effort saved, and number of affected users
    - Leads to a faster decision on Change Request priority based on measurement, not on perception

Conclusion and future work

- 2 small software organizations with similarities, facing different issues
- A single measurement program cannot suit any small organization
  - Similar measures and indicators can be defined
    - Effort per phase, functional size, defects, and schedule delivery
- Training and resources are key issues
- Measurement programs implemented as half-day workshops
  - Few disturbances of current projects schedule
  - Allowed team members to implement improvements
- Implement solutions to current challenges

Acknowledgement

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