

Software Process Improvement

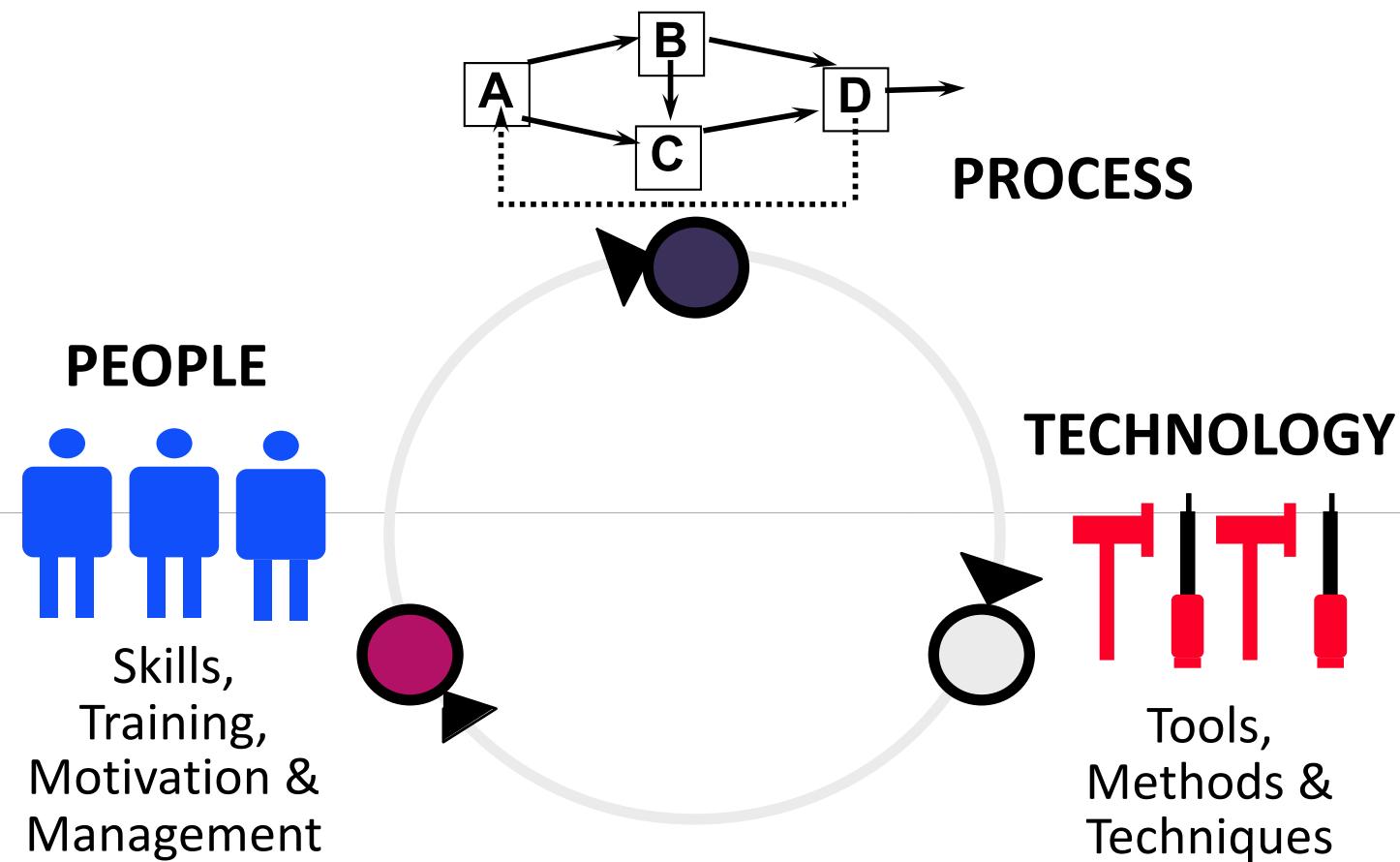
Overview

- Process Implementation
- Process Maturity
- Process Improvement
- Software CMM
- Integrated Capability Maturity Model (CMMI)

Effective Process Implementation

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Defining the process alone is just the first step



Comparison of Processes

➤ Immature Process

- ❑ Ad hoc & poorly controlled
- ❑ Highly dependent on practitioners
- ❑ Results unpredictable
- ❑ Likely cost, schedule & quality problems
- ❑ Use of new technology risky

➤ Mature Process

- ❑ Defined & documented
- ❑ Well controlled
- ❑ Measured
- ❑ Focused on process improvement
- ❑ Supported by technology

Non-Software Example



How long does it take to build a house?

Non-Software Example (cont.)

- 2005 Tyler Area Builders Association, Texas
 - 2 hours, 52 minutes, 29 seconds
 - 3 bedroom home fully landscaped
 - ❖ normally 90 days
 - Success attributed to training, practice, planning, innovation, new technology, shared mission and goals (>600 people!)
- 1983 competition in San Diego
 - 2 hours, 52 minutes, 31 seconds
- Habitat for Humanity
 - Alabama: 3 hours, 26 minutes, 34 seconds
 - New Zealand: 3 hours, 44 minutes, 59 seconds

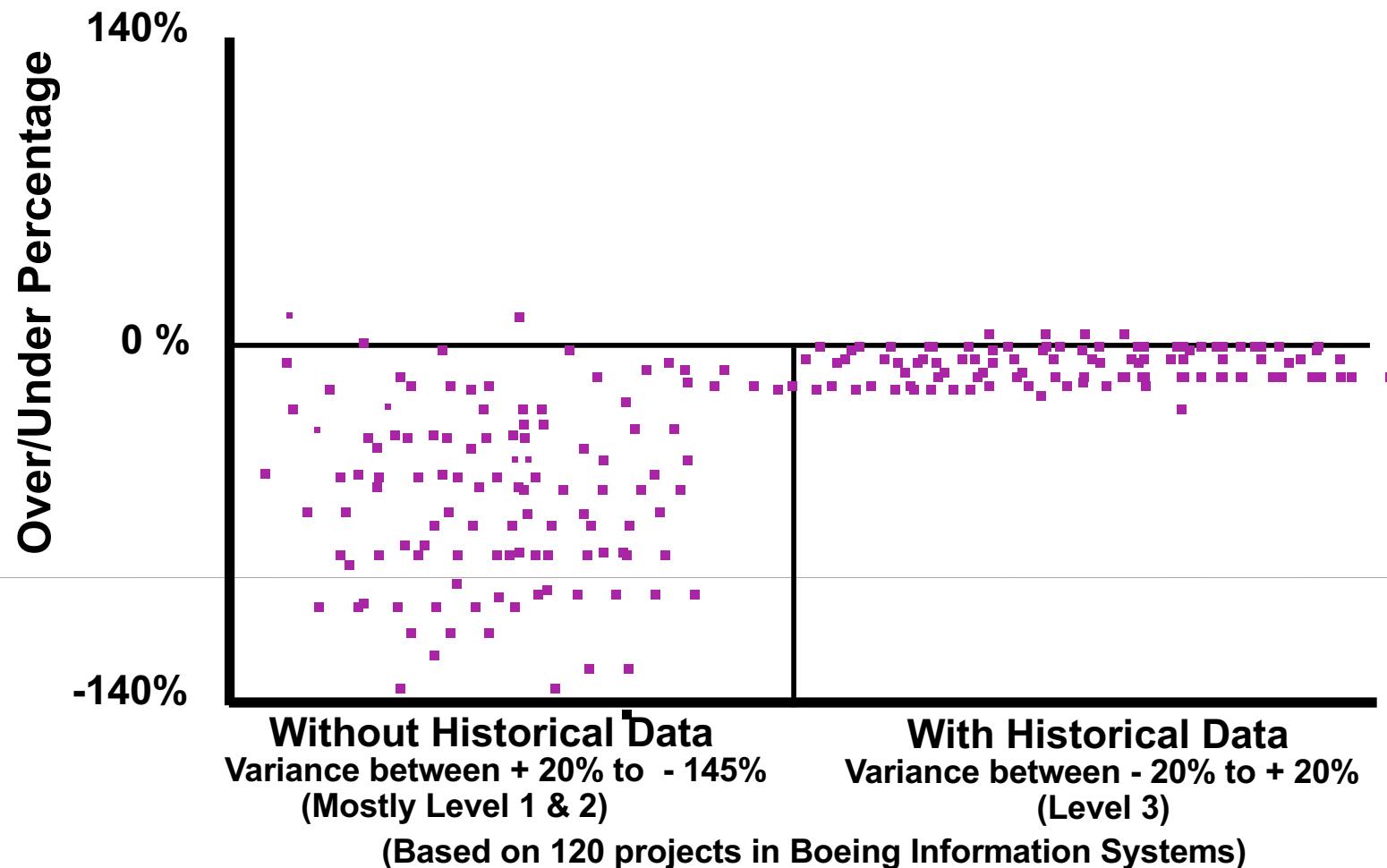
Process Improvement

- Consistently apply practices that work
- Change practices that cause problems
 - deciding requires introspection and analysis
- Keys to success
 - communication
 - management support and commitment
 - willingness to seek long-term benefits

Process Improvement Benefits

- Improved schedule and budget predictability
- Improved cycle time
- Increased productivity
- Improved quality (as measured by defects)
- Increased customer satisfaction
- Improved employee morale
- Increased return on investment
- Decreased cost of quality

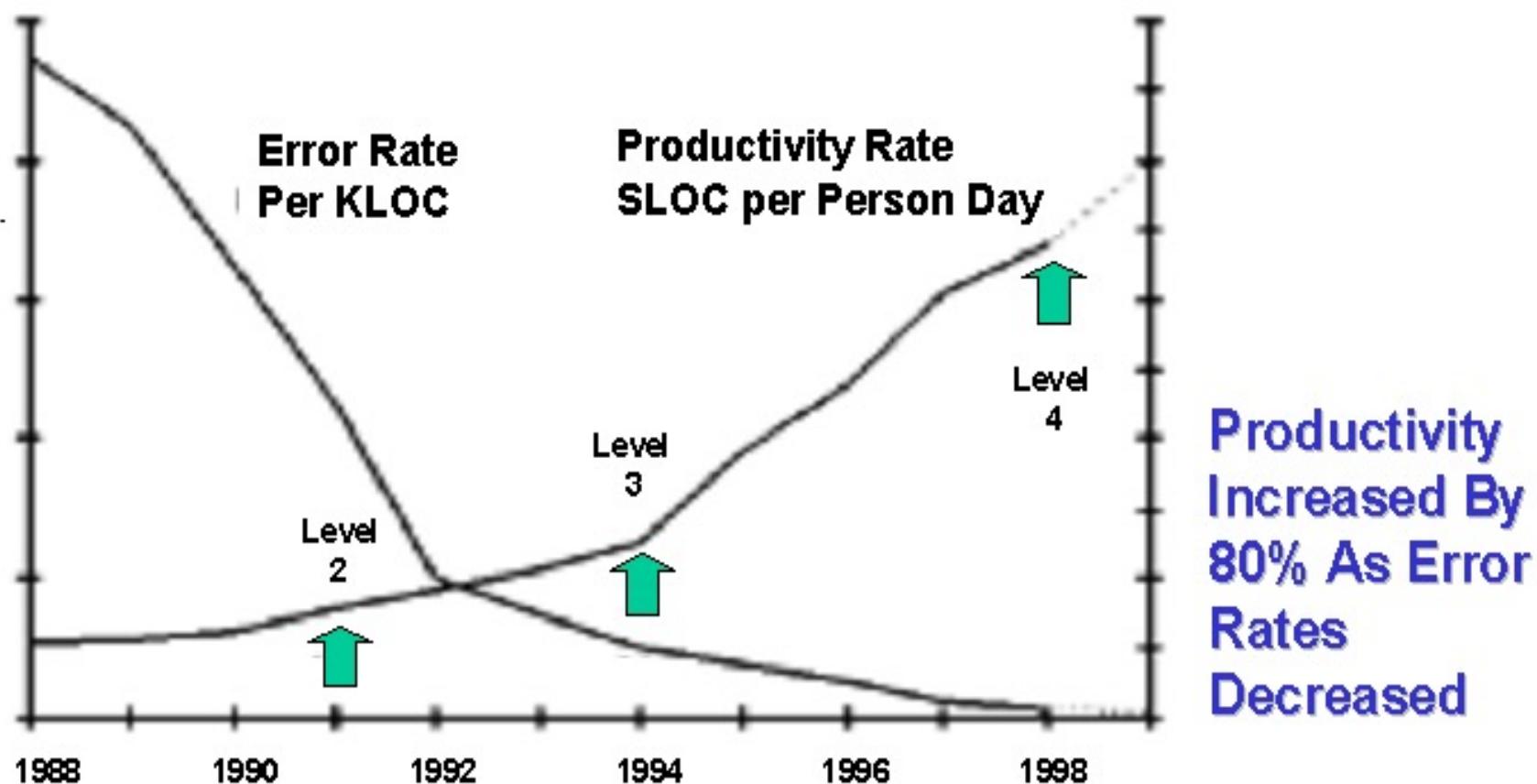
Improved Schedule and Budget Predictability



John D. Vu. “Software Process Improvement Journey: From Level 1 to Level 5.” 7th SEPG Conference, San Jose, March 1997.

Increased Productivity and Quality¹⁰

Productivity Rate and Quality Performance * For Software Programs

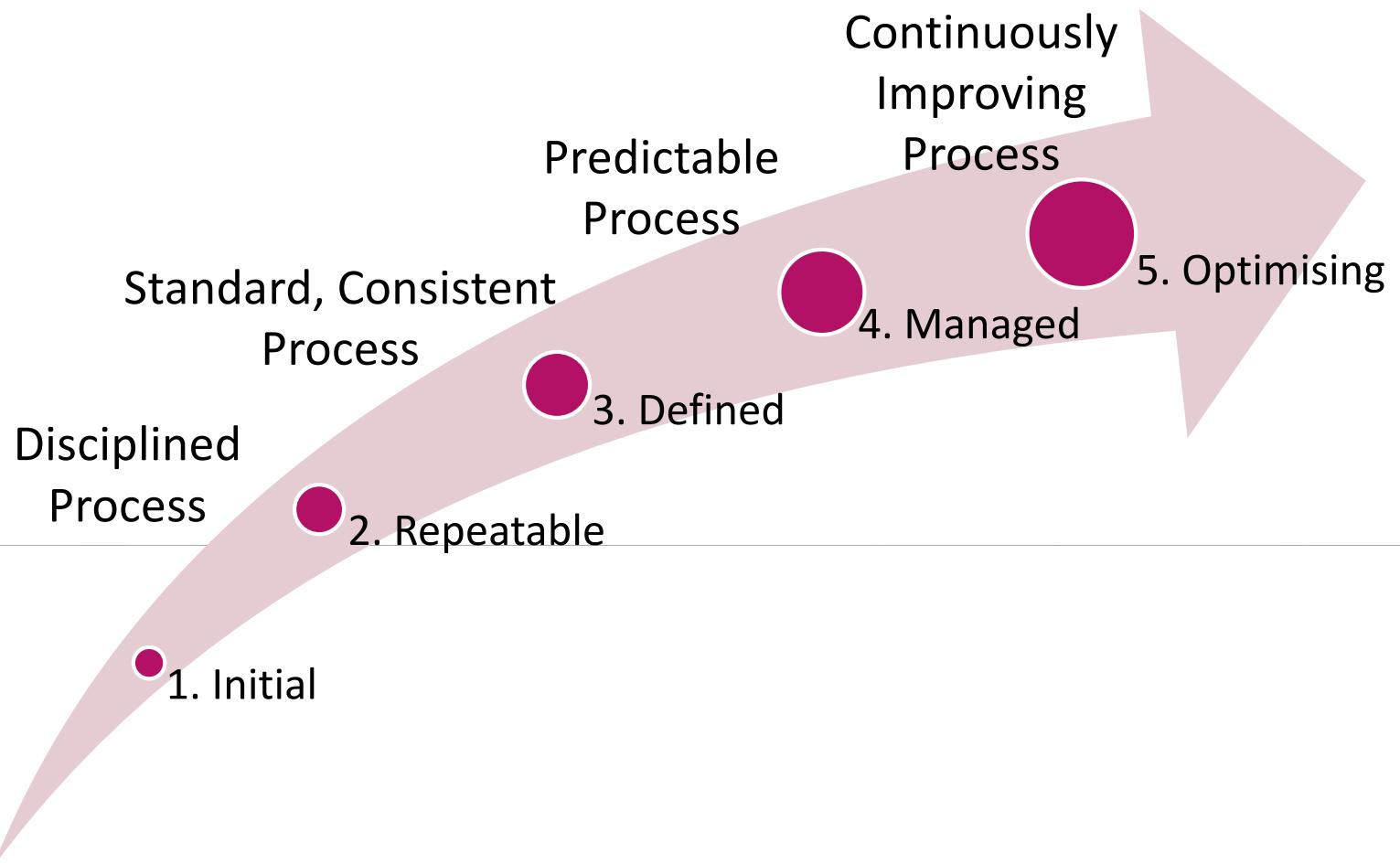


Capability Maturity Model (CMM)

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- Framework representing a path of improvements recommended for software organisations
- Five maturity levels
 - measuring maturity of organisation's process
- Each level builds on preceding one

CMM Levels



Initial (1)

- Ad hoc and occasionally even chaotic
- Few processes are defined and success depends on individual effort (rather than teamwork)
- During a crisis, projects typically abandon planned procedures and revert to coding and testing

Repeatable (2)

- Basic project management processes
 - track cost, schedule and functionality
- Process discipline is in place to repeat earlier successes on similar projects
- Project standards are defined
 - management ensures that they are followed
- Commitments are understood and managed

Defined (3)

- Processes for both management and engineering activities are documented and standardised
- Projects *tailor* standard process
 - develop their own process to account for unique characteristics of the project
- Organisational process improvement effort
 - Software Engineering Process Group (SEPG)

Managed (4)

- Relationships between cost, schedule and quality are understood in numerical terms
- Performance is predictable
- Quantitative product quality and process productivity goals are set for each project
- Product quality and process productivity are continually measured and corrective action taken when required
- Organisation-wide software process database is used to collect and analyse data about software processes

Optimising (5)

- Continuous process improvement
 - quantitative feedback from the process
 - piloting innovative ideas and technologies
- Software teams analyse defects to determine their causes
 - evaluate software processes to prevent known types of defects from recurring
 - disseminate lessons learnt throughout the organisation

Key Process Areas

- Each maturity level is decomposed into key process areas
 - indicate where to focus improvements
- Identify issues that must be addressed to achieve the corresponding level
- To be at level 3, an organisation must have addressed all key process areas at levels 2 & 3

Key Process Areas (cont.)

- Repeatable(2)
 - ❑ requirements management
 - ❑ software project planning
 - ❑ software project tracking and oversight
 - ❑ software subcontract management
 - ❑ software quality assurance
 - ❑ software configuration management

Key Process Areas (cont.)

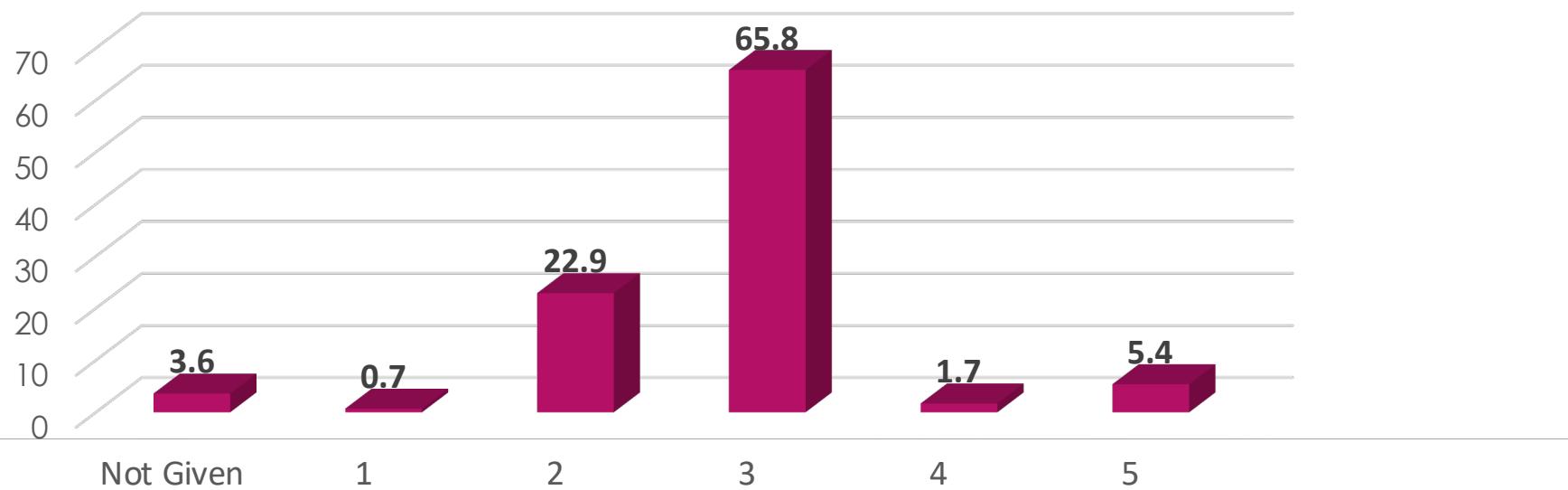
- Defined (3)
 - ❑ organisation process focus
 - ❑ organisation process definition
 - ❑ training program
 - ❑ integrated software management
 - ❑ software product engineering
 - ❑ intergroup coordination
 - ❑ peer reviews

Key Process Areas (cont.)

- Managed (4)
 - ❑ quantitative process management
 - ❑ software quality management
- Optimising (5)
 - ❑ defect prevention
 - ❑ technology change management
 - ❑ process change management

In the Real World ...

% of Organisations



Source: SEI, March 2012 Appraisal Results
Based on most recent assessment of 4731 organisations

Costs and Benefits

- Software engineering division of Hughes Aircraft
 - spent \$500,000 between 1987 and 1990 for assessments and improvement programs
- Moved from level 2 to level 3 in three year period
- Estimated annual savings: about \$2,000,000
 - fewer crises
 - decreased overtime
 - improved employee morale
 - lower turnover of software professionals

Costs and Benefits

- Raytheon IDS
 - Level 3 – 2003
 - Level 4 – 2005
 - Level 5 – 2008
- Overall ROI 24:1
- SEI 2006 study
 - CMMI ROI ranged from 1.7:1 to 27.7:1

Costs and Benefits (cont.)

Level	1	2	3	4	5
Duration (mths)	29.8	18.5	15.2	12.5	9
Effort (p-mths)	593.5	143	79.5	42.8	16
Faults (develop)	1,348	328	182	97	37
Faults (customer)	61	12	7	5	1
Cost	\$5.4M	\$1.3M	\$728K	\$392K	\$146K

- ▶ Based on data from 1300 projects, for a 200,000 line data processing product

Another Comparison

Faster, Better & Cheaper?

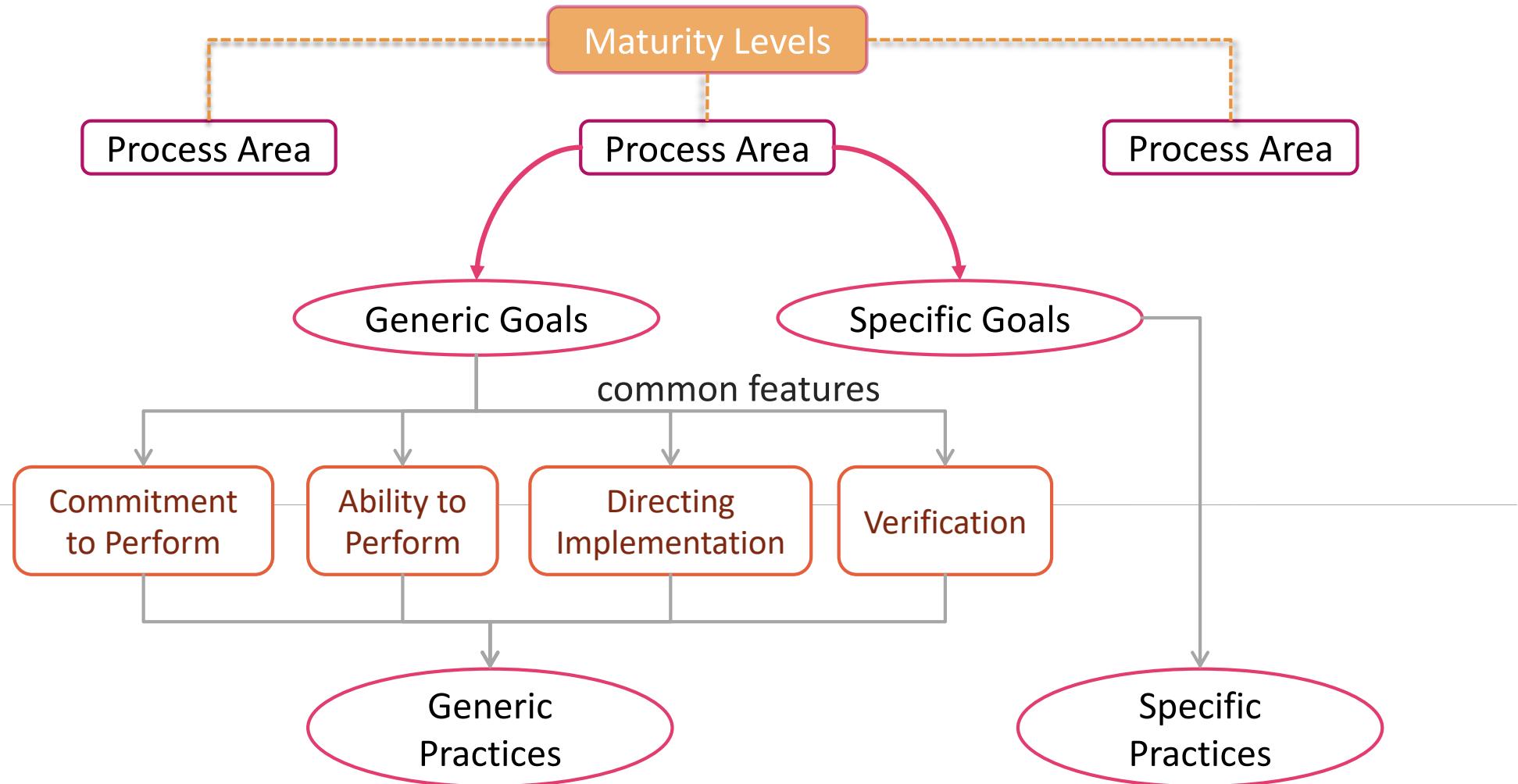
SEI level	Quality (defects/KSLOC)	Productivity (KSLOC/hr)	Total cost	Cost SLOC	Development time
1	9+	1	\$33M	\$66	40 mo.
2	3	3	\$15M	\$30	32 mo.
3	1	5	\$7M	\$14	25 mo.
4	0.3	8	\$3M	\$6	19 mo.
5	<0.1	12+	\$1M	\$2	16 mo.

Lockheed } Toshiba & TRW } IBM Shuttle

CMM Integration

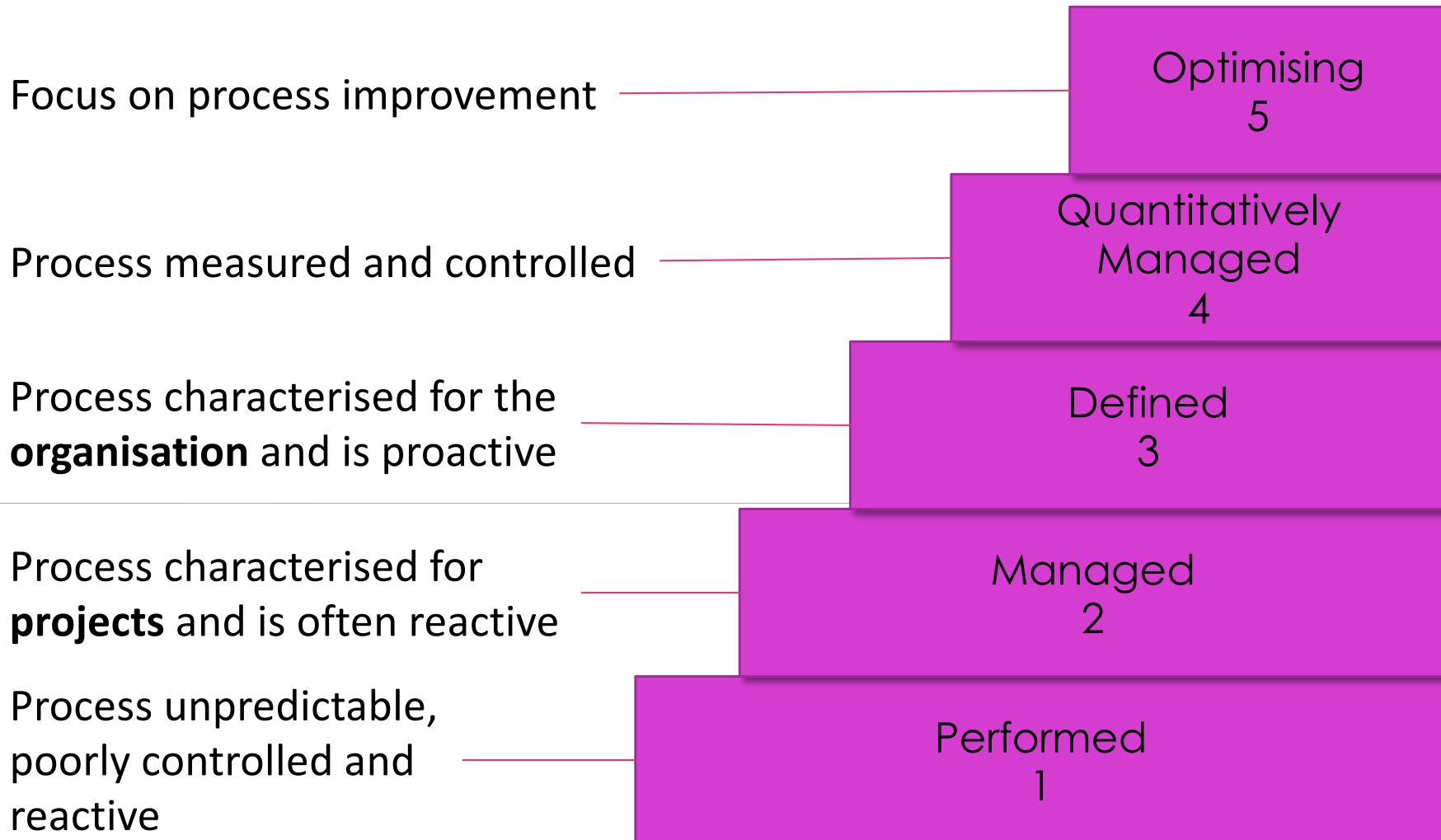
- Set of integrated models
 - software engineering, systems engineering, integrated product and process development (IPPD), software acquisition
- Framework to integrate future process areas
- Integrated set of assessment and training
- Used existing models
 - e.g. CMM, EIA 731 (systems engineering), IPD CMM, SA CMM, ...

CMMI Staged Representation



CMMI Staged – Maturity Levels

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Reading

- Sommerville
 - ❑ Section 2.4
- Weigers
 - ❑ Chapter 31