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# CMMI

**Ing. David Janota, Ph.D.**

**director QA, CN Group**

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# Schedule

1. Introduction
2. What is quality and quality assurance in software development
3. What is CMM/CMMI, history and purpose
4. Levels
5. Process areas and groups
6. Specific and general goals
7. Pros and cons of CMMI
8. Practical experiences
9. What CMMI means for you?
10. Questions/discussion

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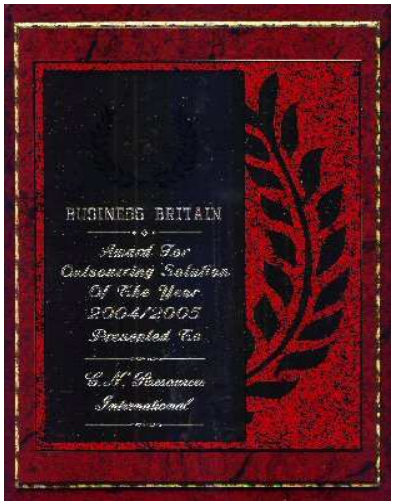
# Introducing – CN Resources International (cont.)

- **ownership**
  - 50% CORENA A/S (Denmark)
  - 50% Anritsu A/S (Japan-Denmark)
- **190+ employees**
- **technologies – Java, C++, .NET, XML, VBA, etc.**
- **strong focus on quality assurance**
  - CMM L2 (the first assessment level 2 in CZ)
  - CMMI L3 (the first and only assessment level 3 in C
- **turnover 194 mil. CZK in 2007**

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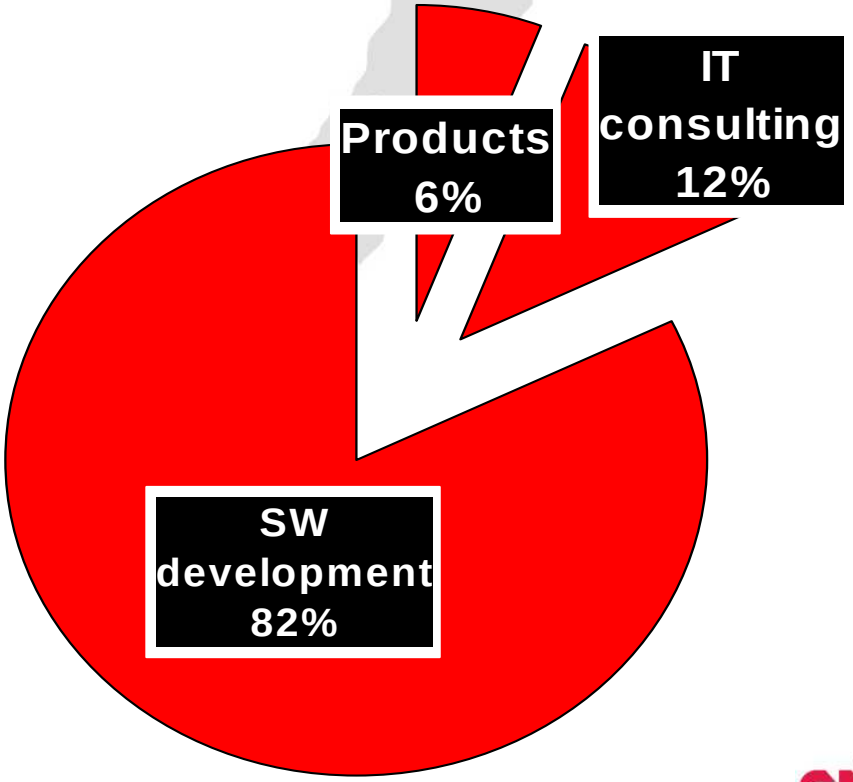
# Introducing – CN Group

- **outsourcing for software development**
  - banking
  - telecommunications
  - aviation
- **IT consultancies**
- **products (content management)**

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# Introducing – David Janota

- **working in CN Group as director QA**

- **education**
  - Tomas Bata University in Zlín
  - Ph.D. from technical cybernetics

- **working experience**
  - Daimler-Chrysler (DE)
  - Carl-Zeiss (DE)
  - Honeywell (US)
  - Robert Bosch (CZ)

- **professional background**
  - programming (C/C++,C#, ASP.NET,MFC,COM...)
  - quality assurance (Six Sigma, CMM/CMMI, automotive industry)
  - project leading

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# Before we start....

- do not hesitate to interrupt me with questions
- please, switch the mobile phones into silent mode

*official materials: http://www.sei.cmu.edu/cmmi*

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# Abbreviation

- CMM(I) = Capability Maturity Model (Integration)
- CM = configuration management
- QMS = quality management system
- PA = key process area

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# Why CMMI?

- companies usually establish CMMI because of requirements of customers

- CN Group has CMMI certification because
  - our main customer wants it (Anritsu)
  - it is a good trademark
  - it increase the prevention from mistakes
  - it improves your maturity and capability for your products and services

# Schedule

1. Introduction (5 min)
2. *What is quality and quality assurance in software development (5 min)*
3. What is CMM/CMMI, history and purpose (10 min)
4. Levels (5 min)
5. Process areas and groups (20 min)
6. Specific and general goals (10 min)
7. How to obtain the certification (5 min)
8. Pros and cons of CMMI (10 min)
9. What CMMI means for you? (5 min)
10. Questions/discussion (???)

# Software development....

- **is a pretty difficult part of industry**
- **according to the research, 80-90% of software projects are delayed or underestimated (or both)!!!!**
- **why?**
  - software development is relatively new area
  - software is different type of goods than others (buildings, bridges, cars...)
  - every step in software development is unique
  - it is similar to research, writing books or filming movies, but with BIG pressure on quality

# What is quality

- **lots of definitions (what customer says, policy and future, process of whole company....)**
- **Quality is the degree of customer satisfaction using set of inherent factors (official definition)**
- **inherent factors = bound with product**
  - number of bugs
  - delays
  - support
  - sufficient warranty
  - .....

# What is quality assurance

- **Quality assurance = creation and maintenance of activities, which could help with keeping of quality**
- **How?**
- **As you want.....**
  - focusing on processes
  - prevent from bugs
  - track the project risks
  - watch the requirements
  - review the code
  - ....

# Quality assurance

1. Thousands of people already used quality assurance activities.
2. Another thousand of people defined different technologies how to track the quality.
3. Customers wanted these technologies from their suppliers.

   e.g.

   - ISO 9001:2000
   - QS 9000
   - VDA 6.1
   - CMMI
   - Prince 2
   - .....

## Creation of standard

1. Ask the companies for the experiences
2. Analyze the projects
3. State “best practices”
4. Create STANDARD

***.. and you have CMM***

# Schedule

1. Introduction
2. What is quality and quality assurance in software development
3. *What is CMM/CMMI, history and purpose*
4. Levels
5. Process areas and groups
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8. Pros and cons of CMMI
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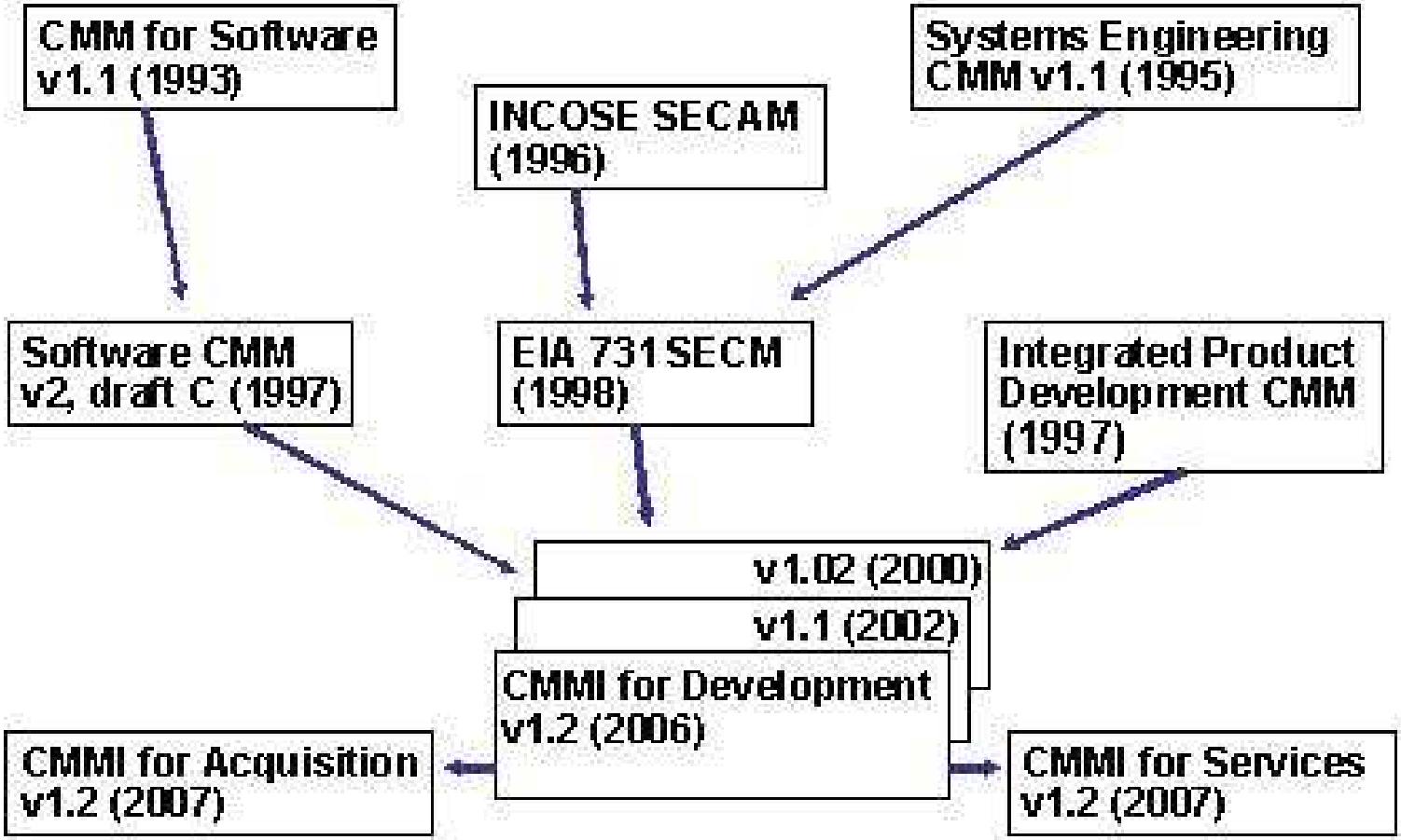
# What is CMM/CMMI

- **Capability Maturity Model (Integration) (CMM / CMMI)** is a methodology developed by the Software Engineering Institute (SEI) on Carnegie Mellon University in 1991 (the 1st version).
- It was created as the grant of Ministry of Defence for their projects
- It is focused on **definition, standardization and continuous improvement** of development processes.

# History

- **first version of CMM v1.0 was divided**
  - SW-CMM (software development)
  - SE-CMM (system engineering)
  - P-CMM (people management)
  - SA-CMM (software acquisition)
- **in 2002, SEI integrated other models (like SPICE=ISO 15 504) into new version – CMMI v1.1**
  - SW-CMMI (software development)
  - SE-CMMI (system engineering)
  - ...
- **in 2006, SEI released the newest version (1.2) and integrated part of the parts into one**
  - CMMI

# History (cont.)



# Usage

- **it is de-facto American standard**
  - 50% of CMM/CMMI certifications are from USA
  - it is a must for government projects
- **Japan companies have strong focus on quality**
  - 30% of CMM/CMMI certifications are from Japan
  - it is bind also with their suppliers
  - our company has also Japan owner ☺
- **India became the software "factory"**
  - 10% of CMM/CMMI certifications are from India
  - I have no idea why

# Usage (cont.)

- situation in Europe is slightly specific
  - European companies use ISO certifications
  - software development have no strong tradition as it has in US
- during the last five years, it is becoming very “in”
  - big companies create the development centres in eastern and middle Europe
  - very big pressure on quality because of Tchai-wan and Japan

# Subject and purpose

- *"....to help organizations improve their development and maintenance processes for both products and services"*

- **according to the research, it brings experiences**
- **according to the experiences, it states goals and practices (recommendations) how to work within whole life-cycle**

- **it brings mainly**
  - **reproducibility (of success)**
  - **definition (of all processes)**
  - **continual improvement**
  - **project and process control**

- **it is specific for development, but still GENERAL**

# Example

- **CMMI in one process area (Configuration Managements) says:**
  1. **you must have defined baselines**
  2. **you must have defined change management**
  3. **you must assure the integrity**

  **goals**

- **and e.g. for point 3, it recommends:**
  - **establish CM records**
  - **perform CM audits**

  practices

# Types of CMMI

- CMMI means evolution and improvement
- evolution could be performed
  - continuously
  - in steps (staged)

- *continuous CMMI* – develop yourself in ALL areas of life-cycle, step by step

- *staged CMMI* – choose parts of life-cycle (e.g. project planning) and develop yourself ONLY in these areas, but completely

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# Schedule

1. Introduction
2. What is quality and quality assurance in software development
3. What is CMM/CMMI, history and purpose
4. *Levels*
5. Key process areas and groups
6. Specific and general goals
7. How to obtain the certification
8. Pros and cons of CMMI
9. What CMMI means for you?
10. Questions/discussion

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# Levels

- CMMI = evolution in stages

  Level 1 Initial

  Level 2 Managed

  Level 3 Defined

  Level 4 Quantitatively Managed

  Level 5 Optimizing

- to successfully achieve the level, you have to fulfil
  - specific goals of the level
  - general goals of the level

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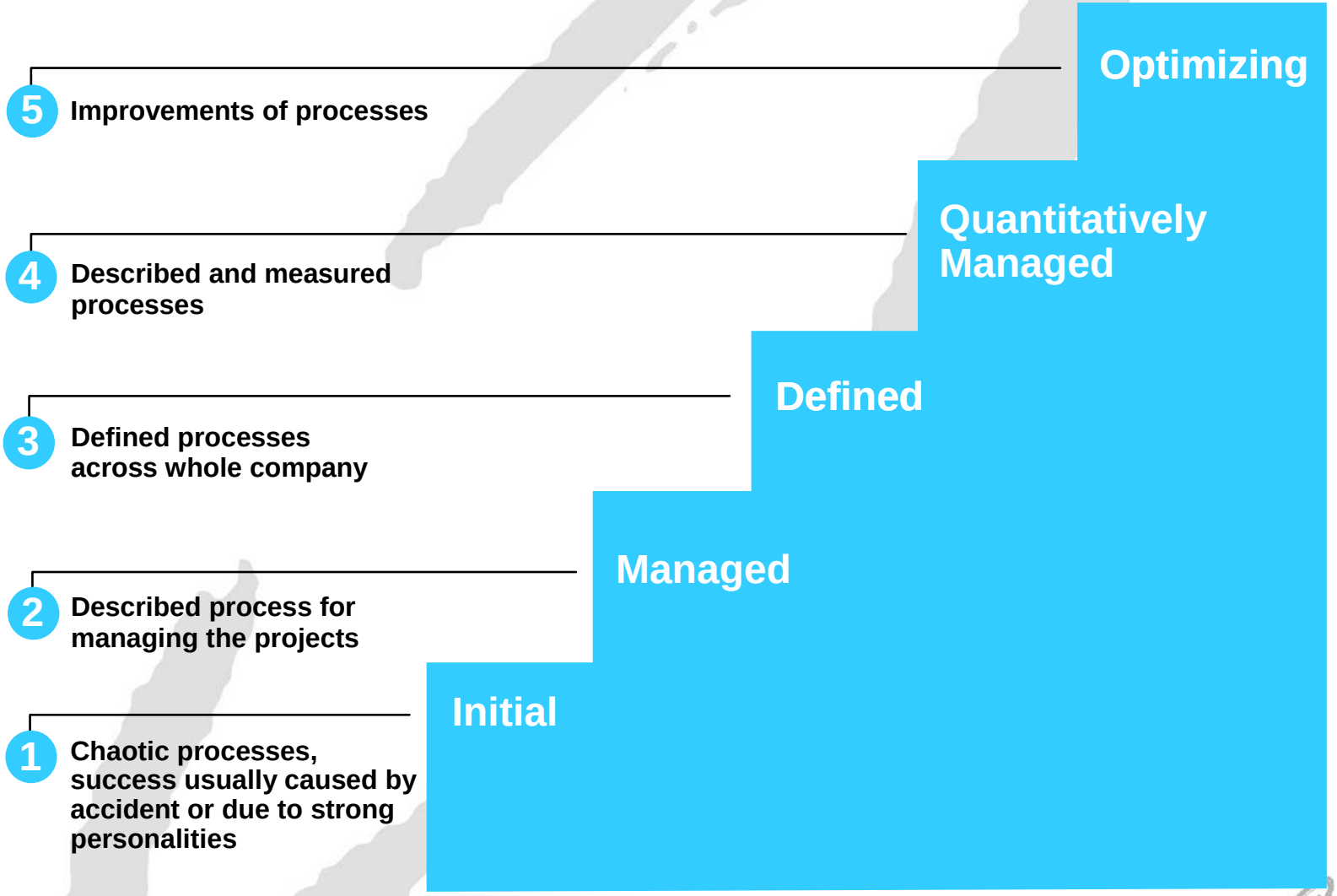
# Levels (cont.)

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# Schedule

1. Introduction
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5. *Process Areas and groups*
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# Process areas

- **every level has several PA (process areas)**
  - Level 2 – 7 areas
  - Level 3 – 11 areas
  - Level 4 – 2 areas
  - Level 5 – 2 areas

- **every are belongs to the group**
- **e.g. level 2 has**
  - 4 supporting areas
  - 3 project management areas

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# Process areas

| | |
|---|---|
| L5 - Optimizing | Causal Analysis and Resolution |
| | Organizational Innovation and Deployment |
| L4 - Quantitatively Managed | Quantitative project management |
| | Organizational Process Performance |
| L3 - Defined | Requirements Development |
| | Technical Solution |
| | Product Integration |
| | Verification |
| | Validation |
| | Organizational Process Focus |
| | Organizational Process Definition |
| | Decision Analysis and Resolution |
| | Organizational Training |
| | Integrated Project Management |
| | Risk Management |
| L2 - Managed | Requirements Management |
| | Project Planning |
| | Project Monitoring and Control |
| | Quality Assurance |
| | Configuration Management |
| | Supplier Agreement Management |
| | Measurement and Analysis |

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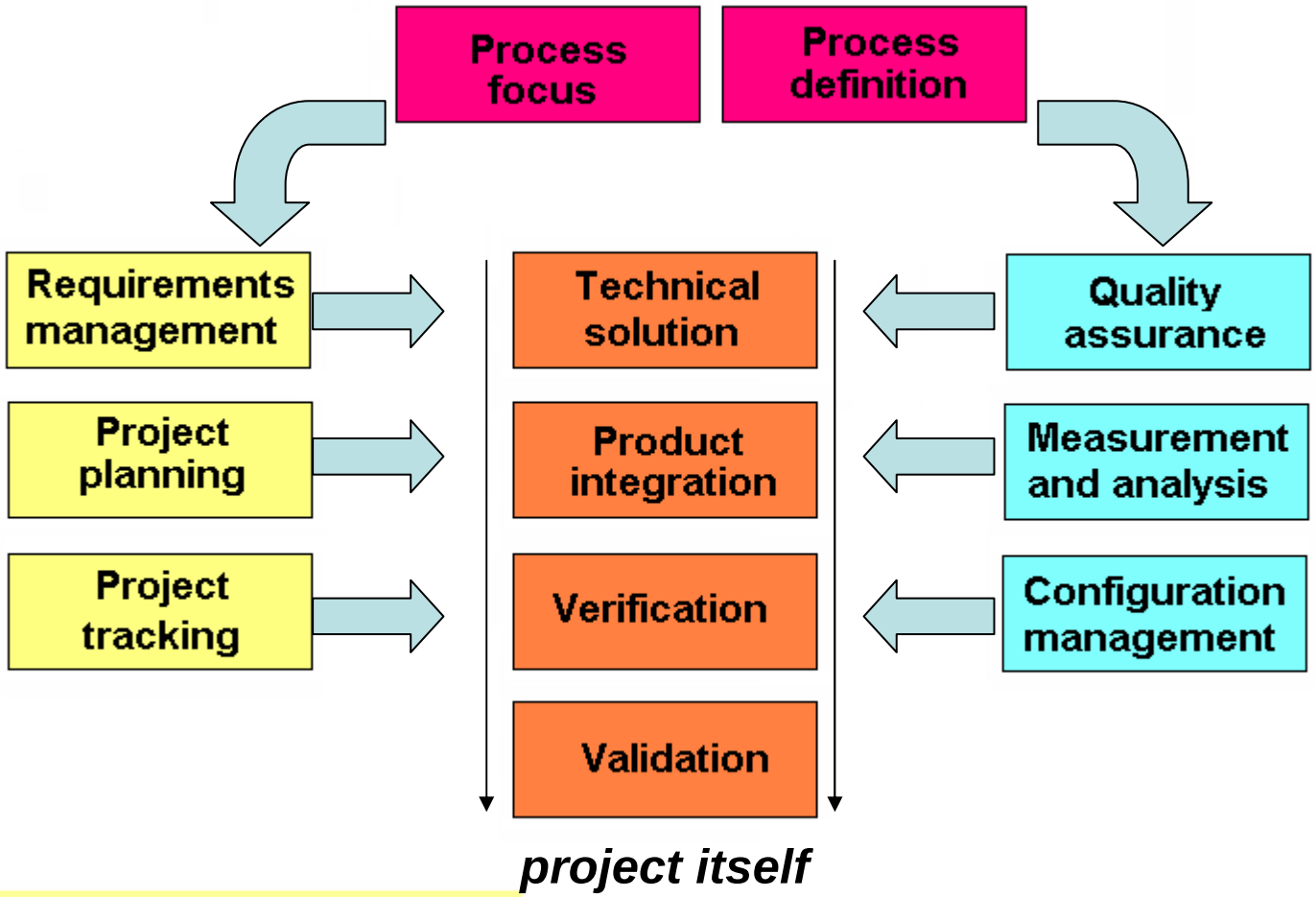
# Groups

**CMMI is organized into four basic groups:**

1. **project management**
   - **how to plan projects**
   - **how to track projects**
   - **how to track risks**
2. **process management**
   - **defining the company processes**
   - **how to measure processes**
3. **engineering**
   - **how to design**
   - **how to code**
4. **support processes**
   - **how to define baselines**
   - **how to perform internal audits**

# Groups (cont.)




*project management*
*process management*
*engineering*
*support processes*

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# PA and groups

| | | |
|---|---|---|
| Level 5 | CAR | Causal Analysis and Resolution |
| | OIR | Organization Innovation and Deployment |
| Level 4 | OPM | Organization Process Performance |
| | QPM | Quantitative Project Management |
| Level 3 | RD | Requirements Development |
| | TS | Technical Solution |
| | PI | Product Integration |
| | VER | Verification |
| | VAL | Validation |
| | OPF | Organization Process Focus |
| | OPD | Organization Process Definition |
| | OT | Organization Training |
| | RM | Risk Management |
| | DAR | Decision Analysis and Resolution |
| | IPM | Integrated Project Management |
| Level 2 | REQM | Requirements Management |
| | PP | Project Planning |
| | PMC | Project Monitoring and Control |
| | SAM | Suppliers' Agreement Management |
| | MA | Measurement and Analysis |
| | PPQA | Process and Product Quality Assurance |
| | CM | Configuration Management |
| | | |
| | | supportive areas |
| | | project management |
| | | process management |
| | | engineering |

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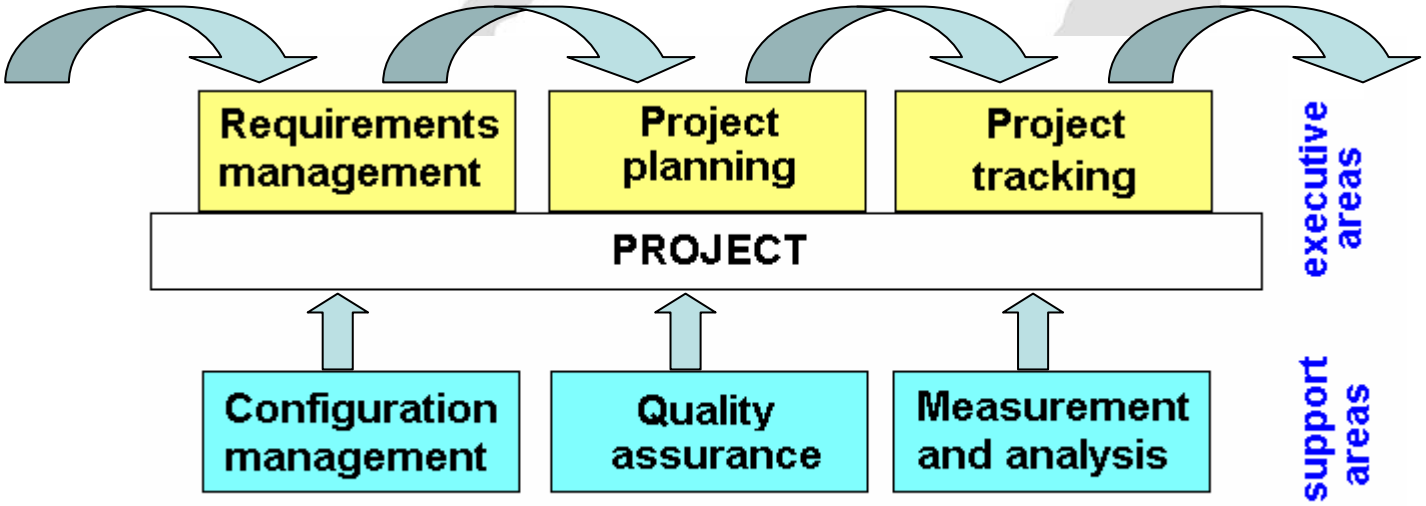
# Example – PA and groups on level 2

**CMMI L2 process areas in projects**

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# PA on level 2

**Requirements management (REQM)**

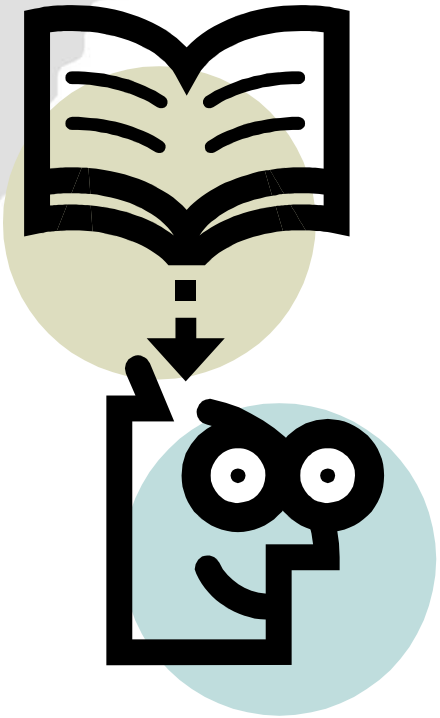
- obtain the requirements
- track the changes in requirements
- identify inconsistencies

**Project planning (PP)**

- estimate the work
- develop the project plan
- commitment of plan

**Project monitoring and control (PMC)**

- track the project plan
- solve the discrepancies



# PA on level 2 (cont.)

**Product and process quality assurance (PPQA)**

- evaluate processes and products
- performing internal audits

**Measurement and analysis (MA)**

- measure the processes
- communicate results

**Supplier agreements management (SAM)**

- evaluate suppliers
- define the process for purchased product

**Configuration management** - see previous slides

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# Specific goals

- every PA has specific goals
- every specific goals has specific practices

- fulfillment of goals is MANDATORY
- fulfillment of practices in RECOMMENDED

CMMI defines for every practice also sub-practices and typical products – see example

# Example

- **CMMI in one key process area (Configuration Managements) says:**
  1. you must have defined baselines
  2. you must have defined change management
  3. you must assure the integrity

  **goals**

- **and e.g. for point 3, it recommends:**
  - **establish CM records**
  - **perform CM audits**

  practices

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# Example (cont.)

- **L2, PA Configuration Managements says:**

  3. **you must assure the integrity**

     *(and it recommends)*

     - **establish CM records**
     - **perform CM audits**

     **(which means)**

     1. evaluate baseline
     2. check the real and defined state
     3. check procedures and description
     4. track the CM items

***typical product: result of audit***

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# Specific goals

| Configuration Management | | | | | |
|---|---|---|---|---|---|
| **Cíl** | **Název cíle** | **Proces** | **Název procesu** | **Postup** | **Typický produkt** |
| SG 1 | Zavedení baselines | SP 1.1 | Identifikace konf. položek | Výběr konf. položek | Identifikované konf. položky |
| | | | | Přiřazení unikátní identifikace | |
| | | | | Specifikace charakteristiky každé položky | |
| | | | | Specifikace času vložení pod CM | |
| | | | | Specifikace vlastníka | |
| | | SP 1.2 | Zavedení CM systému | Stanovení CM úrovní | CM systém s řízením procesů a produktů |
| | | | | Uložení a zisk konf. jednotek v CM systému | Databáze change requestů |
| | | | | Sdílení a přenos mezi jednotlivými úrovněmi | |
| | | | | Uložení a obnova archivovaných verzí | |
| | | | | Uložení, update a zisk záznamů o CM | |
| | | | | Vytvoření CM reportů z CM systému | |
| | | | | Ochrana CM systému | |
| | | | | Případná revize struktury CM systému | |
| | | SP 1.3 | Vytvoření nebo uvolnění baseline | Zisk autorizací od CCB před vytvořením nebo uvolněním baseliny | Baselines |
| | | | | Vytvoření nebo uvolnění baseliny JENOM z položek, obsažených v CM | Popis baselines |
| | | | | Dokumentace položek v baselině | |
| | | | | Zpřístupnění baseliny | |

specific practice

specific goal

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# Generic goals

- all KPA have generic goals TOGETHER
- generic goals have also practice
- they must be fulfilled for every PA (for that level)
- one generic goal ("Establish managed process") with following practices

**define the policy**

**plan the process**
**define resources**
**assign responsibility**
**train people**

**integrate into CM system**
**inform stakeholders**
**monitor the process**

**check the adherence**
**review process with management**

| | |
|---|---|
| | Commitment to Perform |
| | Ability to Perform |
| | Directing Implementation |
| | Verifying Implementation |

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# Generic goals

generic goals

PA

| | GP 2.1 | GP 3.1 | GP 2.2 | GP 2.3 | GP 2.4 | GP 2.5 | GP 2.6 | GP 2.7 | GP 2 |
|---|---|---|---|---|---|---|---|---|---|
| | CO1 | AB1 | AB2 | AB3 | AB4 | AB5 | DI1 | DI2 | DI |
| | Politika | Def. | Plán | Zdroje | Zodpovědnost | Školení | Konfigurace | Stakeholders | Monito kontr |
| REQM | Očekávání organizace na plánování a spuštění procesu (řízení, sledování nekonzistencí...) | | Typicky součást PMP | Poskytnutí zdrojů pro spuštění procesu, vývoj produktu a poskytnutí servisu (sledovací nástroje, zpětná sledovatelnost) | Spuštění, vývoj a servis | Např. doména, definice, revize, nástroje... | Umístění pod CM (požadavky, matice sledovatelnosti) | Identifikace a vtažení (kdokoliv, kdo je zasažen - testeři, vývojáři, manageři...) | Kontrola pr + nápravná |
| PP | Pro odhady a plánování projektů, interních a externích odsouhlasení, vývoj plánu | | Plán na plán (kdy, kde, jak).. v rámci firmy | Zdroje na proces, vč. prací na odhady, časové plány, technické expertízy, nástroje... | Spuštění, vývoj a servis | Odhady, rozpočty, vyjednávání, identifikace rizik, data mgmt, plánování.. | Např. WBS, plán projektu, data mgmt plán... | Identifikace a vtažení (kdokoliv, kdo je zasažen - testeři, vývojáři, manageři...) | Např. počet plánu, rozpt časového p effortu... |
| PMC | Pro sledování výkonnosti proti plánu a řízení nápravných opatření | | Plán pro sledování a kontrolu projektu | Zdroje na běh sledování a kontrolu, např. tracking system, mpp, atd. | Spuštění, vývoj a servis | Např. sledování a kontrola projektu, risk mgmt, data mgmt | Umístění pod CM | Např. pro ohodnocení projektu proti plánu, revizi závazků, revizi rizik, sledování nápravných opatření. | Např. počet otevřených uzavřených opatření, po milestones, revizí... |
| MA | Pro cíle měření, information needs... | | Může být v PMP | Na proces, výsledek a servis + např. statistické nástroje | Spuštění, vývoj a servis | Např. statistické metody, procesy sběru dat, měření goals... | Např. specifikace měření, procedury, sady dat, výsledky analýz.. | Např. ti, co ustanovují procesy a procedury, hodnotí data, poskytují feedback... | Kontrola pr + nápravná |
| | | | | | Přiřazení | | | | |

# Example – Managed process

- there exist policy (usually in Quality Manual), how to deal with configuration management
- how to manage configurations is part of project plan
- it is clear who will do it, what he will need for this job and he has the time for it
- somebody is responsible for it
- people were trained and know what to do
- outputs are under CM
- all stakeholders ("zainteresovaní") are informed
- some metric is defined and it is tracked
- somebody checks the process against its description (usually in audit)
- results are reviewed with management (on higher level)

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# Certification

## How to achieve CMMI certification for x-th level?

1. **Choose the certification authority.**
2. **Prove the fulfillment of specific and generic goals.**

**but auditor will track that very carefully:**

- **whether the processes are not only on paper**
- **whether people use QMS**
- **why the practice was not used**
- **whether exists records**

**.....**

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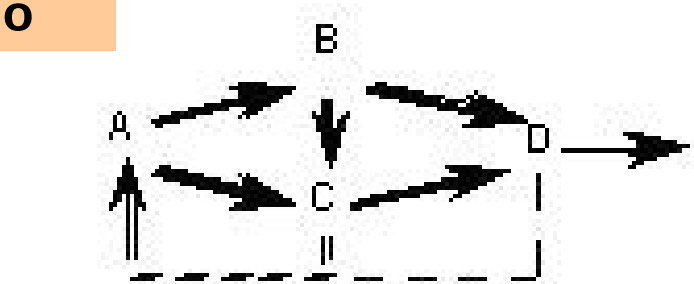
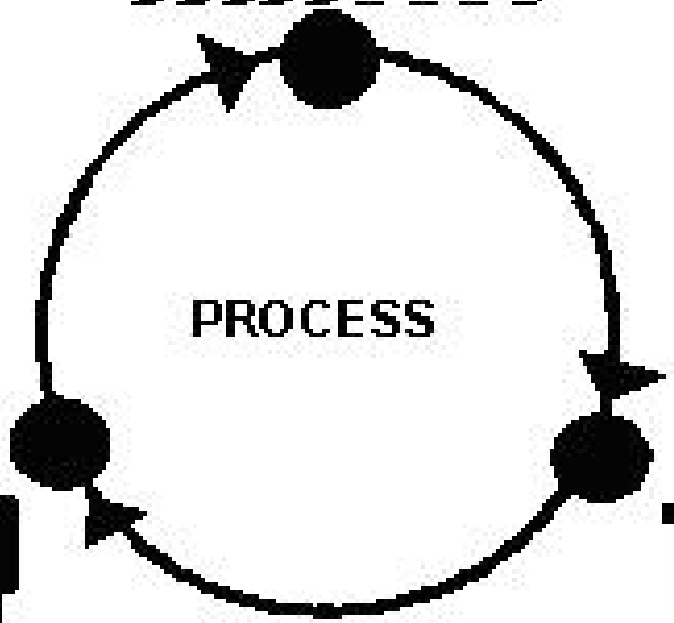
# CMMI – pros

- **CMMI increases the probability of success**
- **it helps with using best experiences**
- **it has defined processes**
- **it increase the productivity of project management (level 2)**
- **it prevents from**
  - delays
  - underestimations
  - financial problem
- **it brings INTEGRATION**

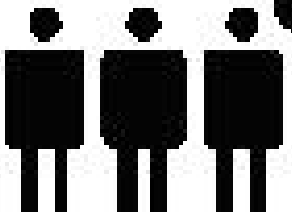
# CMMI – pros (cont.)

**WHAT to do**

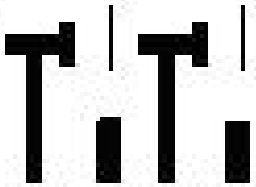



**WHO does that**



**WITH what it must be done**



# CMMI - cons

- CMMI is convenient for big projects
- it brings “paper work”
- you cannot improvise or only in a set of borders (using tailoring)
- ???? (developers usually find another ☺ )

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# What CMMI brings you?

- **project managers**
  - **defined way of managing the project**
  - **clear control and responsibility in project**
  - **set of tools for managing and reporting (templates, statistics...)**

- **developers**
  - **defined processes and channels for requirements accepting**
  - **you should estimate what you will do**
  - **coding standards**
  - **templates for designing**
  - **more strict configuration management and rules**

# What CMMI brings you? (cont.)

- **testers**
  - **defined way of release management**
  - **templates for testing plans, scripts and specifications**
  - **exact metrics (e.g. for bug severity)**

- **management**
  - **defined processes**
  - **planning the activities**
  - **defined responsibility**
  - **better control**
  - **metrics**

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*Questions?*

**Thanks for the attention.**

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