1.264 Lecture 5

System Process: CMMI, ISO

Next class: Read UML chapters 1 (skim), 2 (skim), 4, 8, 9
Make sure you have Visual Paradigm installed. We start using it Monday in class.
Homework 1 solutions posted Monday

Discussion: Case studies

- **Chemical inventory case study**
  - List the errors made
  - Outline resource estimation steps that should have been used
  - Outline process steps that should have been followed
- **RFID case study**
  - What lifecycle model would you use?
  - How would you give a time estimate?
  - List major project risks and how to mitigate them

Capability Maturity Model Integration

- **Developed at Software Engineering Institute (SEI), Carnegie-Mellon University (www.sei.cmu.edu)**
- **Method for process assessment and improvement**
- **Five level model of maturity and capability**
  - **1: Initial/Performed**
  - **2: Managed**
  - **3: Defined**
  - **4: Quantitatively Managed**
  - **5: Optimizing**
- **Predictability, effectiveness and control of software processes improve as organization moves up these levels**
- **One old reading on CMM/CMMI is on course Web site**
- **Current material is at http://www.sei.cmu.edu/cmmi/**

CMMI Motivation

- **CMMI covers three interlocking areas:**
    - **Development**
    - **Services**
    - **Acquisition**
- **CMMI Development:**
    - **20 years of unfulfilled promises about productivity and quality gains from new software technology**
        - **Databases, object oriented programming, Internet, …**
    - **Organizations realized fundamental problem is the inability to manage the software process**
    - **CMMI provides guidance on how to evolve toward a culture of software engineering and rational management**

CMMI Maturity Level 1: Initial

- **Ad hoc, occasionally chaotic**

- **Few processes defined**

- **Success depends on individual effort and heroics**

  - **This is what you're taught to do in school…**

CMMI Maturity Level 2: Managed

- **Basic project management processes established to <u>track</u> cost, schedule, functionality**
- **Discipline in place to <u>repeat</u> earlier successes on projects with similar applications**
- **Key processes focus on <u>basic</u> project management <u>controls</u>**
  - **Requirements management: initial spec, change control**
  - **Software project planning: resource estimation based on past performance**
  - **Software project tracking and oversight**
  - **Software subcontract management**
  - **Software quality assurance: code reviews, test plans, tracking**
  - **Software configuration management**
- **At level 2, you can measure what's going on, and that helps understand future projects**
  - **A project or group can assess at level 2**

CMMI Maturity Level 3: Defined

- **Software process for management and development is <u>documented, standardized and integrated</u> into an overall process for the organization**

- **<u>All</u> projects use approved, <u>tailored</u> version of standard process**

- **Key process areas focus on institutionalizing effective process**
  - **Organization process: spiral model, tracking, control**
  - **Training program: managers, analysts, developers**
  - **Integrated software management: lines of code, defects, time,…**
  - **Software product engineering: alternative designs, scopes…**
  - **Intergroup coordination: Web, database, analyst, coder, customer**
  - **Peer reviews: initiate at requirements, design, QA. Continue code reviews**

- **At level 3, you begin to have some control; you can actually predict times/costs for new projects and make some choices on how to approach them (fastest, most efficient, nominal…)**
  - **The entire organization must assess at level 3; you can't do it for an individual project or group**

CMMI Level 4: Quantitatively Managed

- Detailed measures of software process and product quality are collected, in addition to product measures
- Process and products are quantitatively understood and controlled
- Key processes focus on quantitative understanding of process
  - Quantitative process management: measure and manage time at all stages: requirements, design, code, QA
  - Software quality management: reviews at all stages, tests and traceability at all stages
- At level 4 you have real control: you can measure and manage all aspects of the project

CMMI Level 5: Optimizing

- **Continuous process improvement through quantitative feedback**

- **Piloting innovative technology and ideas**

- **Key process areas focus on continual process improvement**

  - **Defect prevention ('extreme programming', refactoring, reviews)**

  - **Technology change management (new tools, training, pilots, tests, knowledge sharing)**

  - **Process change management**

- **At level 5, you not only have control but are efficient**
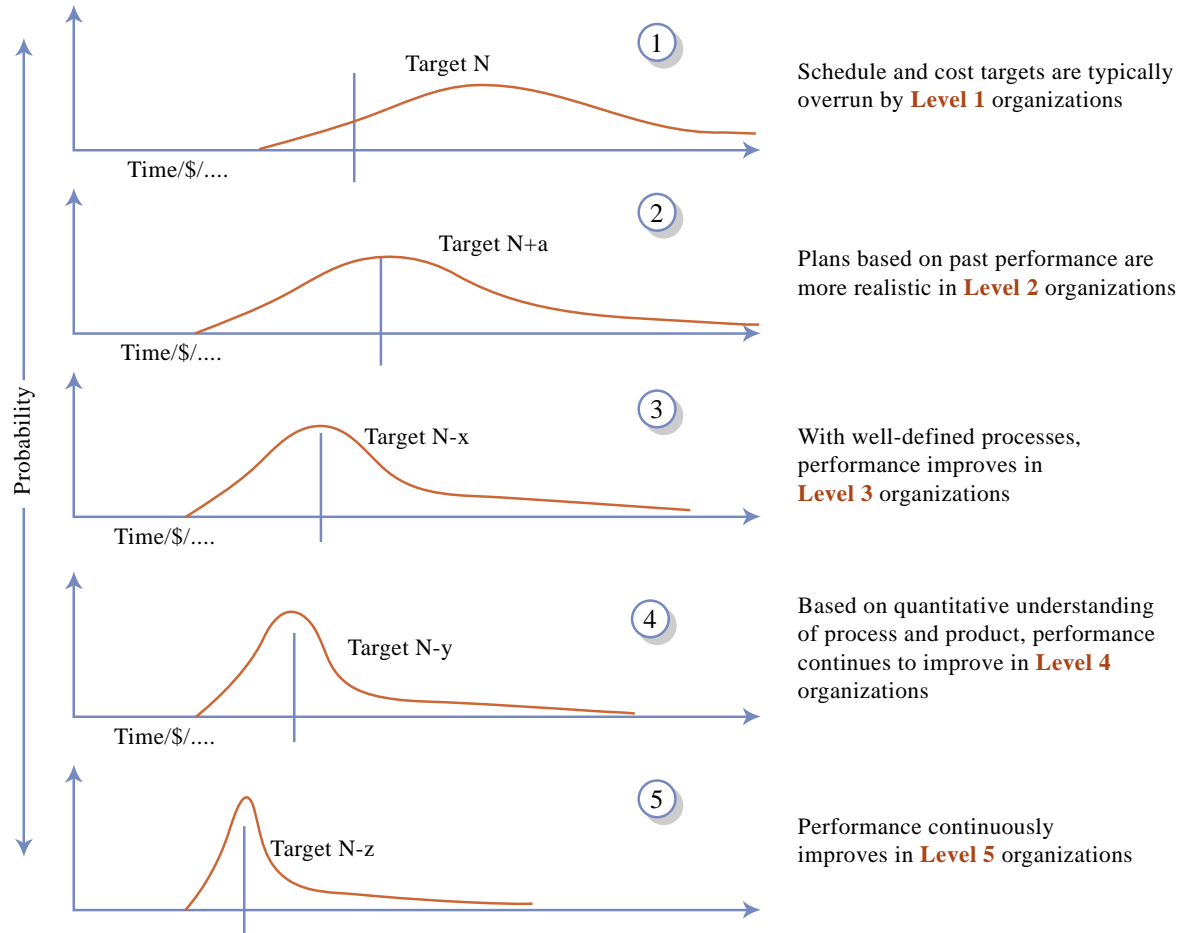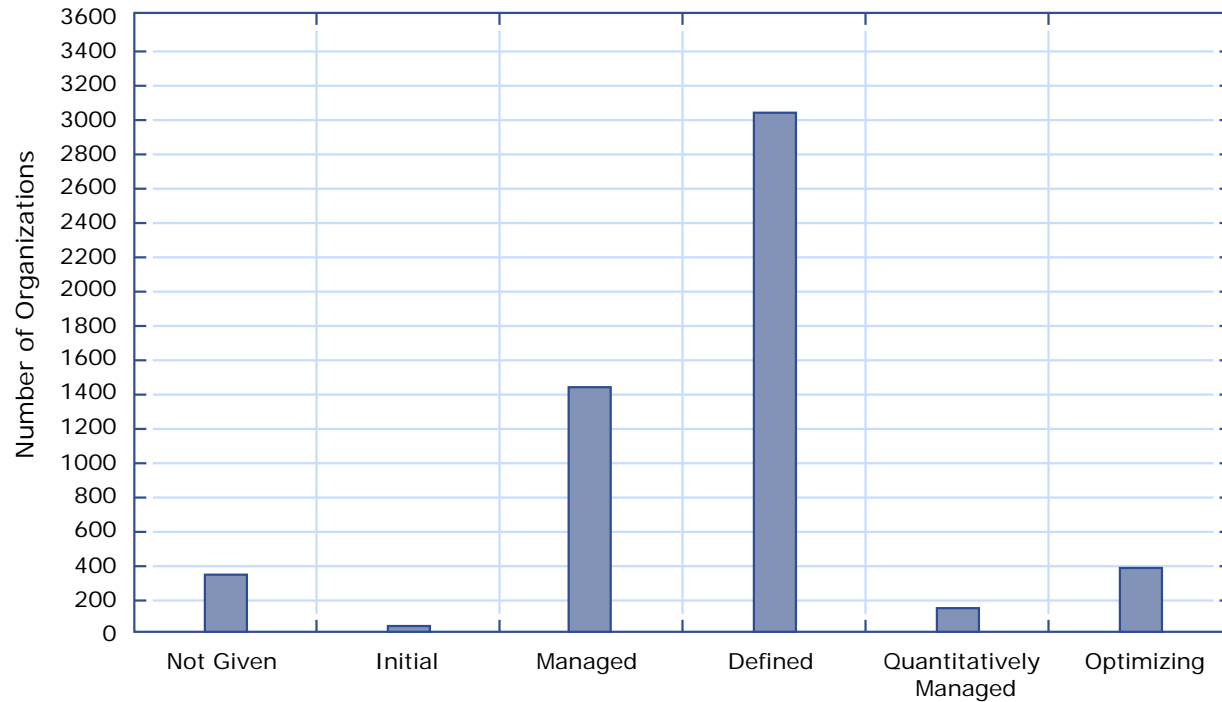
PROCESS CAPABILITY AS INDICATED BY MATURITY LEVEL

Schedule and cost targets are typically overrun by **Level 1** organizations

Plans based on past performance are more realistic in **Level 2** organizations

With well-defined processes, performance improves in **Level 3** organizations

Based on quantitative understanding of process and product, performance continues to improve in **Level 4** organizations

Performance continuously improves in **Level 5** organizations

Image by MIT OpenCourseWare.

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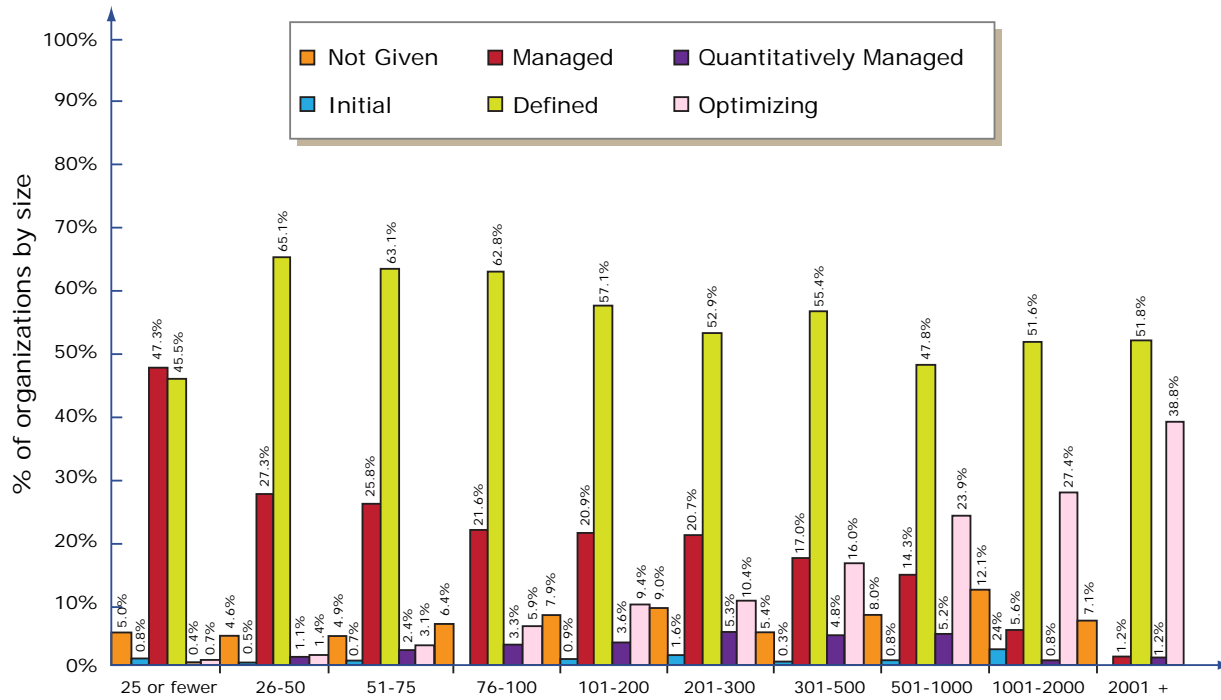
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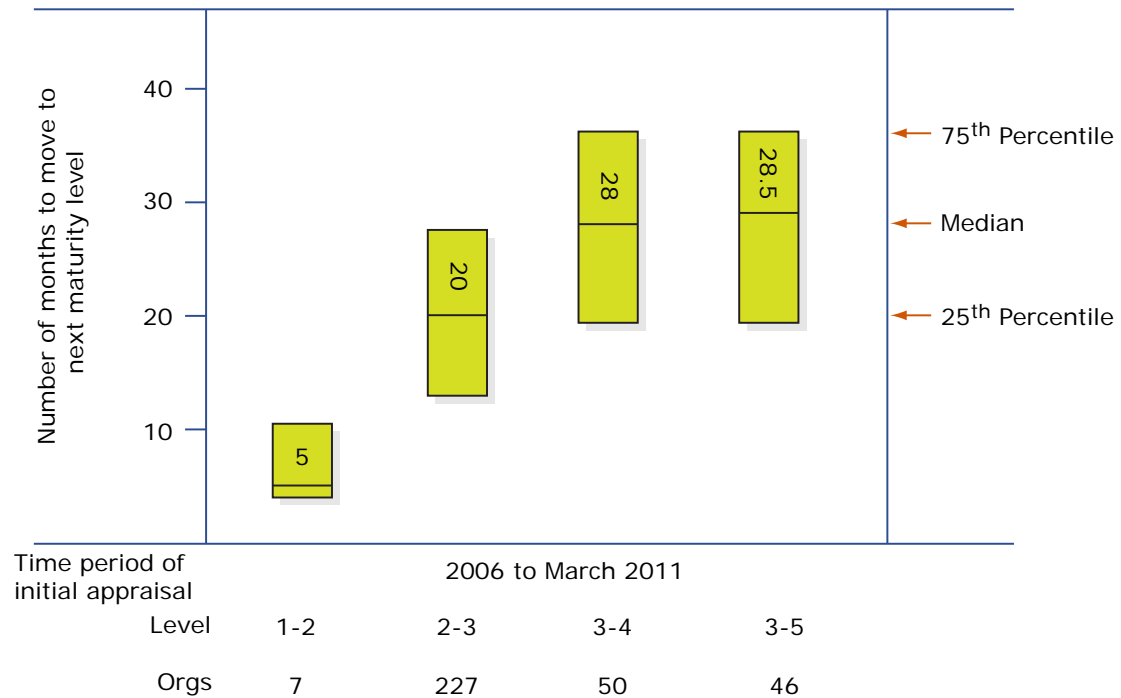
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Exercise

- **Briefly assess the pros and cons of using spreadsheets (Excel) as the major analysis method in running a business or managing a project**

Solution

- **Pros:**
  - **Spreadsheets are very quick to develop**
  - **Most staff know how to write and use them**
- **Cons:**
  - **Incorporate decision making that is not known to central organization**
  - **Hard to pass on spreadsheet to successor or other user**
  - **Spreadsheets rarely documented or tested well**
  - **Spreadsheets are rarely completely correct**
  - **No business rules, like a database**
- **Heavy use of spreadsheets indicates a low process maturity organization**

ISO 9001:2008

- **International Standards Organization (ISO)**
  - **National standards bodies from 100+ countries**
- **ISO 9001:2008**
  - **First major modification of ISO standard in 20 years occurred in 2000, and was updated in 2008**
  - **No longer primarily a manufacturing standard, with military origins, implemented as books of procedures**
  - **New standard addresses all products and services in all industry segments**
- **The new standard requires 8 principles be implemented:**
  - **Customer focus**
  - **Leadership**
  - **Involvement of people**
  - **Process approach**
  - **System approach to management**
  - **Continual improvement**
  - **Factual approach to decision-making**
  - **Mutually beneficial supplier relationships**
  - **(The old standard didn't really require anything)**

ISO 9001:2008 cont

- **ISO 9001 certification important to do business in Europe, and becoming so in Pacific Rim and eventually Americas**
- **General approach**
  - **Create a quality steering team in management**
  - **Create project plan for ISO 9001 certification**
  - **Perform gap analysis (good process vs current process)**
  - **Write needed system development, quality procedures**
    - **Often takes 6-12 months**
  - **Train employees in new procedures**
  - **Use new materials, retain records**
 - **3 certification options: self, clients or independent body**

Exercise

- **Steelmaker: current software**
  - **Steelmaking process control software: custom**
  - **Substantial raw material and outbound logistics: custom**
  - **Enterprise resource planning software: custom and SAP**
  - **Customer relationship mgt software: software-as-service**
  - **Demand forecasting: best-of-breed from small vendor**
- **Proposed project:**
  - **Integrate demand forecasting and logistics**
- **Current organization large, not integrated (silos)**
  - **Steelmaking process is ISO 9000, nothing else is ISO/CMMI**
- **What process suggestions do you make?**
  - **Which basis: CMMI or ISO?**
  - **At what CMMI level is the organization likely to be now?**
  - **List a set of initial steps to take**
  - **How long will it take to see substantive process change?**

Solution (one of many)

- **What process suggestions do you make?**
  - **Which basis: CMMI or ISO?**
    - **Could justify either**
    - **ISO 9001: involves major parts of enterprise, not heavy on system development.**
    - **CMMI: choose to focus on systems aspect**
  - **At what CMMI level is the organization likely to be now?**
    - **Level 2, since there is ISO 9001 certification**
    - **Perhaps level 1, since most parts are not certified**
  - **List a set of initial steps to take**
    - **ISO 8 principles, or CMMI level 2 steps, to ensure process**
    - **Then do requirements, design, etc. in a spiral**
  - **How long will it take to see substantive process change?**
    - **ISO often 6-12 months**
    - **CMMI time to move up from level 1 to level 2 is 5-10 months and to level 3 is 20-24 months**
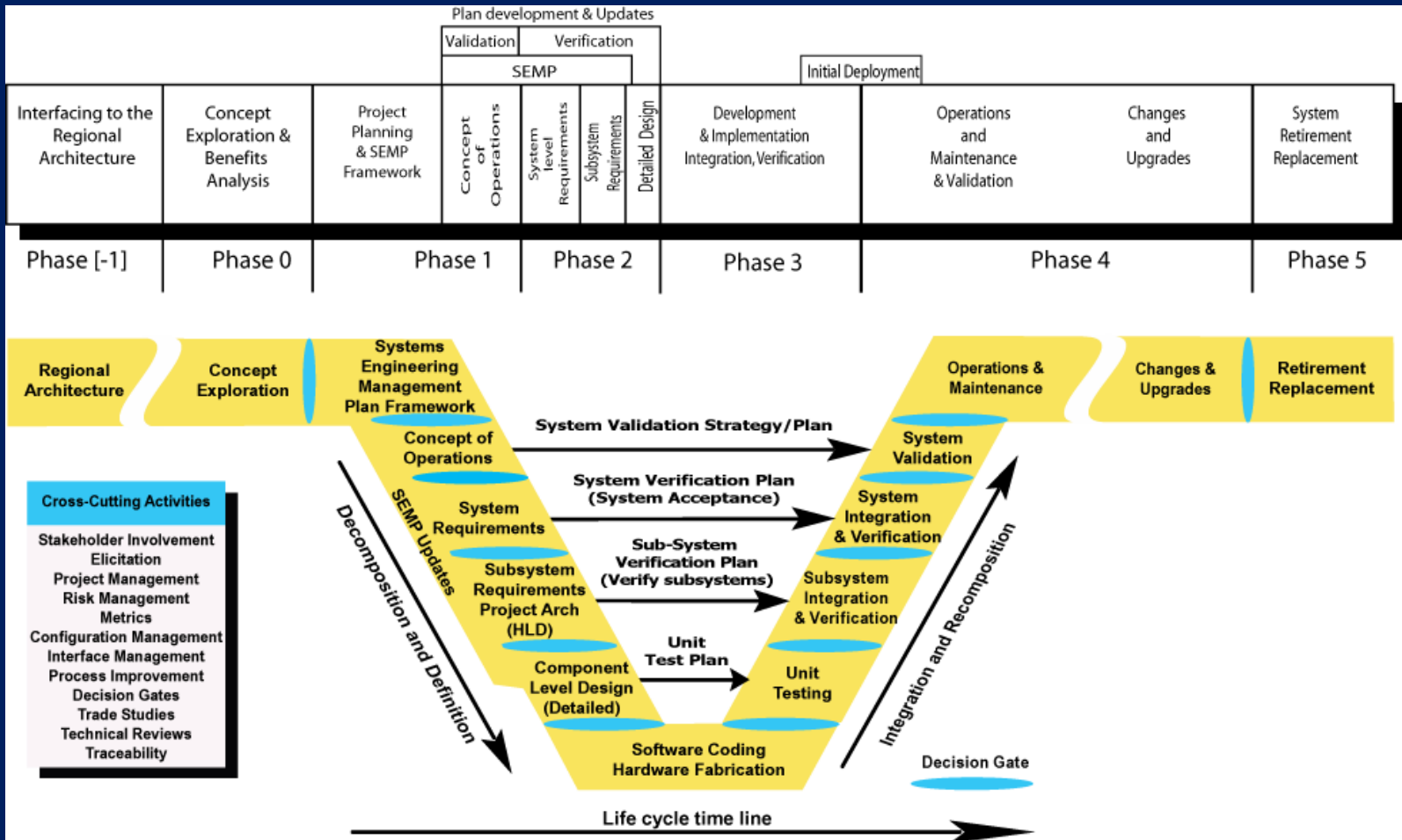
Intelligent Transportation Systems (ITS) project management process
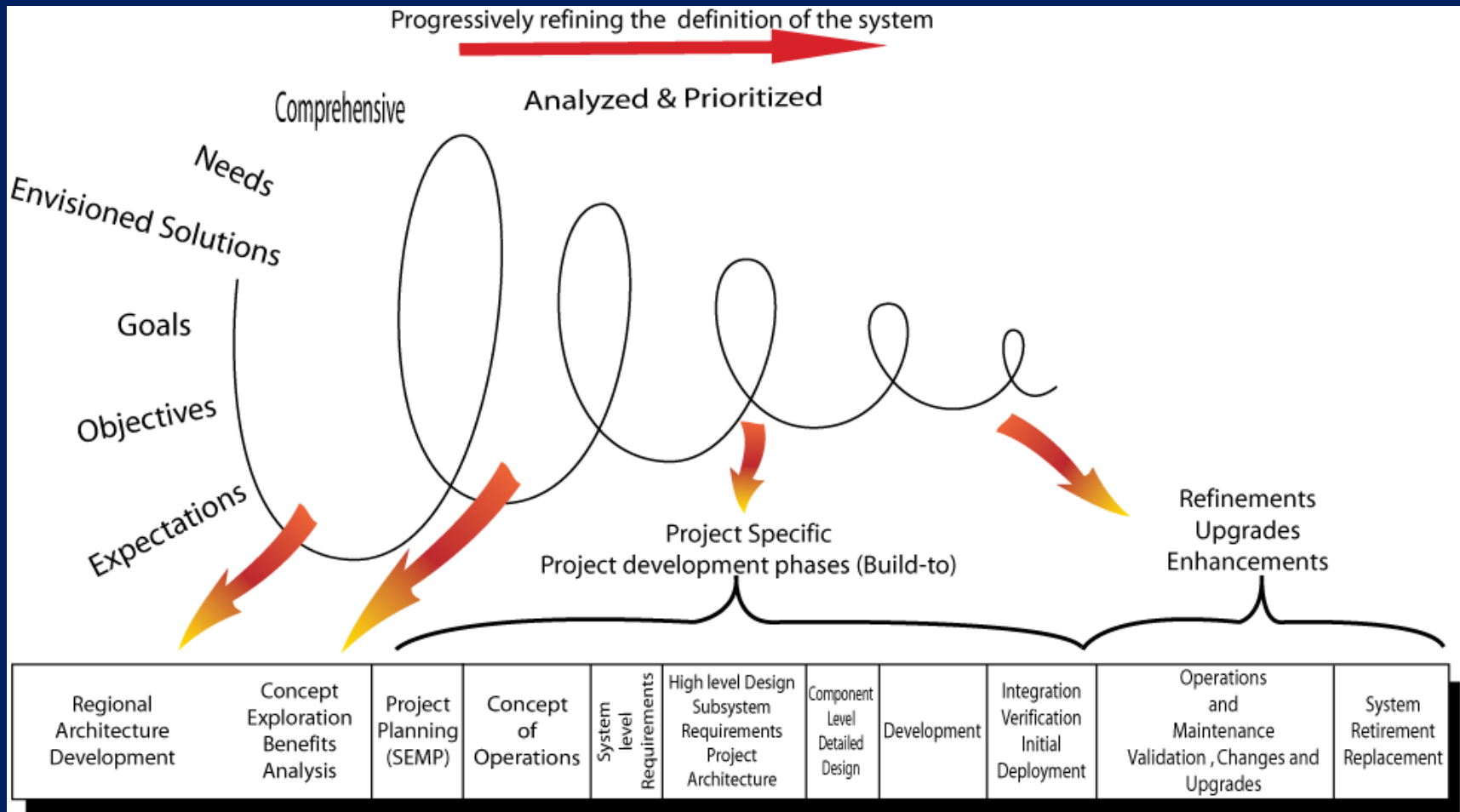
Public domain (US Federal Highway Administration and Caltrans).

Source: ITS Systems Engineering Guidebook for Intelligent Transportation Systems, version 3.0

ITS project management: Vee

Public domain (US Federal Highway Administration and Caltrans).

Comparison of CMMI and ISO

- **CMMI focus:**
  - **Software engineering practices**
  - **Program/project management practices**
  - **Increasing maturity levels**
  - **Appraisals when going to next maturity level**
- **ISO 9001:2008 focus:**
  - **Customer satisfaction**
  - **Process discipline across entire organization**
  - **Continual improvement**
  - **Principled management**
- **ITS:** http://www.fhwa.dot.gov/cadiv/segb
  - **Transportation-specific, includes construction process**

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