# Implementing the Experience Factory Concepts as a Set of Experience Bases

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**Maryland**

# Outline

- Organizational Needs with regard to Experience

- The Experience Factory Organization

- The Experience Management System (EMS)
    - Structure
    - Procedures
    - Tools
    - Content

- Building content
    - Project Presentations

- Example EMS
    - The CeBASE EMS

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## Organizational Needs

- Organizations depend on their ability to deliver services and products effectively and efficiently. This involves:
  - Planning the use of their resources (people, time, schedule) and processes
  - Managing and manipulating their resources and processes
  - Continually improving the business to compete

- This requires that they
  - Understand process and product
  - Evaluate successes and failures
  - Learn from experiences
  - Package successful experiences
  - Reuse successful experiences

**A Successful Company manages its Experience well!**

**But where is this experience and how do you manage it?**

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## Organizational Needs
### Examples of Problems related to Experience Management

- Experience Lost:
  - An employee leaves and the organization loses all of its experience in a certain area and doesn't even know what experience was lost
  - An employee learned a lot during a project, but has no time for packaging and dissemination so the knowledge cannot be leveraged. (All projects)
  - A project manager underestimates again the time it takes to develop a certain kind of product because there was no data collected from previous projects.

- Experience Rediscovered:
  - An consultant spends three weeks developing a course that already exists because he doesn't know that is was done before
  - Someone repeats a $35,0000 mistake for which there is a simple solution (JCI)

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## Organizational Needs
### Examples of Problems related to Experience Management

- Business Development:
  - A project manager underestimates again the time it takes to develop a certain kind of product because there was no data collected from previous projects.
  - A consultant gave a customer a promise, but is now busy with other work. No one else knows about his promise so it doesn't happen

- Employee Development:
  - A new employee is hired, but is for a long time considered a burden instead of a help because he needs detailed support from his coworkers.
  - An employee's application for taking a course is rejected, because with that knowledge he would be too "valuable on the market"

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## Organizational Needs

- Organizations know that they have to learn from its past experiences to deliver products faster, cheaper, and with higher quality than before

- Organizations know that to learn from experience it is vital to document and share knowledge and experience in order to
  - become less dependent on its employees
  - to unload its experts - sharing knowledge the traditional way is very time consuming
  - get new employees to become productive sooner
  - provide a basis for business process improvement
  - promote collaboration among employees and groups

### Why is it that so few organizations do this even though they know it is important?

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## Organizational Needs

- The reason why so few organizations manage their experience is that it is **hard**!
- Experience needs to be
  - Captured,
  - Structured,
  - Searchable,
  - Made available, and
  - Maintained.
- There needs to be
  - An experience management framework with concepts
  - Methodologies governing how the experience is structured
  - Processes, procedures and roles governing how the experience is managed on a daily basis
  - Supporting tools that helps with all of the above

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## The Experience Factory Approach

The Experience Factory Approach:
- defines a framework for Experience Management
- acknowledges the need for a separate support/learning organization that works with the project organization to manage experience
- has been successfully applied to software development at NASA for more than 25 years

The goal of the Fraunhofer Center for Experimental Software Engineering Maryland is to
- capitalize on the ideas of the Experience Factory
- apply them to the management of software and other experiences

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## The Experience Factory Model

Project Organization

Experience Factory

```
        ┌──────────┐                    ┌──────────┐
        │  Doing   │──Produced data──→  │ Analysis │
        └──────────┘                    └──────────┘
             ↑                               ↓
        Execution                       ┌──────────┐
          Model                         │ Synthesis│
             │                          └──────────┘
             │                               ↓
        ┌──────────┐                    ┌──────────┐
        │ Planning │                    │Experience│
        └──────────┘                    │   Base   │
             ↑                          └──────────┘
             │                               ↓
             └──Packaged experience──  ┌──────────┐
                                        │ Business │
                                        │ Support  │
                                        └──────────┘
```

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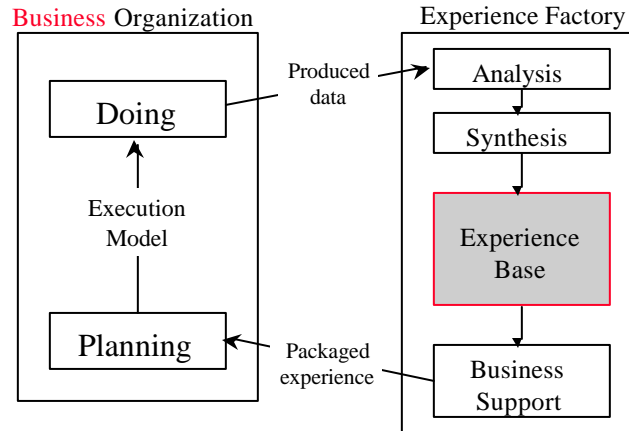Software Engineering,
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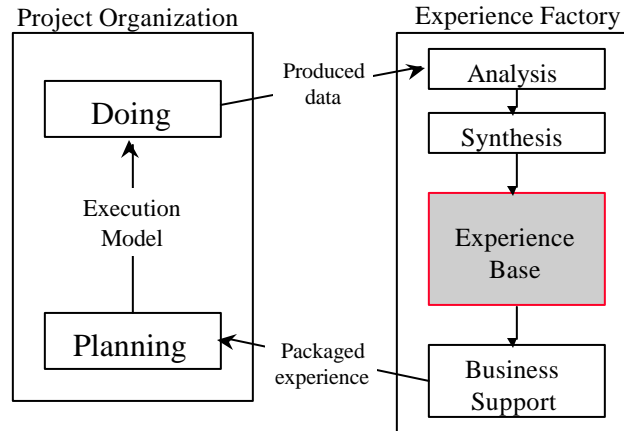
## The Experience Factory Approach

- Software development is different from regular business, but we have found it useful to apply the Experience Factory concepts to the following common problems:
    - Finding the right person, the 'expert', to solve a problem
    - Building models based on experience to improve cost estimation, etc.
    - Identifying patterns and acting on them
    - Capturing, Organizing and Disseminating Lessons Learned to learn from successes and avoid repeating mistakes
    - Reusing all kind of documented experience, e.g. proposals, budgets etc.

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## The Experience Factory Model

Business Organization

Experience Factory

```
┌──────────────────┐         Produced    ┌──────────────────┐
│                  │          data       │    Analysis      │
│   ┌──────────┐   │ ──────────────────► └──────────────────┘
│   │  Doing   │   │                            │
│   └──────────┘   │                            ▼
│        ▲         │                     ┌──────────────────┐
│        │         │                     │   Synthesis      │
│   Execution      │                     └──────────────────┘
│    Model         │                            │
│        │         │                            ▼
│   ┌──────────┐   │                     ┌──────────────────┐
│   │ Planning │   │ ◄──────────         │   Experience     │
│   └──────────┘   │   Packaged          │     Base         │
│                  │   experience        └──────────────────┘
└──────────────────┘                            │
                                                 ▼
                                         ┌──────────────────┐
                                         │    Business      │
                                         │    Support       │
                                         └──────────────────┘
```

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## Culture of an Experience Factory Organization

- In order to improve, employees need to learn from past experience
- In order for employees to learn, you need to create a learning environment
- In such a culture
    - it is allowed to make mistakes and learn from them
    - experience is not hidden or traded, but freely given to people who need it
    - experience is not collected in order to replace or evaluate people, but to help them (e.g. remember, collaborate, organize, spread and share data, information, knowledge, and experience)
    - people are evaluated based on how much they share
    - there are always feedback loops, i.e. an honest dialogue, between people, and between people and the system.
    - Everything is iterated and improved in steps:
        - It's very difficult to get something perfectly correct right away
        - It takes too long to try to get it perfect correctly
- The business organization cannot take more burden, it needs help

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## The Experience Management System (EMS)

- The heart of the Experience Factory is the Experience Base which contains the organizations experience of value or core competence.

- This experience needs to be captured, structured, searchable, made available, and maintained

- To support the Experience Factory Approach, FC-MD has started a series of Experience Management projects (EMSs) that aim at automating, to the degree possible, the development of Experience Bases.

- To this end, FC-MD
  – develops processes, tools, and taxonomies in general
  – works with organizations to tailor the concepts to their needs

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## The Experience Management System (EMS)

- A useful Experience Base must
  – Contain the relevant knowledge for an organization
  – Reside in a well conceived learning framework
  – Have methodologies governing how the experience is structured
  – Have processes, procedures and roles governing how the experience is managed on a daily basis
  – Be automated to the degree possible

- This automation is provided by the Experience Management System (EMS)
  – generalized logical structure and set of experience management procedures
  – methodology for tailoring EMS to to build an Experience Base for the the local organization, and
  – set of tools to support he implementation

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## The Experience Management System (EMS)

- Thus EMS for a particular organization, ORG, ORG-EMS is the physical instantiation of EMS tailored to the specific set of knowledge or experience of that organization

- An individual EMS (ORG-EMS) has
  - Content, i.e. data, information, knowledge, and experience
  - Structure, i.e. the different ways we organize the content
  - Procedures, i.e. instructions on how to manage the EB on a daily basis, e.g. use, package, add,delete, integrate, and update experience
  - Tailored support tools, i.e. support managing the content and the structure and carrying out the procedures, as well as helping capture, store, integrate, analyze, synthesize and retrieve experience

- The work of setting up an EMS for a specific customer is guided by a methodology

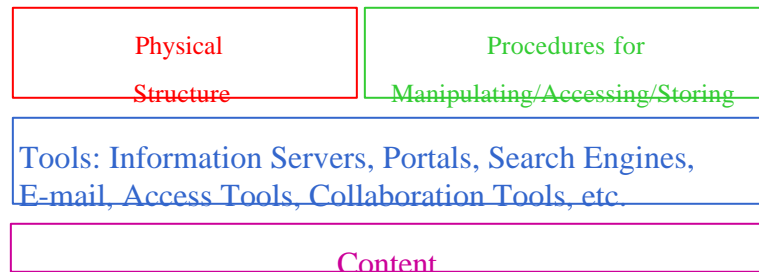**Fraunhofer USA**
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## The Experience Management System (EMS)
## Logical Architecture

| Physical Structure | Procedures for Manipulating/Accessing/Storing |
|---|---|

Tools: Information Servers, Portals, Search Engines, E-mail, Access Tools, Collaboration Tools, etc.

Content

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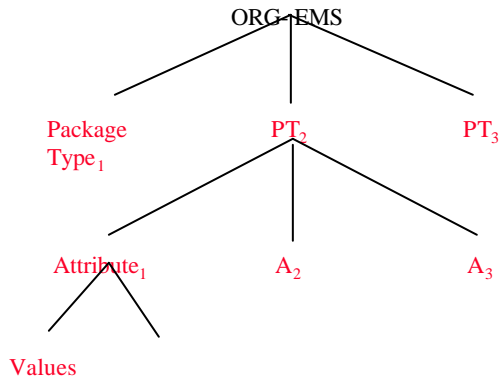Maryland

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**The Experience Management System (EMS)**
**Methodology for Developing a particular EMS**

Characterize the organization and identify the current processes and knowledge

Identify the users and define the user roles

Based on the user roles, processes and knowledge, develop ORG-EMS use cases

From the use cases define the package types (i.e., taxonomies).

For each package type, generate the attributes that to describe that package type

Define acceptable values for each attribute

Gather the above into an organization specific ORG-EMS Requirements Document organization

Build, integrate, and install the ORG-EMS

Evaluate and evolve the ORG-EMS

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**The Experience Management System (EMS)**
**Logical Physical Structure**

ORG-EMS

Package Type$_1$          PT$_2$          PT$_3$

Attribute$_1$          A$_2$          A$_3$

Values

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**The Experience Management System (EMS)**
**Logical Physical Structure**

- Example Package Types: Document, Customer, Project, Lessons Learned, Chat Information, Frequently Asked Questions (FAQ), …

- Attributes represent
    - the definition of the properties of a package, e.g., name, size
    - means of identifying specific packages in that class

- Attributes can be identified
    - top down, based upon use case terminology
    - bottom up, based upon analysis of the raw data

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**The Experience Management System (EMS)**
**Logical Procedures for Managing**

Procedures: How do you use, maintain, manage the Experience Base?
  Populating (Data entry, chat sessions, FAQ's, …
  Accessing (VQI, text search, ….
  Viewing
  Updating
  Maintaining
  Analyzing and Synthesizing
  Packaging
  …
Roles: Who does it?
  Topic Owners, Classification Manager, ...

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## The Experience Management System (EMS)
## Tools

There are a variety of tools currently in use for EMS and this set will increase and vary depending upon the tool set available at the organization
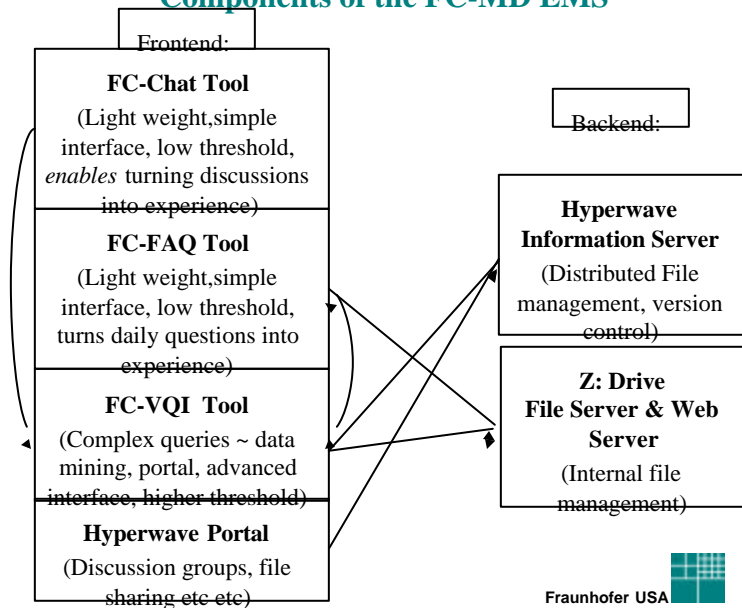
Thus any tools that support sharing experience, ideas, information, knowledge, resources, and all kinds of collaboration are potential candidates for EMS

Examples of tool types are:
– Portals, Information Servers, File Servers, E-mail, Calendars, Resource Managers, Search Engines, Collaboration support tools, Reference management tools, ...

Currently, we use Hyperwave as our information server and portal and a variety of support tools, e.g., a VQI Tool, a FAQ Tool, a Chat Tool, a Lessons Learned Tool, Reference Manager, Outlook

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## Components of the FC-MD EMS

Frontend:

**FC-Chat Tool**
(Light weight,simple interface, low threshold, *enables* turning discussions into experience)

**FC-FAQ Tool**
(Light weight,simple interface, low threshold, turns daily questions into experience)

**FC-VQI Tool**
(Complex queries ~ data mining, portal, advanced interface, higher threshold)

**Hyperwave Portal**
(Discussion groups, file sharing etc etc)

Backend:

**Hyperwave Information Server**
(Distributed File management, version control)

**Z: Drive File Server & Web Server**
(Internal file management)

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## The Experience Management System (EMS)
## Content

Types of Knowledge

- Documented (Systematized and not systematized) Knowledge
  - Exists outside of a person, written down, easy to collect
  - Example: Any (electronic) document: Word files, PowerPoint presentations, Process descriptions, Lessons Learned documents, E-mail and other e-discussions, Notes and minutes from meetings
- Undocumented Explicit Knowledge
  - Exists outside of a person, **not** written down, not so easy to collect
  - Example: Any discussion not documented: oral answers to oral questions
- Undocumented Tacit Knowledge
  - Doesn't exist outside of a person, **not** written down, **never** even expressed, knowledge that we often are not aware of, hard to collect
  - Example: Any knowledge that individual employees have, but is never discussed or mentioned, design knowledge

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## Content: How costly is it to capture and document experience?

- **Documented knowledge**                          *Easy*
  - Papers
  - Proposals
  - Presentations
  - Company polices
- **Undocumented explicit knowledge**               *Possible*
  - Project Information
  - Customer Information
  - Company polices
  - Employees' expertise
  - Procedures for meetings
  - Procedures for hiring
  - Best practices for proposals
- **Unavailable tacit knowledge**                   *Hard!*
  - Best practices for projects
  - Best practices for Customer care

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## The Experience Management System (EMS)
## 1. Documented Knowledge

- Problem 1: How do we package and organize documented knowledge so that it becomes useful and available for a larger group of people?

- Approaches to solving 1: Build experience base
  - Collect knowledge
  - Package knowledge,
  - Classify knowledge,
  - Make knowledge searchable and retrievable using search engines,
  - Create business processes and incentives to enable collection and organization of documented knowledge.
  - **Refine further and create Systematized knowledge**, i.e. common processes, computer software that uses knowledge.

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## The Experience Management System (EMS)
## 2. Undocumented Explicit Knowledge

- Problem 2: How do we capture undocumented knowledge?

- Approaches to solving problem 2: Enable electronic capture of knowledge
  - Have people take notes and document what they do
  - Integrate knowledge capture into normal processes, e.g., project presentations
  - Encourage usage of e-mail, discussion groups, chats
  - Implement intelligent FAQ:s based on strategy for organic growth.
  - Create business processes and incentives to enable capturing of undocumented knowledge

Turn problem 2 into problem 1

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## The Experience Management System (EMS)
## 3. Undocumented Tacit Knowledge

- Problem 3: How do we get people to talk about their knowledge?

- Approaches to solving problem 3: Create a sharing environment
  - Create forums for sharing knowledge; workshops, post mortems, discussion groups, coffee breaks.
  - Interview people.
  - Create business processes and incentives to enable people to share their knowledge.

> Turn problem 3 into problem 2

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## Building EMS Content
## Project Presentations at FC-MD

How could one collect and package experiences about projects without adding too much of a burden on the project manager?

A project presentation is a meeting where
- The project manager presents a project report to a group of people within the organization.
- The group works together with the project manager to identify and refine **experience packages!**
- The PowerPoint presentation *is* a prototype experience package with *links* to related files and packages!

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**Building EMS Content**
**Project Presentations at FC-MD**

- The provider --- The project manager (PM)
    - Has to keep track of the project status anyway
    - Gets active help from the group in a brainstorming session
    - Saves time in the long run, as experience is packaged and available

- The consumers, e.g. new team members, new managers, ...
    - Can quickly get information they need about projects
    - Can reuse selected parts, because they are available!

- Example: New team member can find crucial information about project without bothering project manager.

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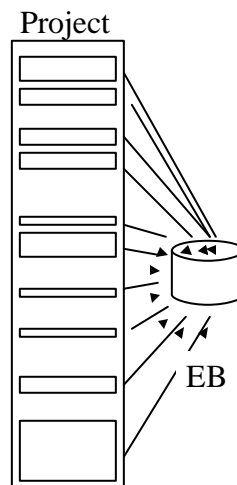Center for Experimental
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**Building EMS Content**
**Project Presentations**

Project

- Three kinds of project presentations
    - Complete version; upon completion
    - Annually
    - Short version; Quarterly
    - Very short version; At any time needed
- Support
    - The packager provides a presentation templates that makes clear what is expected for each type of presentation

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**Building EMS Content**
**Outline of Project Presentation**

- Part 1. Presentation:
  - Title, Customer, Problem to be solved, Vision
  - People (Other Customer related people, FC-MD, partners)
  - Background
  - Description, success criteria, risks
  - Budget + Schedule Status
  - Deliverables
  - Results (so far)
  - Open issues (Get active help)
- Part 2. Prepared brainstorming session:
  - What we have learned about running *projects*, gained *personal expertise*, impact on *corporate core competencies*, *opportunities,* marketable *services* as results of project.

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**The Experience Management System (EMS)**
**EMS Management/Improvement**

- The Experience Base is a living thing and has to be treated accordingly
  - maintained regularly
  - improve over time

- **Structural Management.**
  - A classification manager  is needed for updating the taxonomy, etc.
  - responsible for growing the taxonomy according to new needs
  - Needs come directly from users or based on feedback and analysis

- **Content Management.**
  - A topic area manager is needed for updating content
  - responsible for adding and organizing the content of a topic area
  - May require help from assigned topic experts

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## The Experience Management System (EMS)
## EMS Management/Improvement

- There are several tools for analyzing an Experience Base in order to improve it.
- **Structural Analysis** helps understanding the structure of the experience base.
  - What part of the structure is growing/not growing?
  - Is there an imbalance in the structure?
- **Content Analysis** helps understanding the content of the experience base.
  - Which topic areas are rich/poor as regards content?
  - In what topic area do we have many/few experts?
  - Who is our de facto expert in a certain area?
- **Usage Analysis** helps understanding how the experience base is used
  - Which topic areas are the most/least frequently used today/over time?
  - Which topic areas have the most feedback from users? What is that feedback?
  - What are the characteristics of the users compared to what topics of the experience base they user?

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## Example EMS Projects

- Q-Labs-EMS: software consultants in offices all over the world:
  - Build an experience base for sharing products, sharing customer information, experience regarding projects, products and people

- FC-MD-EMS: applied research in the area of Software Engineering:
  - Build an experience base for collecting experience about research proposals and projects, reusing experience regarding hiring, partnering, contracts, developing personal expertise, corporate competence

- JCI-EMS: design car interiors for different car manufacturers
  - Build an experience base for analyzing lessons learned, sharing lessons learned between design programs, synthesizing lessons learned and turn them into design guide lines, best practices, and design processes

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## Example EMS Projects

- SWIC-EMS: consortium of software organizations in Maryland focusing on software process improvement
  - Build an experience base for sharing collecting, analyzing, organizing SPI experience, sharing experience between organizations, synthesizing experience and packaging them for feedback to organizations

- CeBASE-EMS: empirical Software Engineering research, done by researchers all over the world, need to share data and insights, and build empirical models related to defect reduction techniques and COTS based development
  - Build an experience base for sharing data, lessons learned, and empirical models, for defect reduction techniques and COTS based development

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## CeBASE EMS
## Tools

In the CeBASE EMS implementation the content is stored in Hyperwave Information Server and also on our filesystem (Z drive)

- Hyperwave
  - Used both as an access mechanism (e.g. text search) and storing
- Chat tool
  - Used in e-Workshops, participants comments are captured and analyzed
- FAQ tool
  - Users submit questions that are answered by experts. The questions and answers are automatically captured and added to the EB.
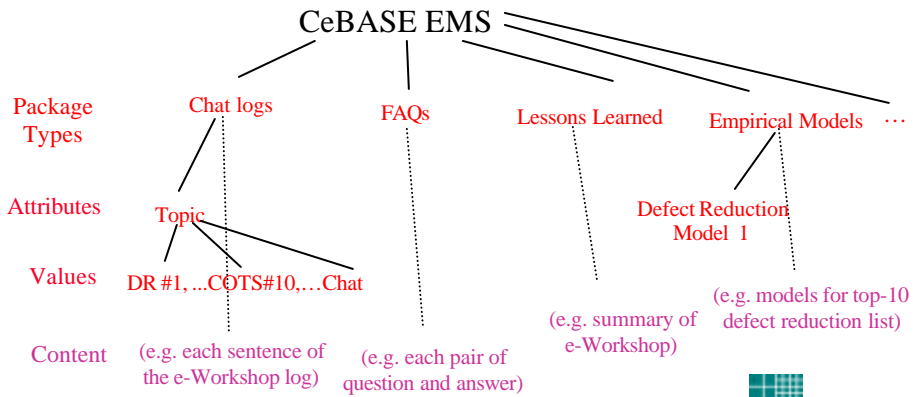- VQI
  - Used both to visualize and analyze information

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**CeBASE EMS**
**Logical/Physical Structure**

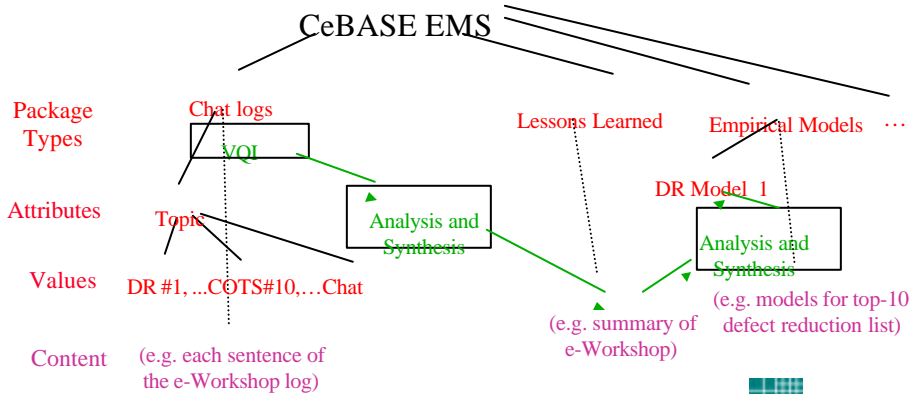CeBASE EMS

Package
Types          Chat logs          FAQs          Lessons Learned          Empirical Models          ...

Attributes          Topic          Defect Reduction
                                                         Model 1

Values          DR #1, ...COTS#10,…Chat

Content          (e.g. each sentence of          (e.g. each pair of          (e.g. summary of          (e.g. models for top-10
                    the e-Workshop log)          question and answer)          e-Workshop)          defect reduction list)

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**CeBASE EMS**
**Procedures for Managing**

CeBASE EMS

Package
Types          Chat logs          Lessons Learned          Empirical Models          ...

                    VQI

Attributes          Topic          Analysis and          DR Model 1
                                         Synthesis          Analysis and
                                                                   Synthesis

Values          DR #1, ...COTS#10,…Chat

Content          (e.g. each sentence of          (e.g. summary of          (e.g. models for top-10
                    the e-Workshop log)          e-Workshop)          defect reduction list)

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**The Experience Management System (EMS)**
**Learning from our Experiences**
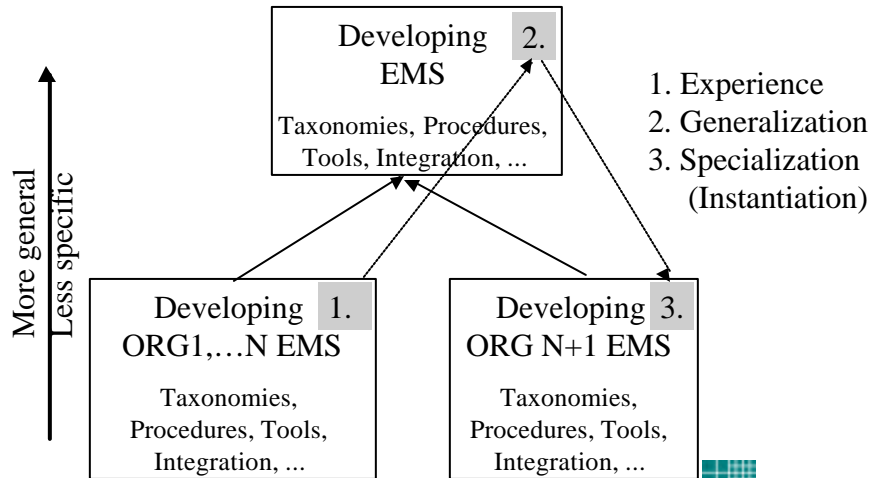
Developing EMS  2.

Taxonomies, Procedures, Tools, Integration, ...

1. Experience
2. Generalization
3. Specialization
   (Instantiation)

More general / Less specific

Developing  1.
ORG1,…N EMS

Taxonomies, Procedures, Tools, Integration, ...

Developing  3.
ORG N+1 EMS

Taxonomies, Procedures, Tools, Integration, ...

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**Next Steps**

- CeBASE-EMS
  - An experience base for educators, practitioners, and researchers
  - will evolve using results from
    - a series of e-Workshops (next e-Workshop July 16, 2001)
    - FAQ analysis
    - integration of lessons learned
    - building of empirical models

- EMS
  - Continuous development and application to new areas
  - Will be applied to the construction industry
  - Proposed to be applied at NASA GSFC to cover gained CMMI experience

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