



# **Towards a Maturity Model for a Reuse Incremental Adoption**

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# Introduction

- The practice of software development has become **increasingly worried** by **high cost, poor productivity**, and **poor or inconsistent quality**
  - [Biggerstaff, 1987], [Frakes, 1994], [Lim, 1994], [Rine, 2000], [Poulin, 2006]
- [reasons] rebuild the same or similar systems **over and over again**

*“Software reuse, the use of existing software artifacts or knowledge to create new software, is a key method for significantly improving software quality and productivity” [Frakes, 1994]*



# Introduction

- Reusability is a **big challenge** on software development
- The main inhibiting factors have been
  - the absence of a clear reusability strategy
  - the lack of specific top-management support
- A reuse adoption model helps an organization to understand **how** reuse will **change the way** it does **business**, and how it **should plan** for that change [Wartik and Davis, 1999]

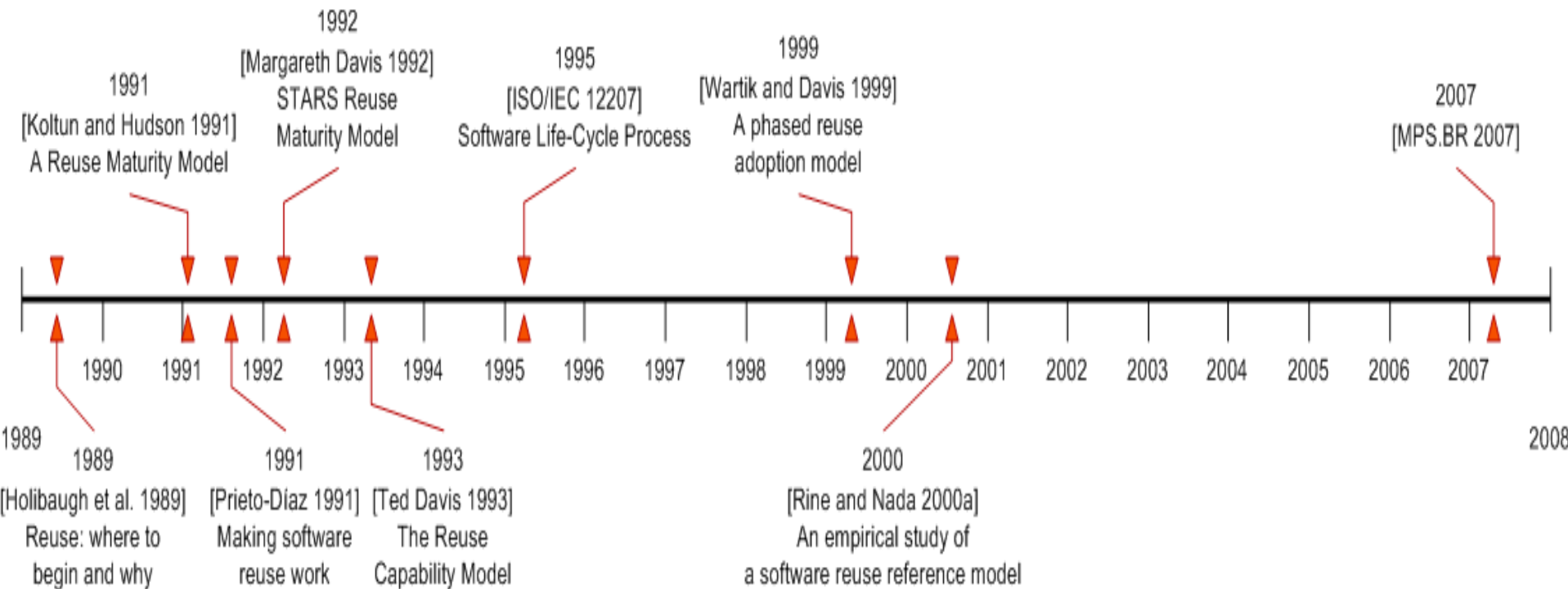


## Our research

- [3 years of experience]
  - failure to develop **necessary details** to support valid software reuse models
  
- Investigated the **success factors** for software reuse
  - The way they **impact** in a software reuse program
  - [How] **construct a framework**
  
- Based on **empirical data** collected in a survey
  - Investigated the **reuse situation** in several organizations in Brazil



# Reuse Adoption Models: A Brief Survey





## Discussion

- Development **for** (DE) and **with** (AE) reuse are needed
- **Early stages** of the software life cycle
- Maturity models and adoption processes
  - natural **part** of development
- The organizations are still **unsure**
  - widely **accepted** model
  - fail in **transferring** the reuse technology to the entire organization {**incremental** and **systematic**}
  - **Gradual evolution** [Rine and Nada 2000b]



# Model Structure

- Serve as a **roadmap**
- Current models typically address organizational processes
  - insight in the way of performing tasks
- Intend to be flexible, modular and adaptable
  - [**modularity**]
    - less coupling and maximum cohesion
  - [**responsibility**]
    - establish one or more (team) responsible for each process





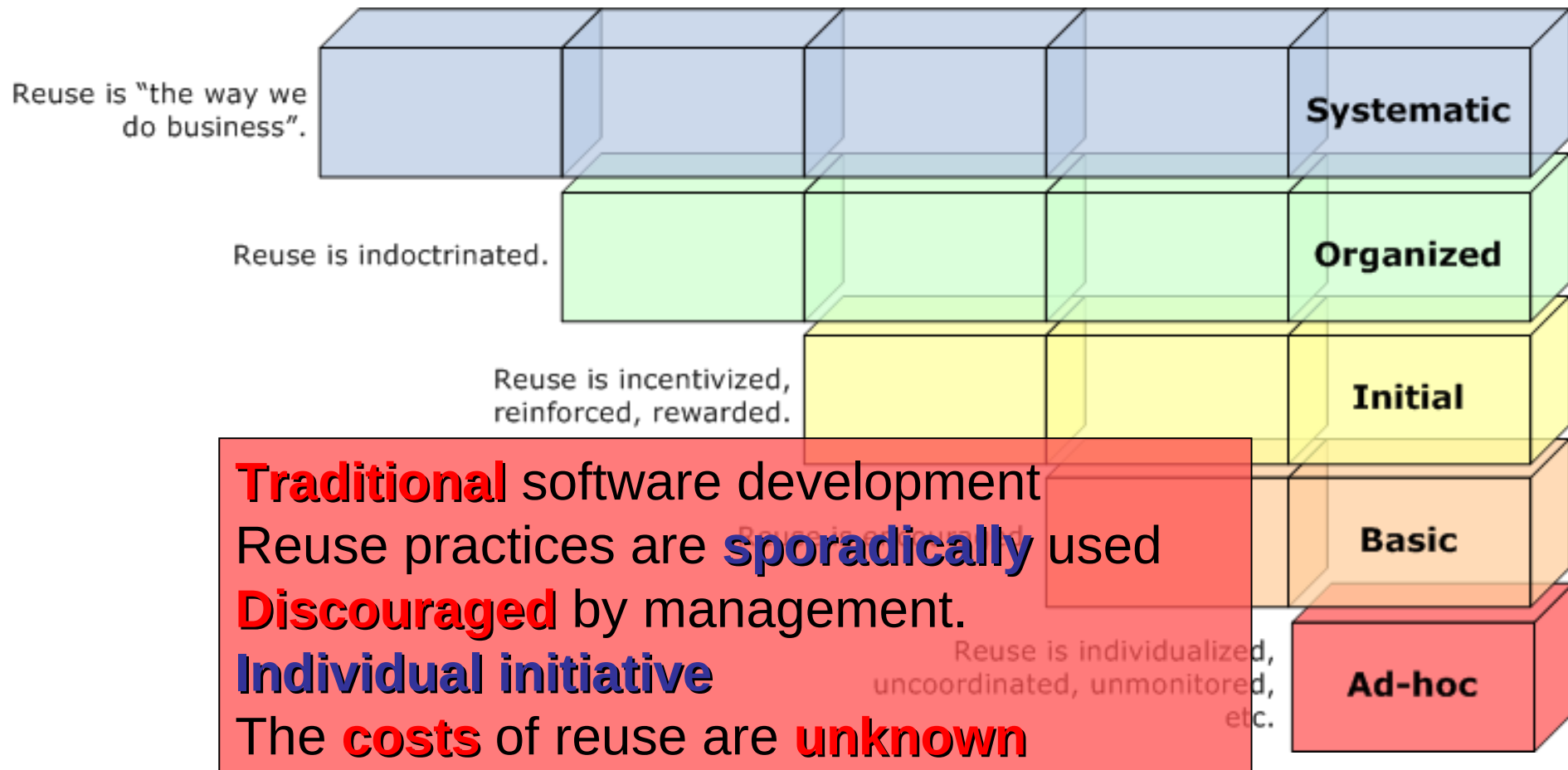
## Model Structure - includes

- Reuse practices grouped by **perspectives** (Organizational, Business, Technological and Processes)
  - Levels
  - Goals are defined for each maturity level
    - guide the assessment of the MM implementation
- Reuse **elements** describing fundamental parts of reuse technology
  - assets, documentation, tools and environments



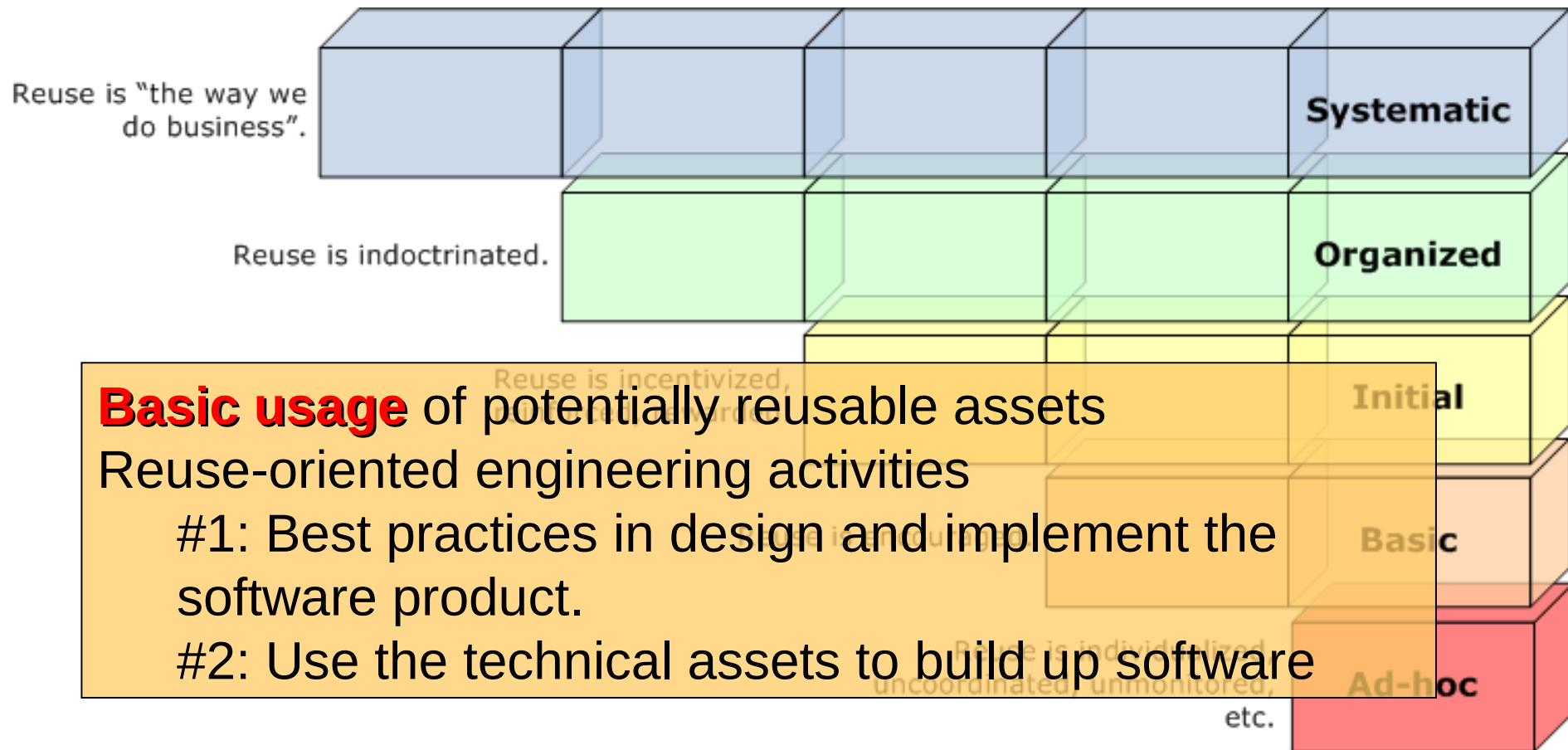


# RiSE Maturity Levels



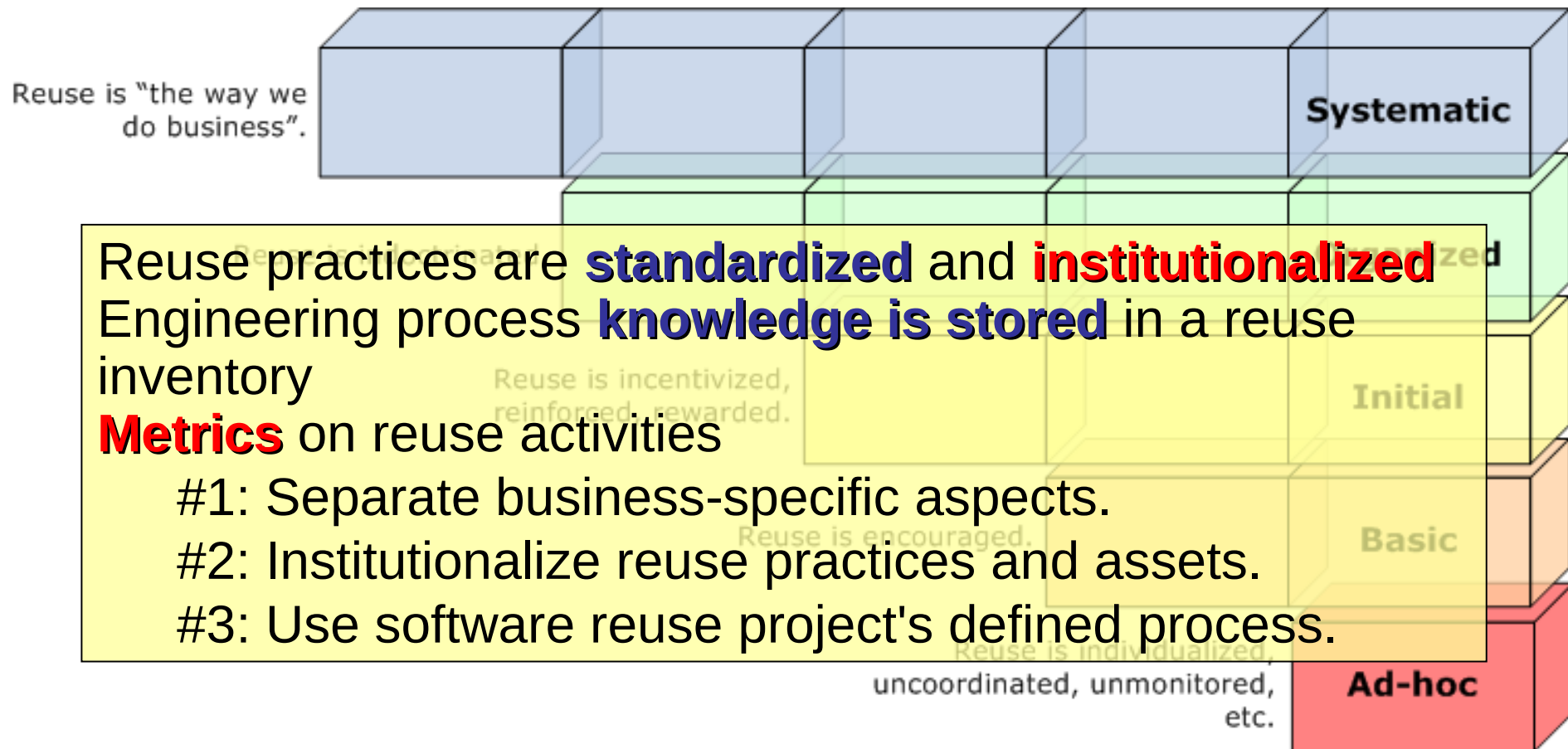


# RiSE Maturity Levels



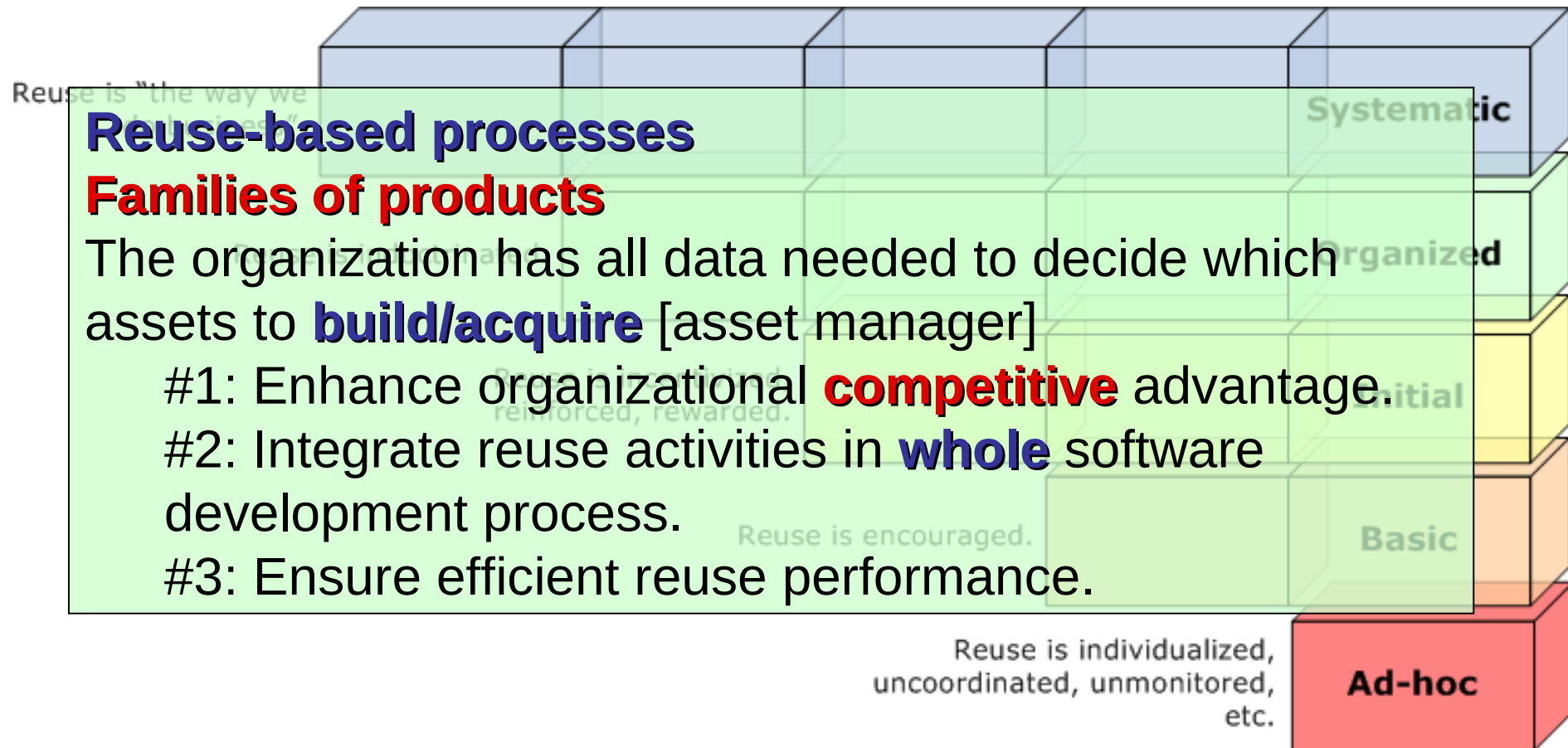


# RiSE Maturity Levels





# RiSE Maturity Levels





# RiSE Maturity Levels

## Domain engineering practices

All software products generalized for **future reuse**.  
 Domain analyses performed **across all product lines**.  
 Planned activity to acquire or develop missing pieces in catalog.

#1: Reuse is *"the way we do business"*.

#2: Establish and maintain complete reuse-centric development.

Reuse is encouraged.

Reuse is individualized,  
 uncoordinated, unmonitored,  
 etc.

Systematic

Organized

Initial

Basic

Ad-hoc

# Perspectives and factors

## Organizational perspective

1. Planning for reuse
2. Software reuse education
3. Legal, Contractual, Accounting considerations
4. Funding, Costs and Financial Features
5. Rewards and incentives
6. Independent reusable assets development team

## Business perspective

1. Product family approach
2. Development Process

## Technological perspective

1. Repository systems usage
2. Technology support

## Processes perspective

- |  |                                |
|--|--------------------------------|
| 1. Quality models usage                    | 4. Origin of the reused assets |
| 2. Software reuse measurement              | 5. Systematic reuse process    |
| 3. Previous development of reusable assets |                                |

- Management decisions necessary to setup and manage a reuse project
- Business domain and market decisions for the organization
- Development activities and infrastructure
- Implementation of the engineering and the project management practices





## Concluding remarks and Future Works

- Characterizing reuse with maturity models and adoption processes is a clear sign of progress toward making reuse a **natural part of development**.
- There isn't a model widely **accepted**.
- The organizations are still **afraid** adopting a reuse program.
  - Cultural
  - Risks





## Concluding remarks and Future Works

- **Reference model** in a Reuse Adoption Program
- **Evaluated** based on **quantitative data**
  - Reuse **Business** and **Engineering** metrics {GQM}
  - **measure** the achievement of the respective objectives
  - the **efficiency** of the applied practices
  - the **quality** of the results obtained
- Definition of **guidelines** to
  - **Adoption** software reuse practices
  - **Evaluate** the **current** reuse practice stage
  - Planned the **next activities**

# Thank you ! Questions ?



- More information available at
  - <http://www.rise.com.br> :: <http://www.cin.ufpe.br/~vcg>
  - [vinicius.garcia@cesar.org.br](mailto:vinicius.garcia@cesar.org.br) :: [vcg@cin.ufpe.br](mailto:vcg@cin.ufpe.br)





# Organizational factors

Factors of influence	Levels				
	1. Ad-hoc	2. Basic	3. Initial	4. Organized	5. Systematic
<i>Planning for reuse</i>	<ul style="list-style-type: none"> <li>Nonexistent.</li> </ul>	<ul style="list-style-type: none"> <li>Grassroots activity.</li> <li>Reuse is viewed as single-point opportunities.</li> <li>Individual achievements are rewarded.</li> </ul>	<ul style="list-style-type: none"> <li>Targets of opportunity</li> <li>Organization responsible for reuse.</li> <li>A key business strategy.</li> </ul>	<ul style="list-style-type: none"> <li>Business imperative.</li> <li>Reuse occurs across all functional areas.</li> </ul>	<ul style="list-style-type: none"> <li>Part of a strategic plan.</li> <li>Discriminator in business success.</li> </ul>
<i>Software reuse education</i>	<ul style="list-style-type: none"> <li>Lack of expertise by the staff members (engineers and managers).</li> <li>Frequent resistance to reuse.</li> </ul>	<ul style="list-style-type: none"> <li>Basic definitions of reuse are agreed upon.</li> </ul>	<ul style="list-style-type: none"> <li>The staff has the expertise and how to obtain benefits with reuse.</li> </ul>	<ul style="list-style-type: none"> <li>The staff members know the reuse vocabulary and have reuse expertise.</li> </ul>	<ul style="list-style-type: none"> <li>All definitions, guidelines, standards are in place, enterprise-wide.</li> </ul>
<i>Legal, Contractual, Accounting considerations</i>	<ul style="list-style-type: none"> <li>Inhibitor to getting started.</li> </ul>	<ul style="list-style-type: none"> <li>Internal accounting scheme for sharing costs, allocating benefits.</li> </ul>	<ul style="list-style-type: none"> <li>Data rights and compensation issues resolved with customer.</li> </ul>	<ul style="list-style-type: none"> <li>Royalty scheme for all suppliers and customers.</li> </ul>	<ul style="list-style-type: none"> <li>Software treated as key capital asset.</li> </ul>
<i>Funding, Costs and Financial Features.</i>	<ul style="list-style-type: none"> <li>Costs of reuse are unknown.</li> </ul>	<ul style="list-style-type: none"> <li>Costs of reuse are "feared".</li> </ul>	<ul style="list-style-type: none"> <li>Payoff of reuse is "known" and understood for a given domain.</li> <li>Investments made in reuse, payoffs expected.</li> <li>Costs of reuse are "known".</li> </ul>	<ul style="list-style-type: none"> <li>All costs associated with an asset's development and all savings from its reuse are reported and shared.</li> </ul>	<ul style="list-style-type: none"> <li>All costs associated to a product line or a particular asset and all savings from its reuse are reported and shared.</li> </ul>
<i>Rewards and incentives</i>	<ul style="list-style-type: none"> <li>Reuse is discouraged by management.</li> </ul>	<ul style="list-style-type: none"> <li>Reuse is encouraged.</li> </ul>	<ul style="list-style-type: none"> <li>Reuse is motivated, reinforced, rewarded.</li> </ul>	<ul style="list-style-type: none"> <li>Reuse is indoctrinated.</li> </ul>	<ul style="list-style-type: none"> <li>Reuse is "the way we do business".</li> </ul>
<i>Independent reusable assets development team.</i>	<ul style="list-style-type: none"> <li>Individual initiative (personal goal; as time allows).</li> </ul>	<ul style="list-style-type: none"> <li>Shared initiative.</li> </ul>	<ul style="list-style-type: none"> <li>Dedicated individual.</li> </ul>	<ul style="list-style-type: none"> <li>Dedicated group.</li> </ul>	<ul style="list-style-type: none"> <li>Corporate group (for visibility not control) with division liaisons.</li> </ul>





# Business factors

Factors of influence	Levels				
	1. Ad-hoc	2. Basic	3. Initial	4. Organized	5. Systematic
<b>Product family approach</b>	<ul style="list-style-type: none"> <li>Isolated products.</li> <li>No family product approach.</li> </ul>	<ul style="list-style-type: none"> <li>Common features and requirements across the products.</li> <li>Commonalities and reuse possibilities were identified.</li> </ul>	<ul style="list-style-type: none"> <li>Product line domain analyses performed.</li> </ul>	<ul style="list-style-type: none"> <li>Focus on developing families of products.</li> <li>Domain Engineering performed.</li> </ul>	<ul style="list-style-type: none"> <li>Domain analyses performed across all product lines.</li> <li>Product family approach.</li> </ul>
<b>Software reuse education</b>	<ul style="list-style-type: none"> <li>Chaotic development process; unclear where reuse comes in.</li> </ul>	<ul style="list-style-type: none"> <li>Reuse questions raised at design reviews (after the fact).</li> <li>Development process defined (some reuse activity indications).</li> </ul>	<ul style="list-style-type: none"> <li>Design emphasis placed on reuse of off-the-shelf parts.</li> <li>Product line domain analyses performed.</li> <li>Shared understanding of all the activities needed to support reuse.</li> </ul>	<ul style="list-style-type: none"> <li>Focus on developing families of products.</li> <li>Reuse-based processes are in place to support and encourage reuse.</li> <li>Domain Engineering performed.</li> </ul>	<ul style="list-style-type: none"> <li>All software products generalized for future reuse.</li> <li>Domain analyses performed across all product lines.</li> <li>Product family approach.</li> </ul>



# Technological factors

Factors of influence	Levels				
	1. Ad-hoc	2. Basic	3. Initial	4. Organized	5. Systematic
<i>Repository systems usage</i>	<ul style="list-style-type: none"> <li>Salvage yard (No apparent structure to collection).</li> </ul>	<ul style="list-style-type: none"> <li>Catalog identifies language- and platform-specific parts.</li> <li>Simple structures like Concurrent Versions Systems.</li> <li>Considered mainly source code.</li> </ul>	<ul style="list-style-type: none"> <li>Catalog includes generic data processing functions.</li> <li>Considered software components, reports and document models.</li> </ul>	<ul style="list-style-type: none"> <li>Catalog organized along application-specific lines.</li> <li>Have all data needed to decide which assets to build/acquire.</li> <li>Considered screen generators, database elements and test cases.</li> </ul>	<ul style="list-style-type: none"> <li>Planned activity to acquire or develop missing pieces in catalog.</li> <li>Considered all artifacts of software development life cycle.</li> </ul>
<i>Technology support</i>	<ul style="list-style-type: none"> <li>Personal tools, if any.</li> </ul>	<ul style="list-style-type: none"> <li>A collection of tools, e.g. CM, but not specialized to reuse.</li> <li>General-purpose analyzers combined to assess reuse levels.</li> </ul>	<ul style="list-style-type: none"> <li>Classification aids &amp; synthesis aids.</li> <li>Standardization on components and architecture.</li> <li>Tools customized to support reuse.</li> </ul>	<ul style="list-style-type: none"> <li>Digital library separate from development environment.</li> </ul>	<ul style="list-style-type: none"> <li>Automated support integrated with development system.</li> <li>Fully integrated with development and reporting systems.</li> </ul>



# Processes factors

Factors of influence	Levels				
	1. Ad-hoc	2. Basic	3. Initial	4. Organized	5. Systematic
<b>Quality models usage</b>	<ul style="list-style-type: none"> <li>No quality model adoption.</li> </ul>	<ul style="list-style-type: none"> <li>Some quality activities were incorporated in the software development process.</li> </ul>	<ul style="list-style-type: none"> <li>Software development process guided by a quality model.</li> </ul>	<ul style="list-style-type: none"> <li>High quality model usage in the engineering department.</li> </ul>	<ul style="list-style-type: none"> <li>Quality model completely adopted in the organization activities.</li> </ul>
<b>Software reuse measurement</b>	<ul style="list-style-type: none"> <li>No metrics on level of reuse, payoff, or cost of reuse.</li> </ul>	<ul style="list-style-type: none"> <li>Number of lines of reused code factored into cost models.</li> </ul>	<ul style="list-style-type: none"> <li>Manual tracking of reuse occurrences of catalog parts.</li> </ul>	<ul style="list-style-type: none"> <li>Analyses performed to identify expected payoffs from developing reusable parts.</li> </ul>	<ul style="list-style-type: none"> <li>All system utilities, software tools, and accounting mechanisms instrumented to track reuse.</li> </ul>
<b>Systematic reuse process</b>	<ul style="list-style-type: none"> <li>No reuse-based process.</li> </ul>	<ul style="list-style-type: none"> <li>Some reuse activities were adopted in the development process.</li> <li>Planning to adapt the software development process of the organization for a reuse-based process.</li> </ul>	<ul style="list-style-type: none"> <li>Development process of the organization is adapted to reuse concepts.</li> </ul>	<ul style="list-style-type: none"> <li>Reuse benefits and concepts are clear for the engineering team.</li> <li>Development process is reuse-based.</li> </ul>	<ul style="list-style-type: none"> <li>Systematic reuse process is enterprise-wide.</li> </ul>
<b>Origin of the reused assets</b>	<ul style="list-style-type: none"> <li>No reuse assets.</li> </ul>	<ul style="list-style-type: none"> <li>Build from scratch, some times indirectly.</li> </ul>	<ul style="list-style-type: none"> <li>Build from existent products; adapting existing products.</li> </ul>	<ul style="list-style-type: none"> <li>Build from existing products; extracted through a reengineering process.</li> </ul>	<ul style="list-style-type: none"> <li>Planning the design and building of reusable assets according to product family.</li> </ul>
<b>Previous development of reusable assets</b>	<ul style="list-style-type: none"> <li>No development of reusable assets.</li> </ul>	<ul style="list-style-type: none"> <li>Parallel with development.</li> </ul>	<ul style="list-style-type: none"> <li>Before development.</li> </ul>	<ul style="list-style-type: none"> <li>Before development.</li> </ul>	<ul style="list-style-type: none"> <li>Before development.</li> </ul>