Enterprise Information Systems

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- **Impact of Computing**

- **Deciphering the alphabet soup**

- **Role of Information Systems**

- **Case Study – Product Data Management**

- **Challenges in Enterprise Integration**

Complex Processing Circa 1949

Dryden Flight Research Center E49-0053 Photographed 10/49
Early "computers" at work. NASA photo

http://www.dfrc.nasa.gov/Gallery/Photo/People/HTML/E49-0053.html

Interesting Quotes

"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us."
Western Union internal memo, 1876.

"Computers in the future may weigh no more than 1.5 tons." - Popular Mechanics, forecasting the relentless march of science, 1949

"I think there is a world market for maybe five computers." - Thomas Watson, chairman of IBM, 1943

"I have travelled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year." - The editor in charge of business books for Prentice Hall, 1957

"But what ... is it good for?"
Engineer at the Advanced Computing Systems Division of IBM, 1968, commenting on the microchip.

"There is no reason anyone would want a computer in their home."
Ken Olson, president, chairman and founder of Digital Equipment Corp., 1977

From Data to Wisdom

- **Data: raw material, unformatted information**

- **Information: processed data → meaningful**

- **Knowledge: understanding relationships between pieces of information**

- **Wisdom: knowledge accumulated and applied**

Deciphering the Alphabet Soup

- **IT - structurally and operationally enable and facilitate information systems**

- **ITC - structurally and operationally enable and facilitate information systems AND communication**

- **IS - An organized combination of people, physical devices, information processing instructions, communications channels, and stored data that gathers, stores, uses and disseminates information in an organization**

Components of an Information System

Process

Data ←→ People

Information System

Technology

Hardware — Software — Telecom
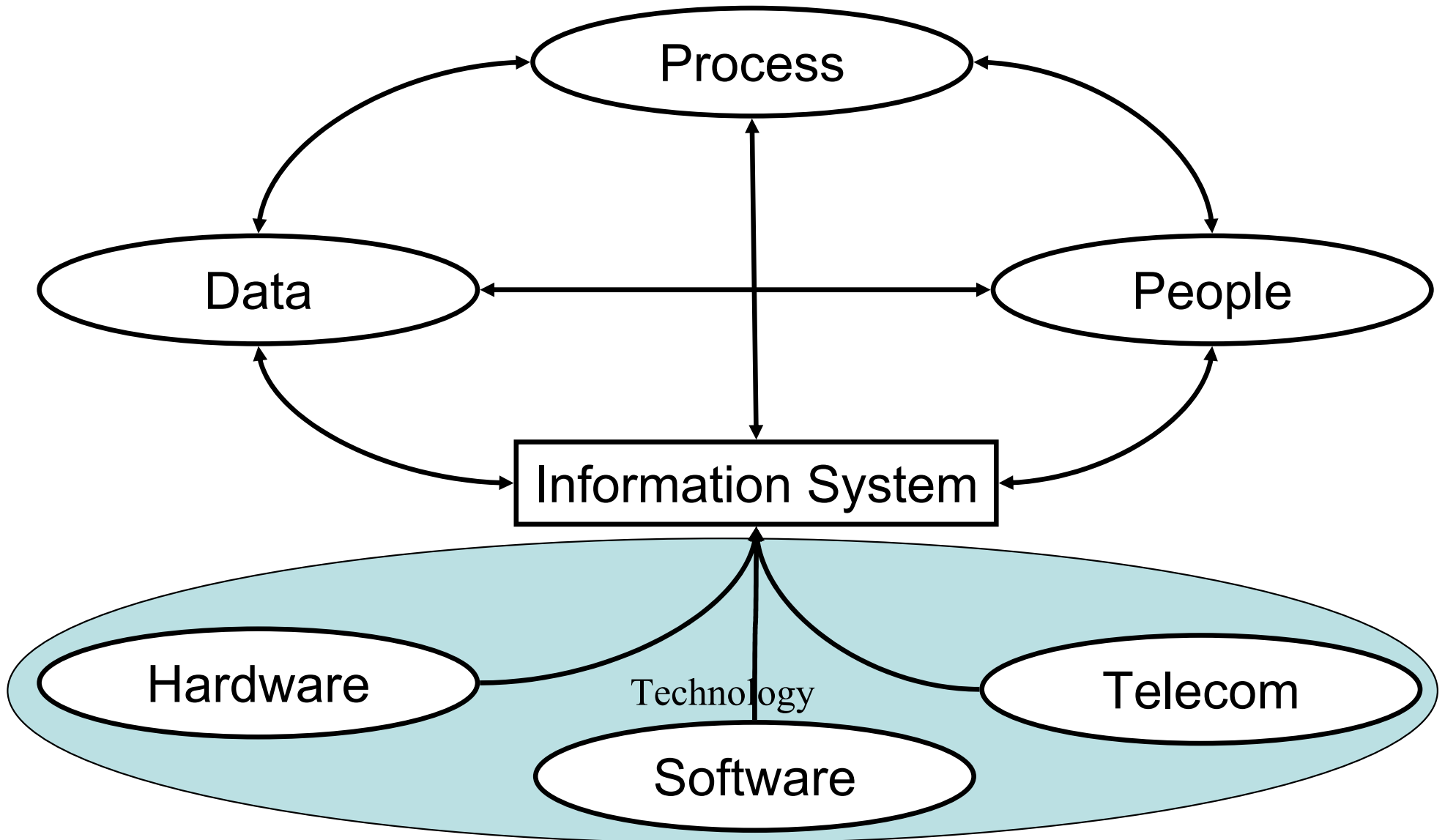
Information System Usage
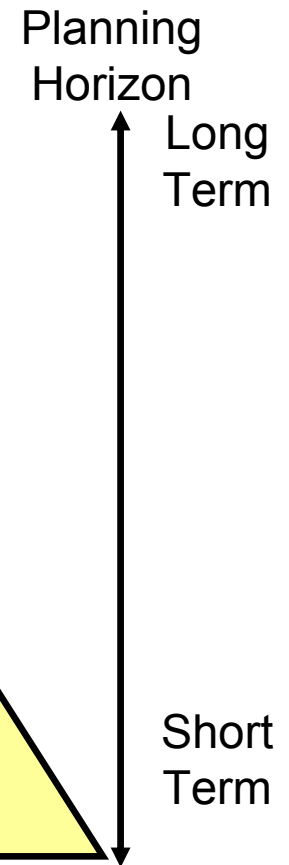
Strategic planning: process of deciding on objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and disposition of these resources"

Strategic Information Systems

"Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives"

Management Information Systems

" Operational control is the process of assuring that specific tasks are carried out effectively and efficiently"

Transaction Processing Systems

Planning Horizon

Long Term

Short Term

Strategic Planning

Tactical Planning and Management Control

Operational Planning and Control

Inward Focus

- **Operations Support Systems**
  - **TPS – Transaction Processing Systems**
  - **PCS – Process Control Systems**

- **Management Support Systems**
  - **MIS - Management Information Systems**
  - **DSS - Decision Support Systems**
  - **EIS - Executive Information Systems**

Outward Focus

- **EWSMS - Enterprise Wide Strategic Management Systems**

- **Global Manufacturing IT Spending $399 billion (2004) to $466 billion (2009)**
  - **Source: Gartner Report**

- **US Automotive IT Spending increases from $7.3 billion (2003) to nearly $8 billion (2008)**
  - **Source: Gartner Report**

Goals of IT Spending

- **Maintenance**

- **Productivity**

- **Growth**

- **Innovation**

IT Decision Taxonomy

- **Principles: high level statements about IT use**

- **Architecture: Integrated set of technical choices**

- **Infrastructure: base foundation of budgeted-for IT capability**

- **Business Application Needs**

- **Investment and Prioritization**

IT Architecture Evolution

- ## Application Silo
  - ### Local optimization to meet specific business needs

- ## Standardized Technology
  - ### Efficiency to meet knowledge worker needs

- ## Rationalized Data
  - ### Process optimization through process integration, and shared data

- ## Modular
  - ### Make strategic choices based on needs

Correlating Governance and Decisions*

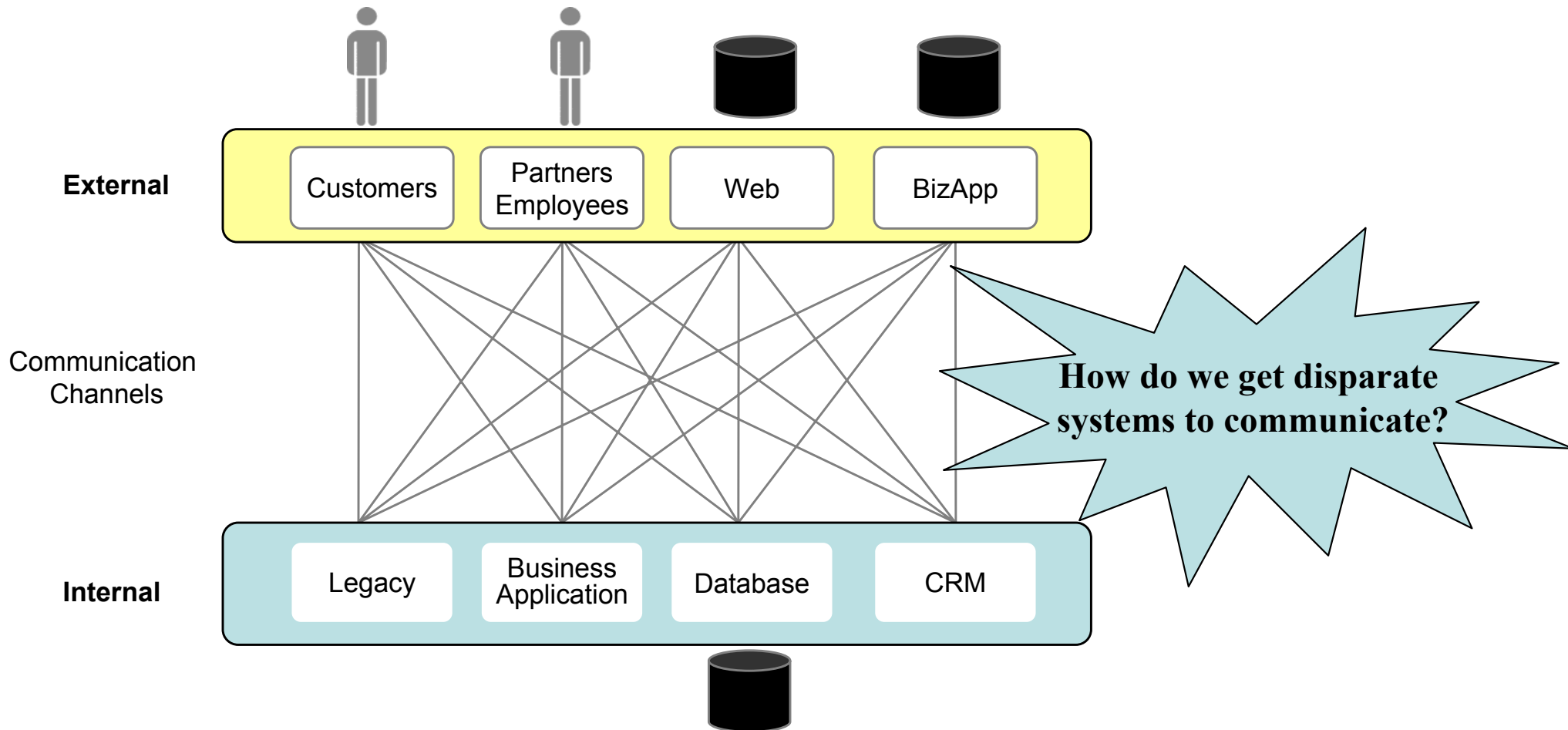| Style \ Domain	IT Principles	IT Architecture	IT Infrastructure	Business Application Needs	IT Investment & Prioritization
Business Monarchy	3	3	3		2 3
IT Monarchy		1 2	2 1		
Feudal					
Federal				1 3	
Duopoly	1 2			2	1
Anarchy					

Development versus Sustainment

- **Applications budget**
  - ≈ 40% of total IT budget; *
  - As high as 60-90% of total IT budget[+]

- **New Application Development**
  - 38% of application budget*

- **Application Maintenance & Enhancement**
  - 62% of application budget*

* IDC

[+] Gartner, Forrester

Enterprise Information Integration (EII)

Communication Channels

External

| Customers | Partners Employees | Web | BizApp |

Internal

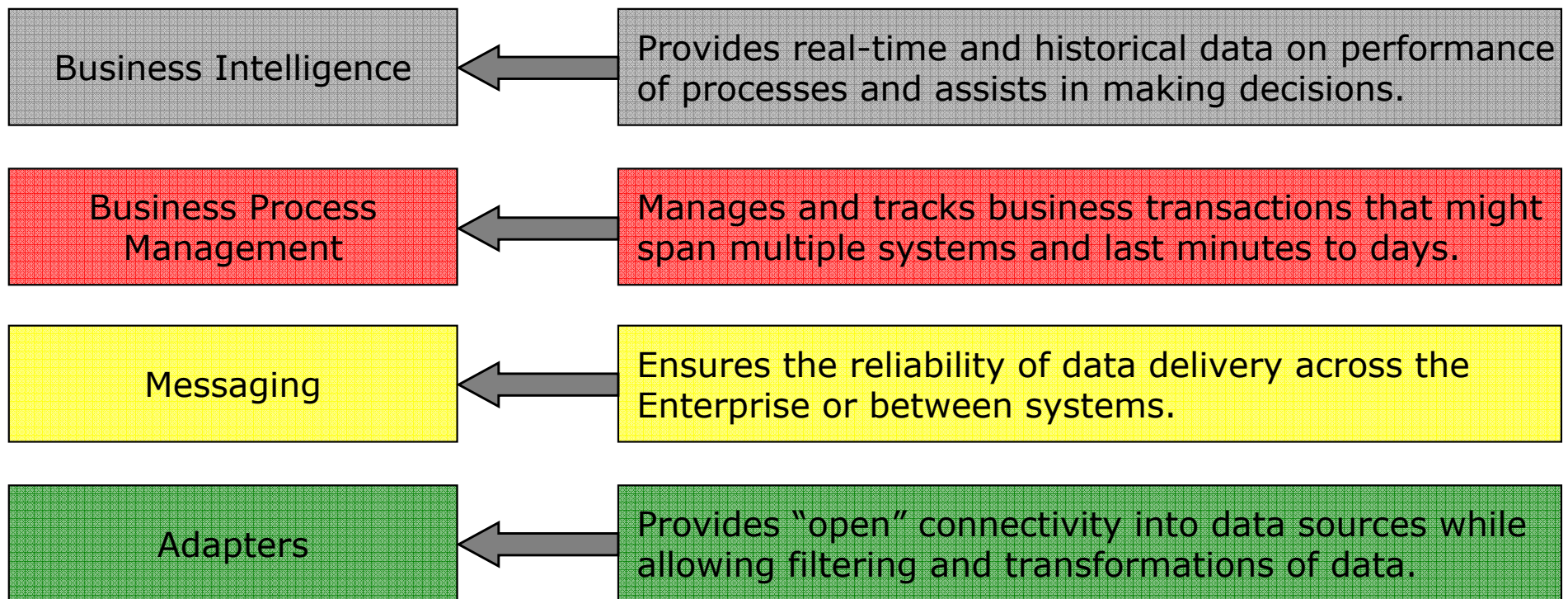| Legacy | Business Application | Database | CRM |

How do we get disparate systems to communicate?
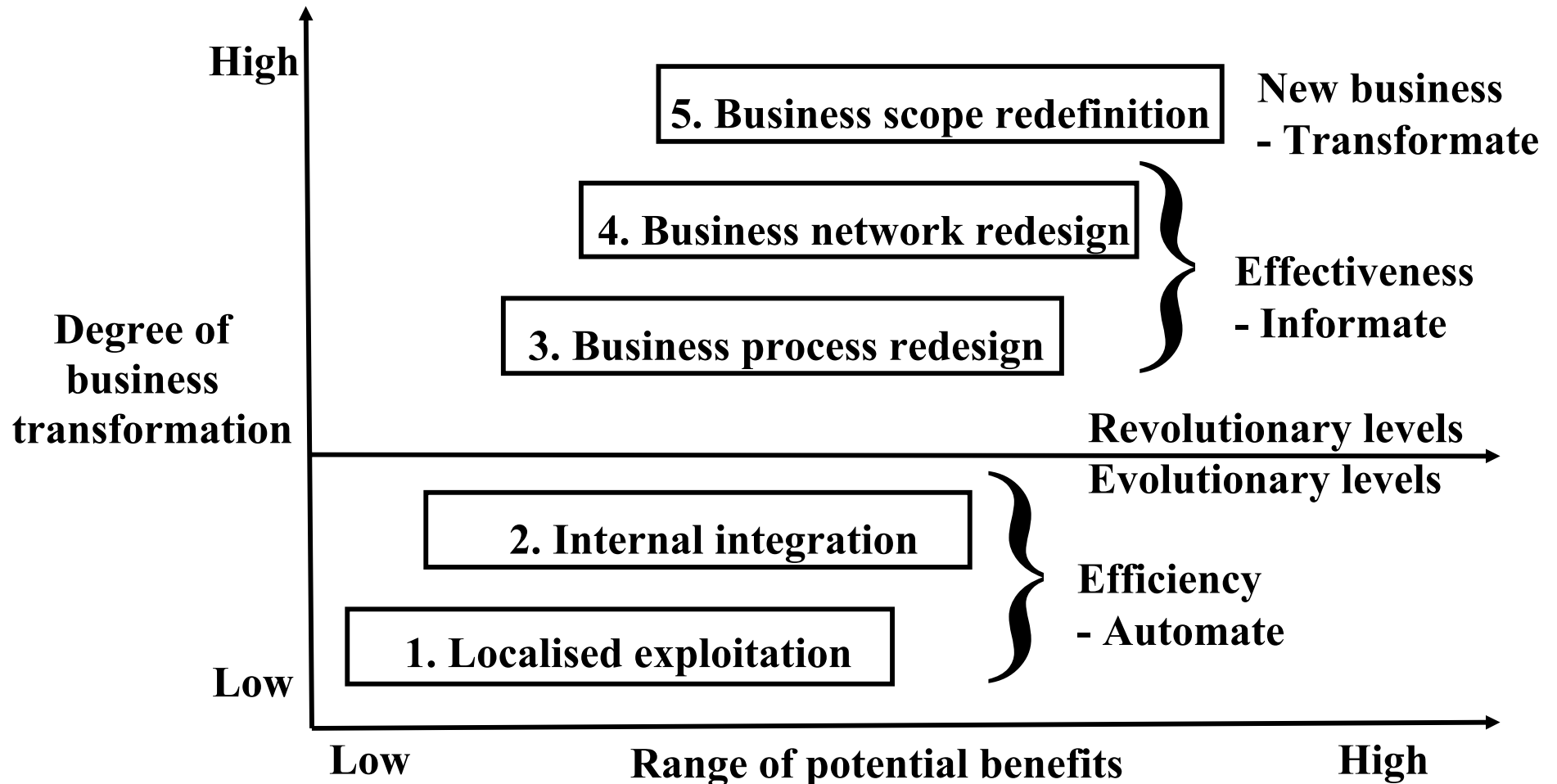
Direct Transformation versus Canonical Transformation

Enterprise Application Integration (EAI)*

- ## Definition

"*The process of integrating multiple applications that were independently developed, may use incompatible technology, and remain independently managed.*"

Business Intelligence	Provides real-time and historical data on performance of processes and assists in making decisions.
Business Process Management	Manages and tracks business transactions that might span multiple systems and last minutes to days.
Messaging	Ensures the reliability of data delivery across the Enterprise or between systems.
Adapters	Provides "open" connectivity into data sources while allowing filtering and transformations of data.

*Integration Consortium.Org

Layers of Transformation

(Source: MIT90s)

Risks in IS Implementation

- **Lack of top management commitment to the program**

- **Failure to gain user commitment**

- **Misunderstanding the requirements**

Here is Edward Bear, coming downstairs now, bump, bump, bump, on the back of his head, behind Christopher Robin. It is, as far as he knows, the only way of coming downstairs, but sometimes he feels that there really is another way, if only he could stop bumping for a moment and think of it. - **Winnie-the-Pooh**, A.A. Milne, 1926

"Like other chief executives, I feel I'm being blackmailed. Not just by the suppliers, I expect that. But by my own IT staff who never stop telling me what the competition are spending ..."

- *Grindley K, Managing IT At Board Level, Pitmans Publishing, p58, 1991.*

The Successful CIO

- **Attributes of a successful CIO**
  - **Versatility**
  - **Vision**
  - **Fast reactions**
  - **Tenacity**

- **Multi-dimensional**
  - **A technology champion**
  - **A business strategist**
  - **A technologist**
  - **A leader**
  - **An integrator**
  - **An impresario**
  - **A good corporate citizen**
  - **A friend to all**

Failure to Gain User Commitment

- "It's always been done this way" syndrome

- Inadequate Training

- Job Security

- Politics

Alice in Wonderland*

Alice: `Would you tell me, please, which way I ought to go from here?'

Cat: `That depends a good deal on where you want to get to,'

Alice: `I don't much care where--'

Cat: `Then it doesn't matter which way you go,'

Alice: `--so long as I get somewhere,'

Cat: `Oh, you're sure to do that … if you only walk long enough.'

*Excerpted From Chapter 6 Pig and Pepper, Alice's Adventures in Wonderland, Lewis Carroll

Misunderstanding Requirements

- **Legacy systems role**

- **Changing business environment**

- **Changing Leadership**

Product Data Management*

- ## Two Cases
  - ### Aero
  - ### Space

*Erisa K. Hines and Jayakanth Srinivasan, "IT Enabled Enterprise Transformation: Perspectives Using Product Data Management" Proceedings of ISD2005

Erisa K. Hines, "Lifecycle Perspectives on Product Data Management", SM Thesis, 2005

Industry Spending on PDM/PLM

Aerospace investment has dropped over the last decade, creating a gap in the technology capability and industry needs

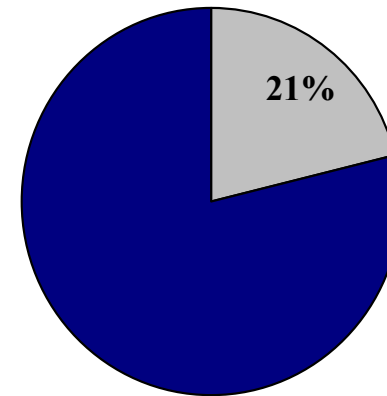**Aerospace alone is an estimated $10.4 Billion market for 2005**
– Daratech Report

"The aerospace companies want to shed IT silos that can't talk to each other, and the vendors want to accommodate them with suites of tools that can …exchange data…"
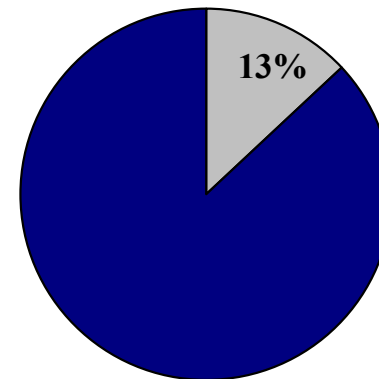**– David Hughes, AWST, 2003**

"PLM is an emerging technology with a lot of growth in front of it. But it is mature enough that the GMs of the world are using it and that's a confidence-building factor"
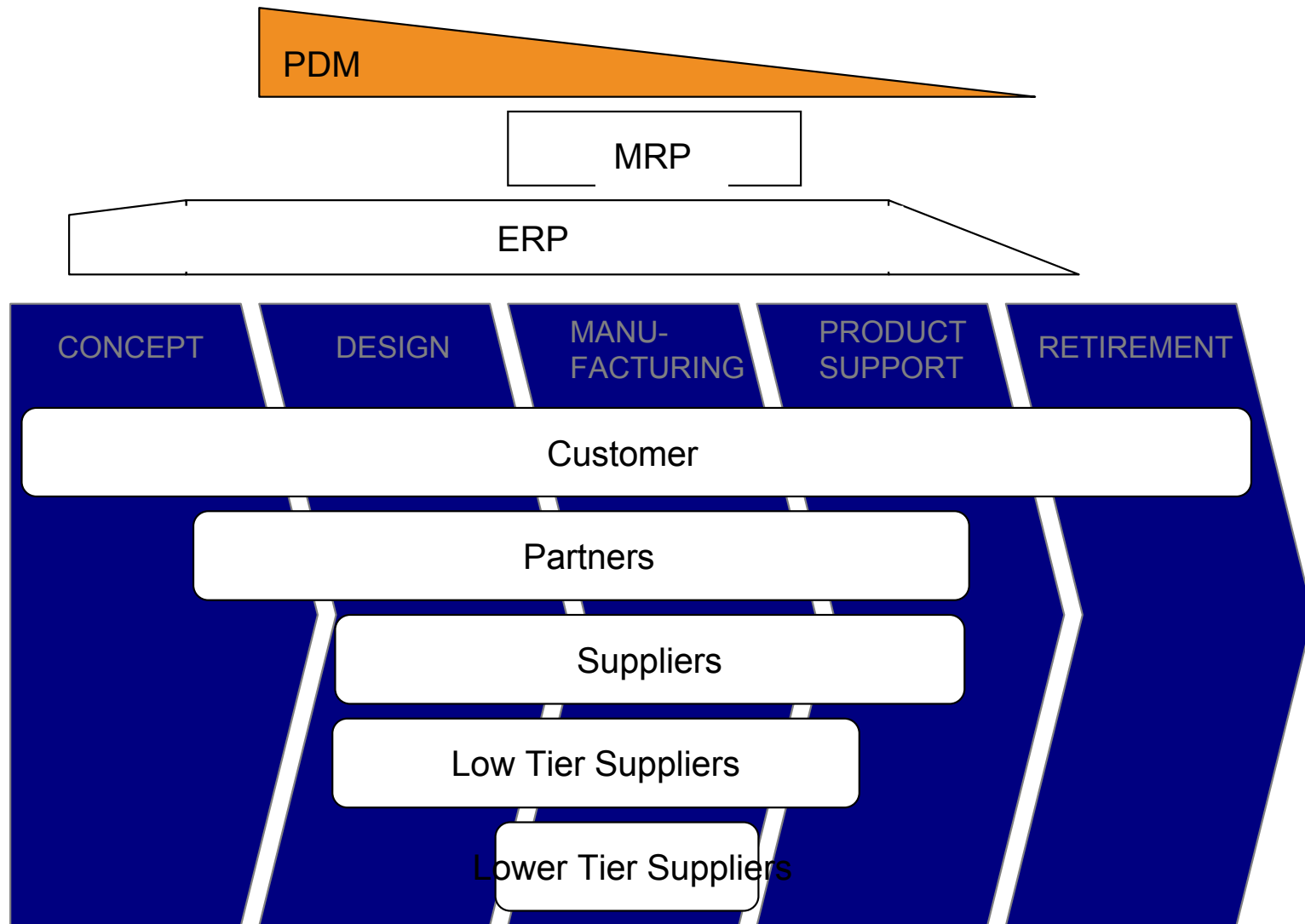**– Bob Nierman, EDS**

Aerospace Market Share of PDM/PLM Early 1990s

21%

Aerospace Market Share of PDM/PLM 2005

13%

PDM's Current Domain in the Lifecycle

PDM

MRP

ERP

| CONCEPT | DESIGN | MANU-FACTURING | PRODUCT SUPPORT | RETIREMENT |

Customer

Partners

Suppliers

Low Tier Suppliers

Lower Tier Suppliers

Current Functional Use of PDM (2004)
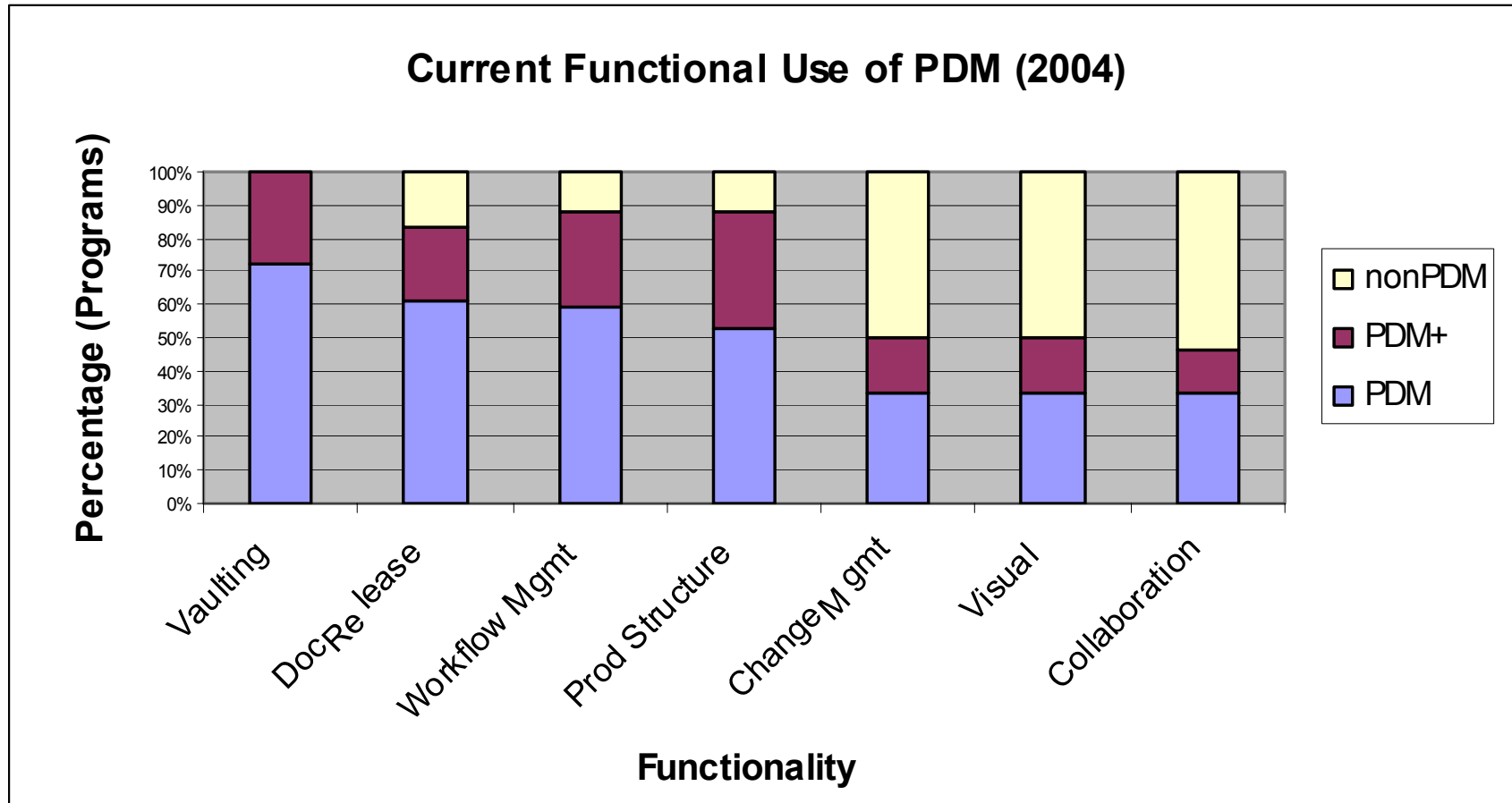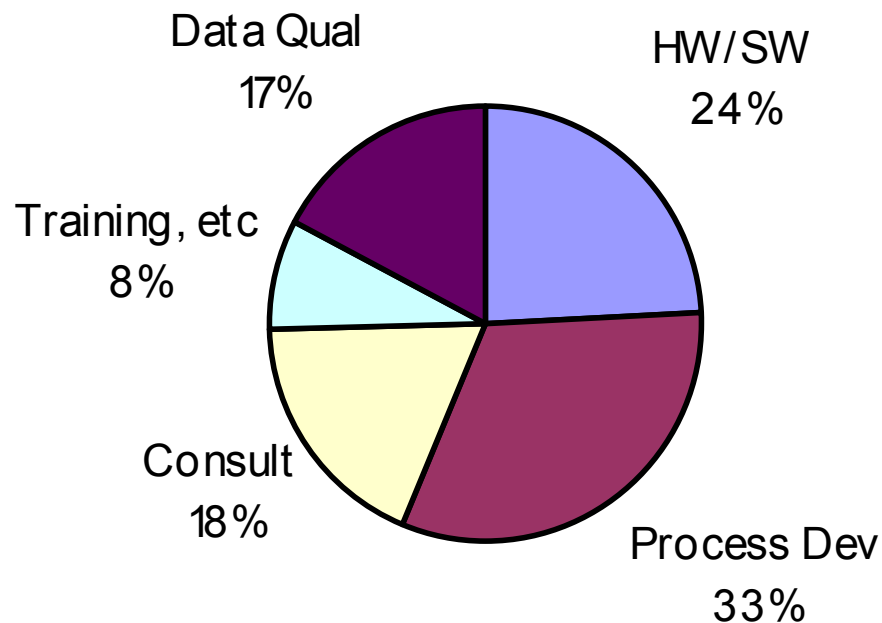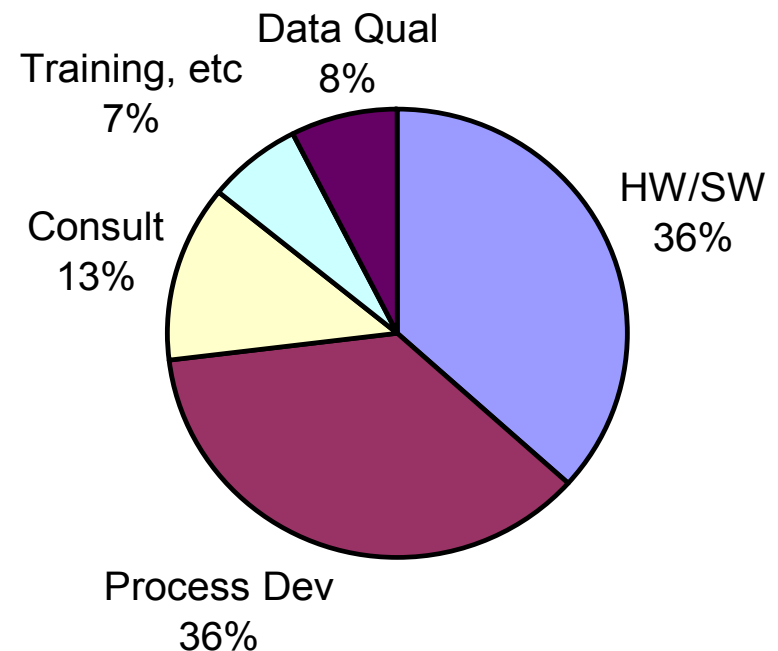

Traditional applications of PDM are distinct from those that are not

PDM Spending Comparison Across Five Categories

Primes

- Data Qual 17%
- HW/SW 24%
- Training, etc 8%
- Consult 18%
- Process Dev 33%

Suppliers

- Training, etc 7%
- Data Qual 8%
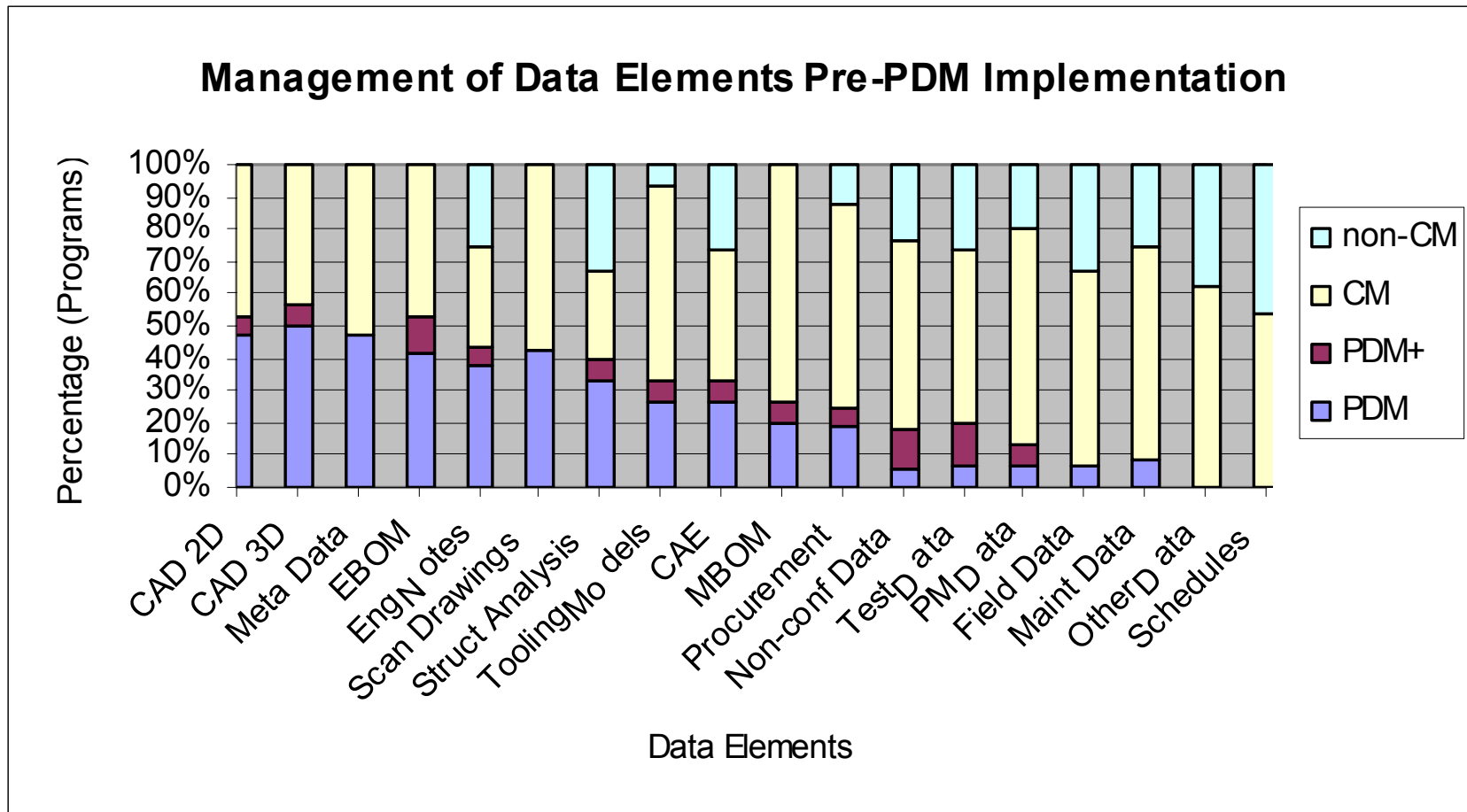- Consult 13%
- HW/SW 36%
- Process Dev 36%

The majority of money is spent on developing processes and the licensing costs

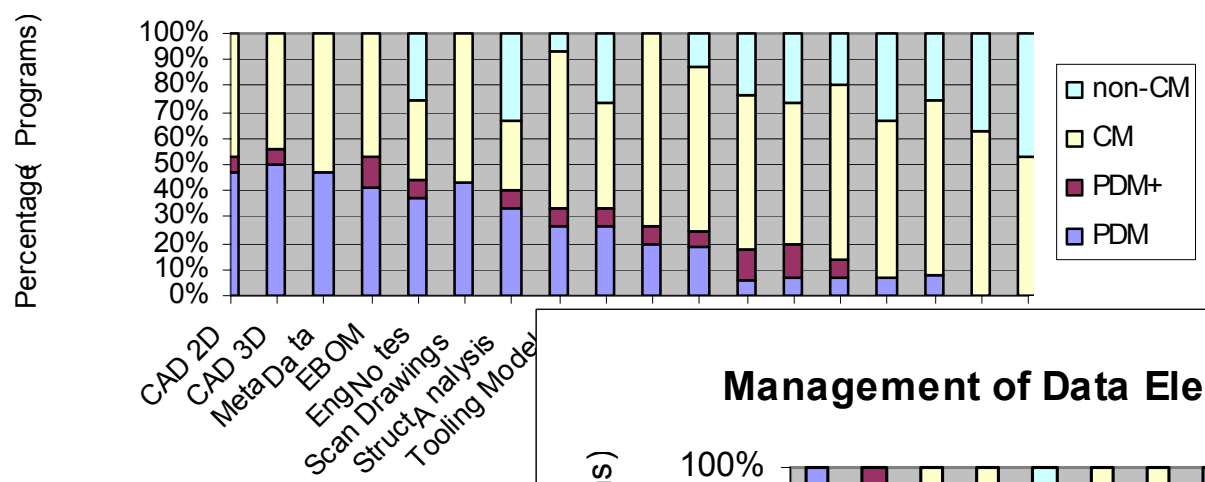Management of Data Elements Pre-PDM Implementation

Use of PDM to manage product data decreases as the type of data progresses from design

Data Management Post-PDM Implementation

Management of Data Elements Pre-PDM Implementation

Percentage(Programs)

Legend: non-CM, CM, PDM+, PDM

Data elements: CAD 2D, CAD 3D, MetaDa ta, EBOM, EngNo tes, Scan Drawings, StructA nalysis, Tooling Models

There is an industry trend in using PDM to manage more traditional engineering design data than in the past

Management of Data Elements Post-PDM Implementation

Percentage (Programs)

Legend: non-CM, CM, PDM+, PDM

Data elements: CAD2 D, CAD3 D, Meta Data, EBOM, Eng Notes, ScanD rawings, Struct Analysis, Tooling Models, CAE, MBOM, Procurement, Non-confD ata, Test Data, PMDa ta, FieldD ata, Maint Data, OtherD ata, Schedules

Data Elements

MBOM is the breakpoint, likely due to other business systems
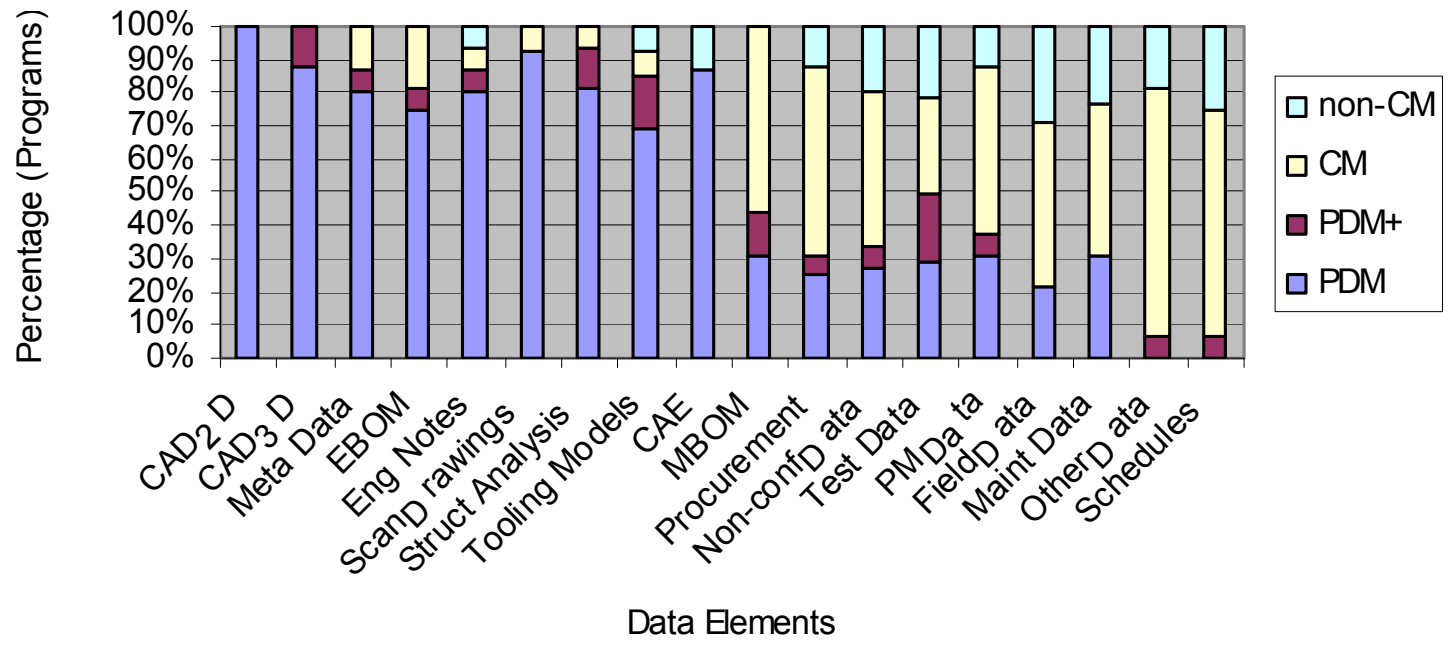
The "Business Case" Value of PDM

- **Guaranteed Savings**
  - **Reduction in Labor Costs**
  - **Reduction/Elimination of Legacy IT Maintenance**
- **Expected Savings**
  - **Cost Avoidance**
    - **Reduction in errors, rework due to bad data quality**
    - **Reduction in lost or missing data**
  - **Improved Cycle Time**

Case Comparison: Context

Context	Aero	Space
Burning Platform	Save the Business	Save the Knowledge
Number of Programs	Less than 5; large programs	Greater than 200; 5% large, 35% medium
PDM Budget	Long-term strategy; Fully funded budget upfront	Short-term strategy; severely phased budget
Management Turnover	Very limited	Very often
Company Culture	Strong relative to industry	Strong relative to industry; more unique
Multi-CAD	Yes, internally and externally	Yes, externally

Case Comparison: Efforts

| *Efforts*	**Aero**	**Space**
Multi-site Effort	**Yes**	**No**
Data Model	**Standard across programs**	**Standard across programs**
Implementation Team Make-up	**Engineering Driven; mixed**	**IT Driven; mixed**
Implementation Approach	**Phased by program**	**Phased by capability and program**
PDM Solution	**Nominal customizations; standard across programs**	**Heavy customization of user interface; less standard across programs**
Current Diffusion of PDM Solution	**Complete implementation across the organization; currently being migrated to sister organization**	**Limited use within programs; not implemented to all programs**

Case Study Lessons Learned

- **One size does not fit all:**
  - The two cases used contrasting IT implementation approaches. Their strategies were a function of resource availability, management commitment and system understanding. The approach adopted must reflect limitations imposed by the organization, technology and culture.
- **Authority to transform the enterprise:**
  - The team given responsibility for designing and implementing the system must be given authority and the requisite budget to drive change.
- **Gaining user commitment:**
  - Not communicating the criticality of transitioning to the new system is a common stumbling block in gaining user commitment. This requires user involvement in the process redesign as well as training of end users in the process changes and in using the tool itself.
- **Managing process evolution:**
  - A successful execution requires management of process changes before, during and after system implementation.

Product Lifecycle Management

"A strategic business approach that applies a consistent set of business solutions in the support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life – integrating people, process, business systems and information (emphasis added)"

– CIMdata definition of Product Lifecycle Management
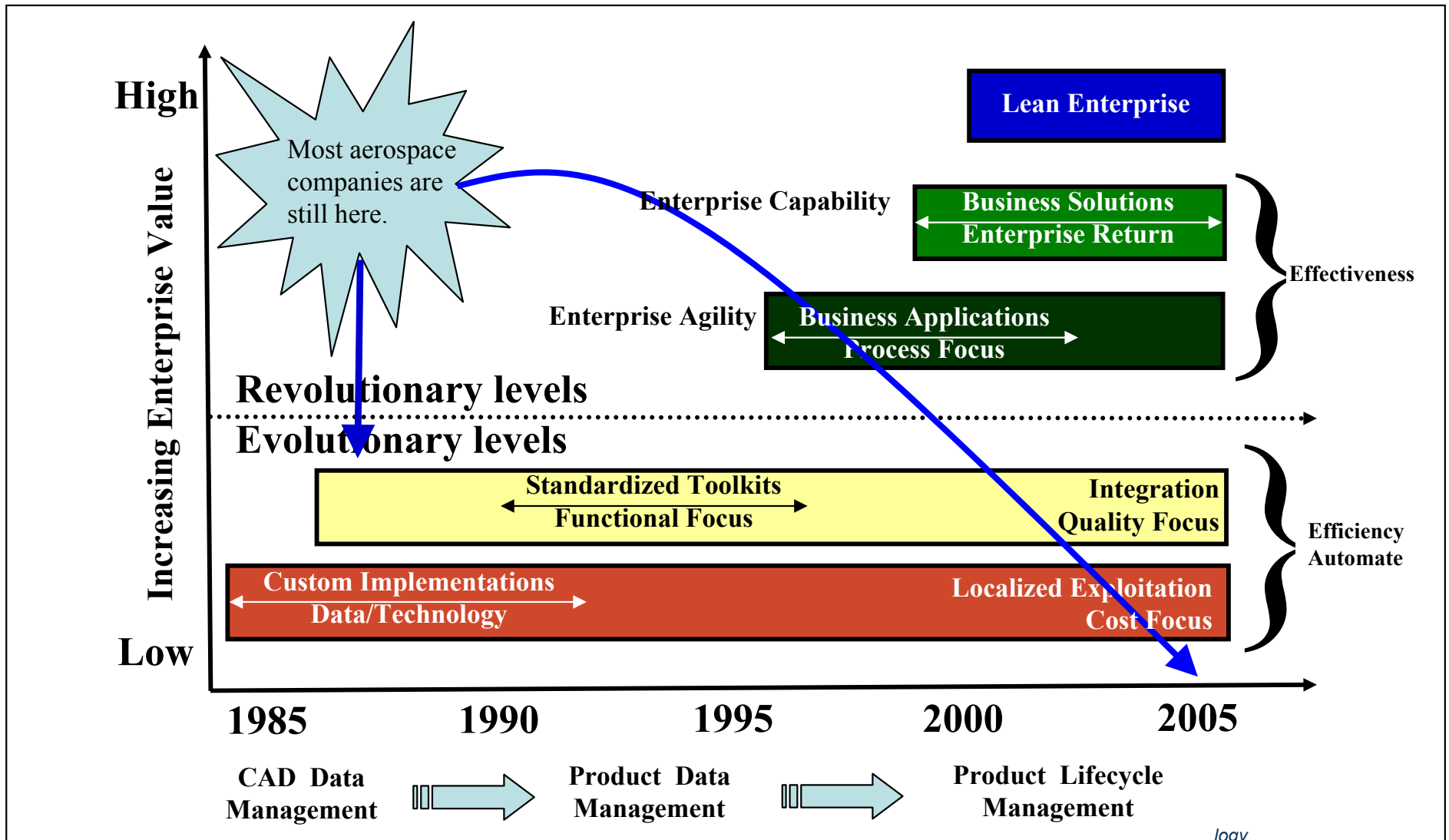
"I guess [the PDM is] working just fine."

~PDM Budget Oversight personnel~

"There is no point in doing a value stream map and finding out where improvements can be made, if you do not have the authority and the funding to actually make changes"
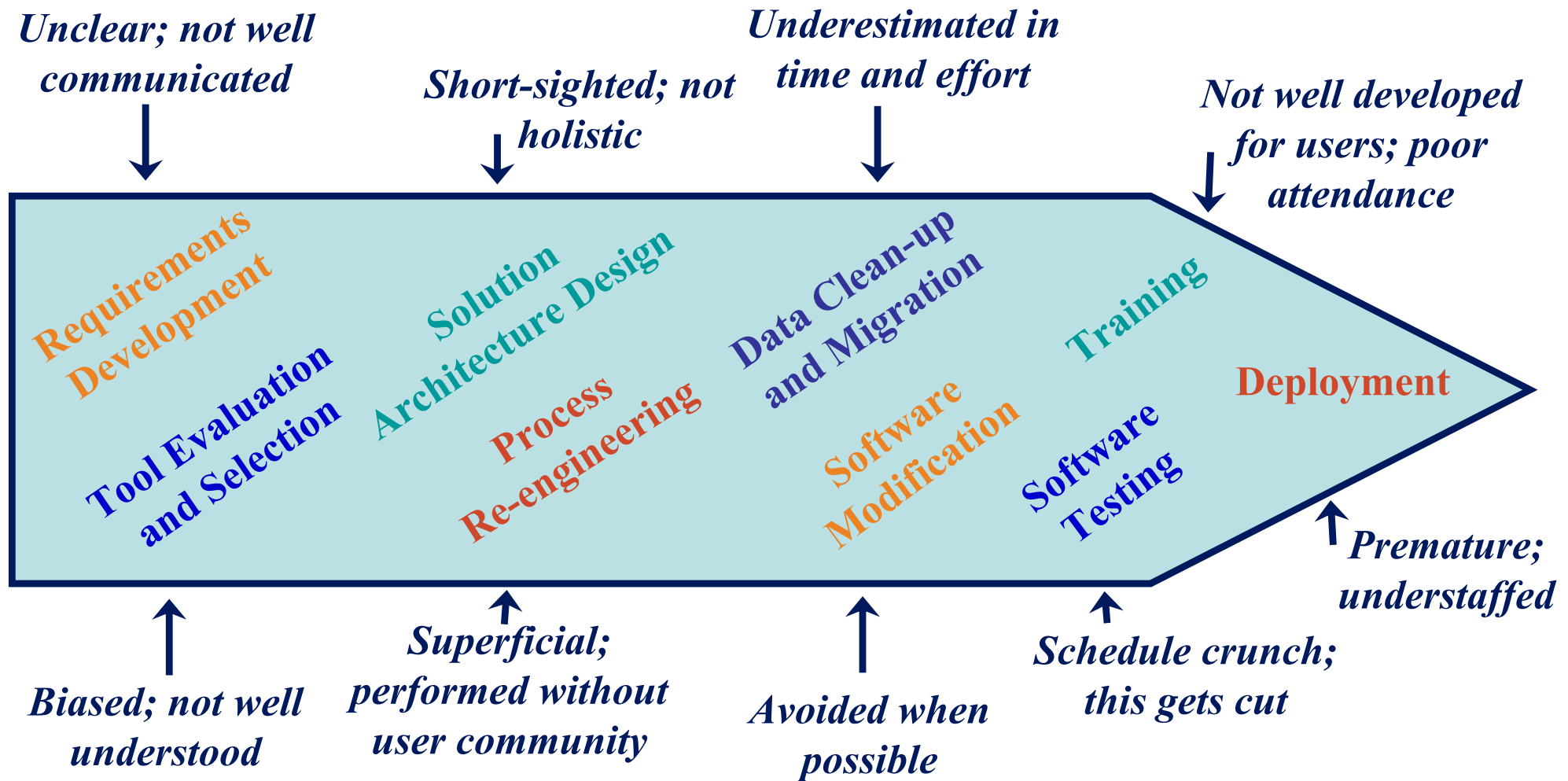
~Senior Manager of Engineering~

"Everyone is into reducing waste and continuous improvement so [Lean] becomes the change agent – the common language we all speak to justify going to our (common) singular system."

~VP of Engineering on Lean~

Implementation Approach Framework

		by Functionality		by Program	
		Phase	Big Bang	Phase	Big Bang
Product homogeneity	high				x
	low			x	
Legacy product data	high volume	x		x	
	low volume				x
Legacy IT	high	x		x	
	low				x
Maturity of the SW	high		x		x
	low	x		x	
Budget support	strong	x			x
	weak	x		x	
Management	will enforce	x			x
	won't enforce	x		x	
Overall Implementation Complexity	high	x		x	
	low		x		x

Common Implementation Mistakes

Unclear; not well communicated

Short-sighted; not holistic

Underestimated in time and effort

Not well developed for users; poor attendance

Requirements Development

Tool Evaluation and Selection

Solution Architecture Design

Process Re-engineering

Data Clean-up and Migration

Software Modification

Training

Software Testing

Deployment

Premature; understaffed

Biased; not well understood

Superficial; performed without user community

Avoided when possible

Schedule crunch; this gets cut

- **Integrating the enterprise requires an enterprise-wide information system**

- **Technology "imposes its on logic" on strategy, culture and organization**

- **There is no "silver" bullet**

- **Everything you learn in ESD61 applies in the IT Context as well!**

Mapping Information Systems

- ## Transaction Processing Systems (TPS)
    - ### Online processing
    - ### Batch Processing

- ## Automate repetitive information processing activity
    - ### Increase speed
    - ### Increase accuracy
    - ### Greater Efficiency

Mapping Information Systems

- ## Management Information Systems (MIS)
  - ### Managing Information Systems
  - ### Information for Mid-Level Managers

- ## Provide reports
  - ### Key-indicator report, Exception report, Drill-down report etc.

- ## Examples:
  - ### Sales forecasting, Financial Management and Forecasting, Inventory Management, Manufacturing Planning etc.

Mapping Information Systems

- ## Executive Information Systems (EIS)
    - ### Used at the strategic Level
    - ### Highly Aggregated Information

- ## Hard and Soft Data
    - ### Facts, News

- ## Examples:
    - ### Long range planning, Crisis Management

Functional Information Systems

- **Decision Support Systems (DSS)**
  - **Cross Layer Usage**

- **Designed to support organizational decision making**
  - **"What-if" analysis**
    - **For example: Microsoft Excel**
    - **Text and graphs**
  - **Models for each of the functional areas**

- ## Enterprise Wide
  - ### Synergizes the organisation and its customers and suppliers

- ## Delivers competitive advantage
  - ### Built on a platform
  - ### Cannot be too quickly or easily copied