



NICTA Research and Empirical Software Engineering

Ross Jeffery (rossj@cse.unsw.edu.au)

Professor, UNSW &

**Empirical Software Engineering Program
Leader, NICTA**



OUTLINE

- **NICTA Positioning**
 - **NICTA View**
 - **Recent Government View**
- Unifying Technical Vision and Themes
- Program Selection
- NICTA Initial Programs
- Projects

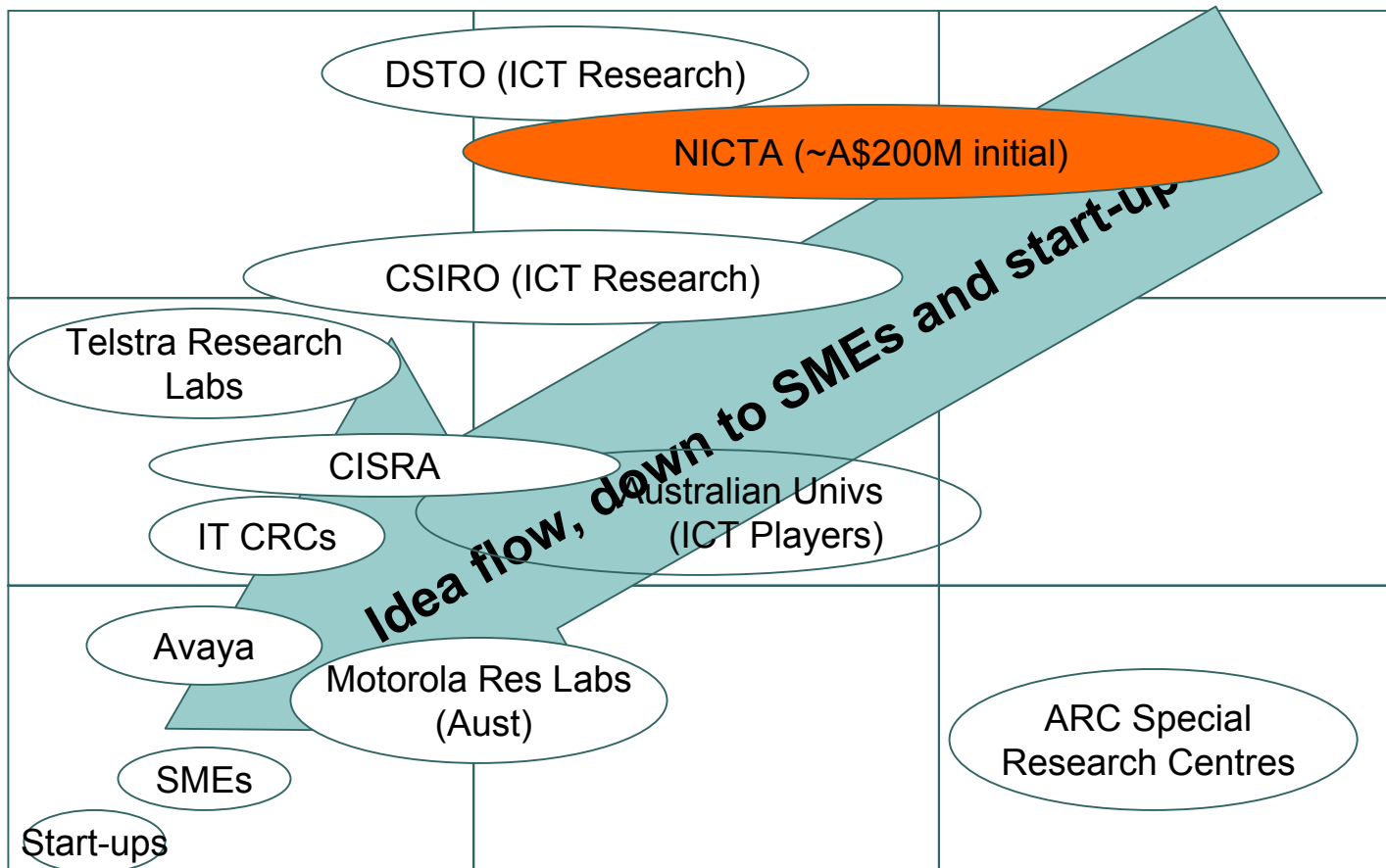
NICTA POSITIONING

SCALE

Large

medium

small



near

medium

long

RESEARCH TIMEFRAME



NICTA POSITIONING ACCORDING TO RECENT GOVERNMENT POLICY

IN SUMMARY:

- More long term research and training
- Make sure there are commercial outcomes for the country.
- Make sure it is world class



OUTLINE

- NICTA Positioning
- **Unifying Technical Vision and Themes**
 - **Universal ICT**
 - **NICTA Themes**
 - **The Inputs**
- Program Selection
- NICTA Initial Programs
- Projects



THE TECHNICAL VISION: UNIVERSAL ICT

- It connotes availability wherever you are, affordability by poor people, and usability by uneducated people
- Wherever you are includes:
 - Accessing the internet from next to the swimming pool, the train when you are going through a tunnel, when you are in a foreign land and cannot read the signs, when you are having an incapacitating heart attack, etc



NICTA THEMES

- Themes will have a longer life than programs
- Multiple themes are appropriate for an institute of the scale of NICTA
- Initial themes are:
 - Infrastructure Technologies
 - Software Engineering
 - Intelligent Systems
 - Human Machine Interaction
 - Foundations



OUTLINE

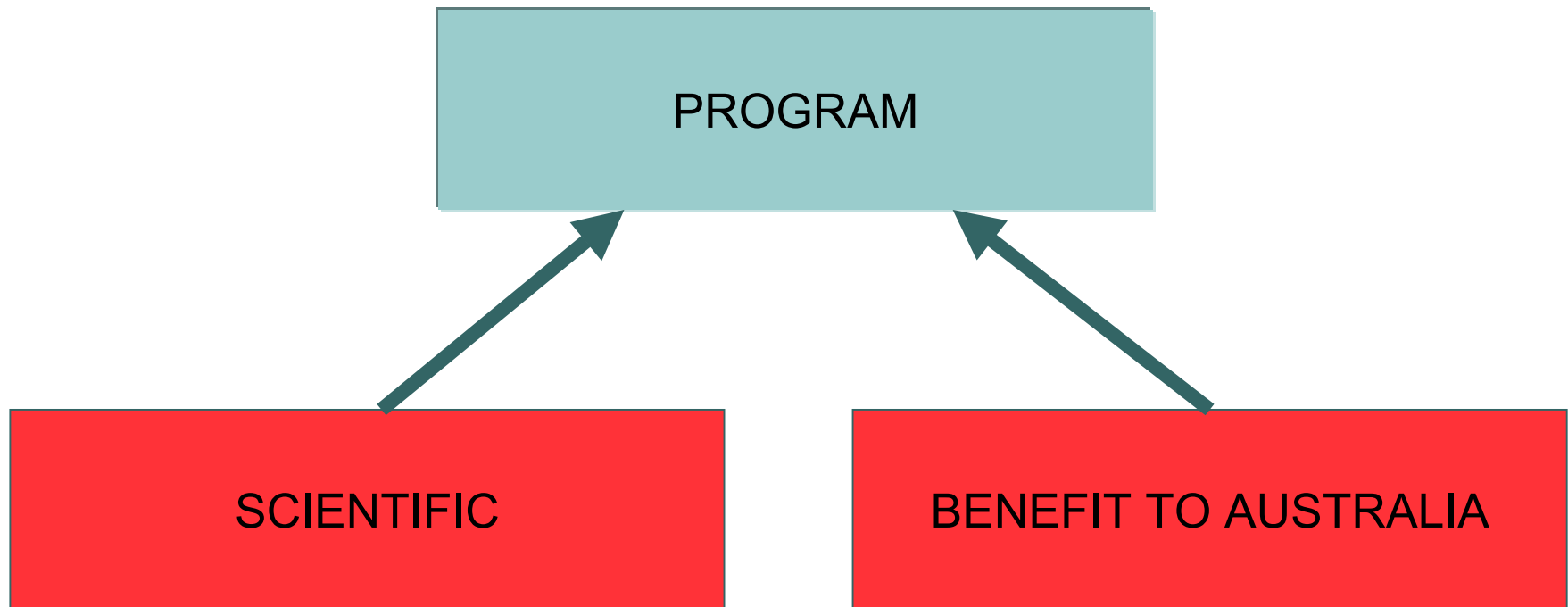
- NICTA Positioning
- Unifying Technical Vision and Themes
- **Program Selection**
 - **Conceptual Challenges**
 - **Core Principles**
 - **Criteria**
 - **Inputs and Studies**
- NICTA Initial Programs
- Projects



CORE PRINCIPLES FOR ALL PROGRAMS

- Critical mass
- Balance of research areas
- Integrating long-term and commercial/end-user connection opportunity
- Culture of excellence, including capitalising on benefit from initial partner universities
- Coherence with big picture, allowing cross-disciplinary work
- Possibility of strategic relationships
- Processes: recruiting researchers, monitoring and updating programs

CRITERIA FOR A PROGRAM: MACRO VIEW





CRITERIA FOR A PROGRAM

○ Scientific

- Existence of Scientific Challenges
- Capability to Contribute Globally
- Availability of staff, especially leadership



CRITERIA FOR A PROGRAM

- Scientific
 - Existence of Scientific Challenges
 - Capability to Contribute Globally
 - Availability of staff, especially leadership

- **Benefit to Australia**
 - Commercialisation including start-up possibility
 - End-user connection
 - Need for human capital
 - National interest
 - Opportunity to shape or influence international standards
 - National research priorities: frontier technologies, security, environment, health

A decorative graphic consisting of three colored circles (dark teal, light teal, grey) and a vertical line extending downwards from the top circle.

OUTLINE

- NICTA Positioning
- Unifying Technical Vision and Themes
- Program Selection
- **NICTA Initial Programs**
 - **What they are**
 - **What they have to do**
- Projects



INITIAL PROGRAMS (cont)

INFRASTRUCTURE TECHNOLOGY

Embed & RI Time Op Sys
Wireless Sig Proc
Networks and Pervasive
Computing

SOFTWARE ENGRG

Empirical Software Eng
Formal Methods

INTELLIGENT SYSTS

Statistical Machine Learn'g
& Sensor Sig Proc
Symbolic Machine Learn'g
Knowledge Rep & Reas
Auton Syst and Sens Tech

FOUNDATIONS

Logic and Computation
Systems Engr &
Complex Sys



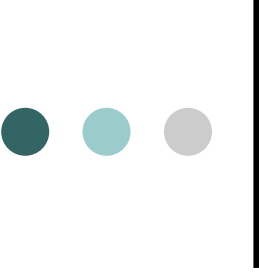
PROGRAM RESPONSIBILITIES

- Programs have responsibility for EACH of the four pillars
 - Research
 - Research Training
 - Commercialisation (End-user linkages)
 - Linkages
-BUT Programs do not have uniform weighting for four pillars



OUTLINE

- NICTA Positioning
- Unifying Technical Vision and Themes
- Program Selection
- NICTA Initial Programs
- **Projects**
 - **Project/Program distinction**
 - **Example**



PROGRAMS VERSUS PROJECTS

- **Programs**

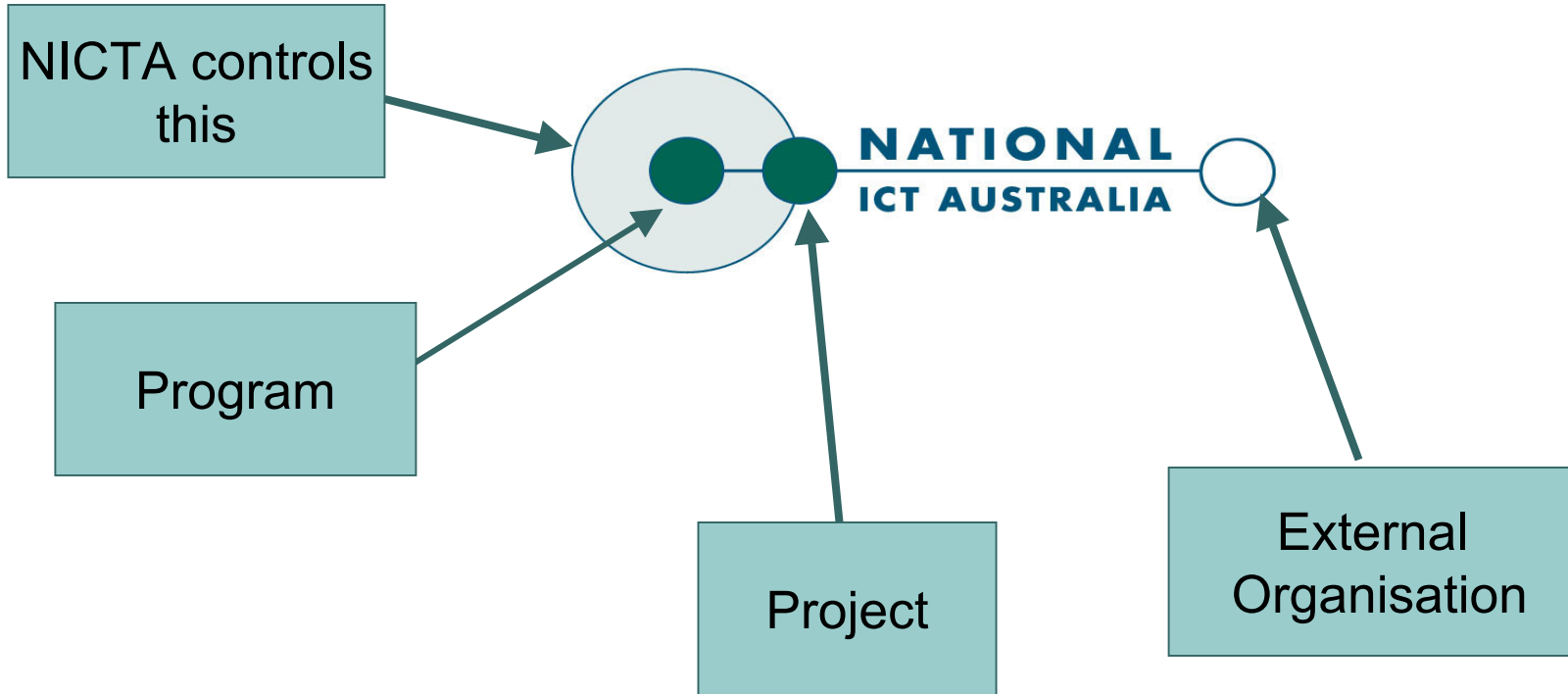
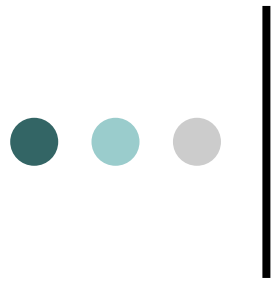
Disciplinary groupings responsible for conceptual advances, organised into 5 themes

- long time scale; conceptual groupings; deliver in all four pillars; every researcher lives in one program

- **Projects**

Collaborative mechanism between Program(s) and partner organisations or between programs

- Can be shorter time scale; focussed on application drivers
- Include deliverables, milestones



The Empirical Software Engineering Program

National ICT Australia





Key Challenge

Of the \$2.5 trillion spent on IT during 1997-2001, nearly \$1 trillion was wagered on unsuccessful projects. One in four software projects are cancelled annually. (Mann, MIT Technology Review, July/Aug 2002)

Standish Group CHAOS studies:

- 23,000 information technology projects studied (1994-1998)
26 % successful, 46% challenged, 28% failed

OASIG Report (1996)

- 80-90% of IT investments do not meet performance objectives: reasons rarely purely technical
- Around 80% of new systems are late and over budget
- Few organizations are good at evaluating performance and impact of IT investments

(courtesy – Shirley Gregor ANU)

A decorative graphic in the top left corner consisting of three colored circles (dark teal, light teal, grey) and a vertical line to their right.

1. INTRODUCTION

Empirical software engineering involves the scientific use of quantitative and qualitative data in the understanding and improvement of software product, software development process and software management. This understanding is often linked to the development of new methods and tools.



Two Key Uses of Data

- Hypothesis generation
 - Theories about the way processes, products and resources work alone and in concert
- Hypothesis testing
 - Is what we believe confirmed by the evidence?



Key Questions (Pfleeger 2003)

- What do we mean when we say that a technology “works”?
- What kinds of evidence (and how much evidence) do we need to demonstrate that it works?
- Who provides the evidence, and who vets the evidence? (For instance, many of the claims about data mining are provided by the vendors.)
- If it works in one domain, does that tell us anything about other domains?
- How can evidence inform our thinking about the social, economic and political tradeoffs of using an imperfect technology?

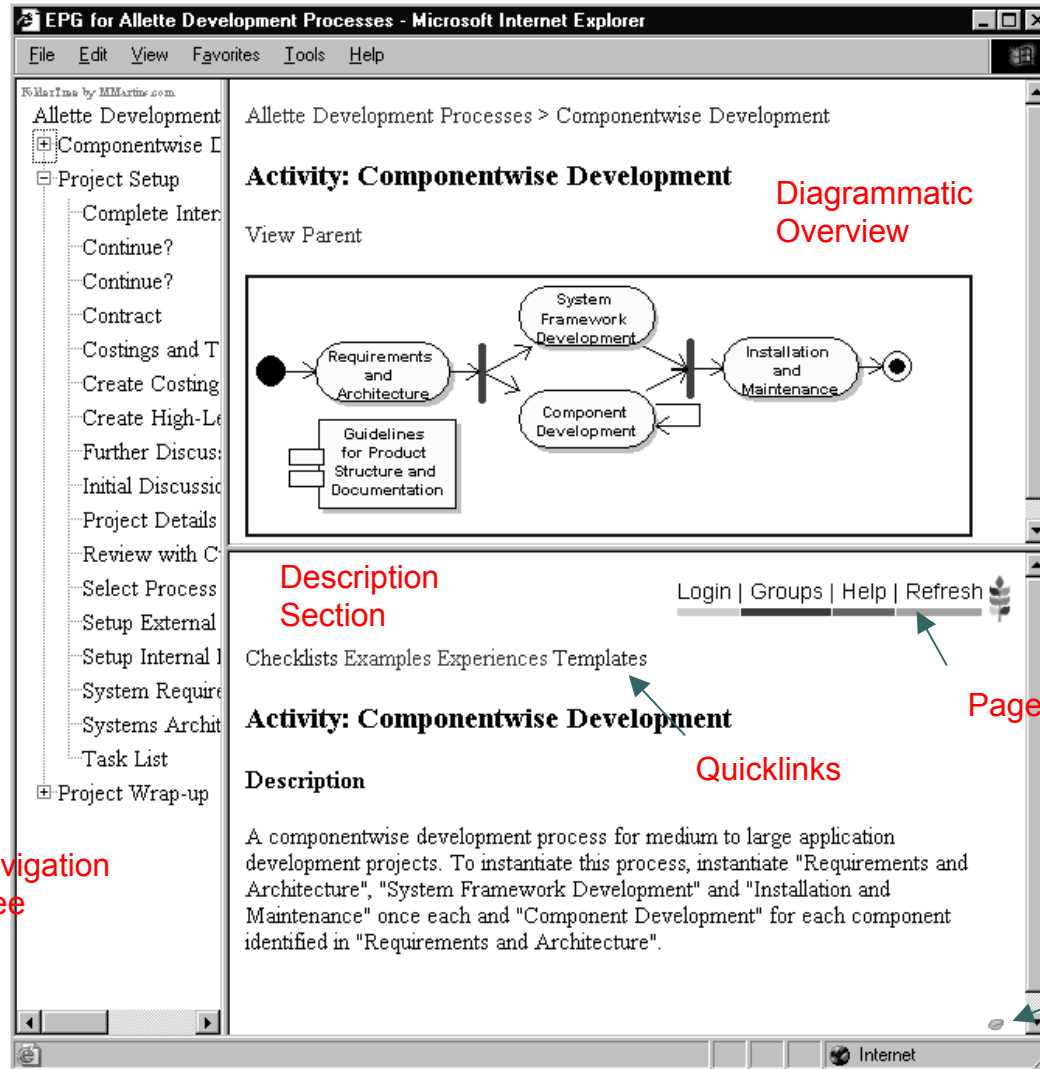


Two Recent Examples

1. Electronic process guide/experience repository
2. Software Development cost estimation support tool

(both installed in an SME collaborating organization)

1. EXPERIENCE REPOSITORY



The screenshot shows a web browser window titled "EPG for Allette Development Processes - Microsoft Internet Explorer". The page content is as follows:

- Navigation Tree (Left):** A tree view under "Allette Development" with "Componentwise Development" expanded. Sub-items include "Project Setup", "Complete Inter...", "Continue?", "Contract", "Costings and T...", "Create Costing...", "Create High-L...", "Further Discus...", "Initial Discussi...", "Project Details", "Review with C...", "Select Process...", "Setup External...", "Setup Internal...", "System Require...", "Systems Archit...", "Task List", and "Project Wrap-up".
- Activity: Componentwise Development (Top):** A diagrammatic overview showing a process flow: "Requirements and Architecture" leads to "System Framework Development" and "Component Development", which both lead to "Installation and Maintenance". A box labeled "Guidelines for Product Structure and Documentation" is also present.
- Description Section (Middle):** Contains a "Description" heading and a paragraph: "A componentwise development process for medium to large application development projects. To instantiate this process, instantiate 'Requirements and Architecture', 'System Framework Development' and 'Installation and Maintenance' once each and 'Component Development' for each component identified in 'Requirements and Architecture'." Below this are "Checklists", "Examples", "Experiences", and "Templates".
- PageSeeder Tools (Right):** Includes "Login | Groups | Help | Refresh" and "PageSeeder Tools".
- PageSeeder Seed (Bottom Right):** A small icon in the bottom right corner of the page content area.

Navigation
Tree

Diagrammatic
Overview

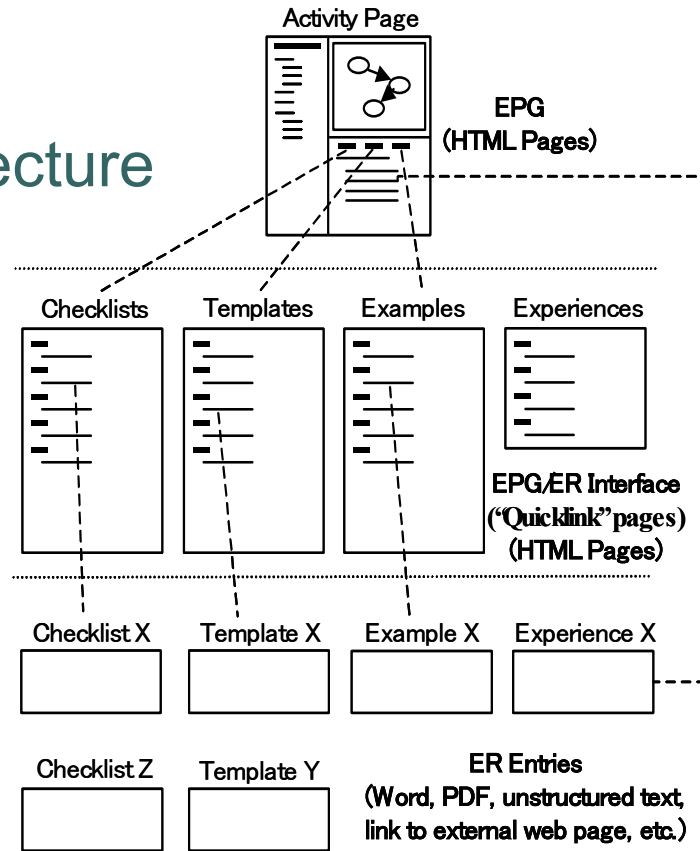
Description
Section

PageSeeder Tools

Quicklinks

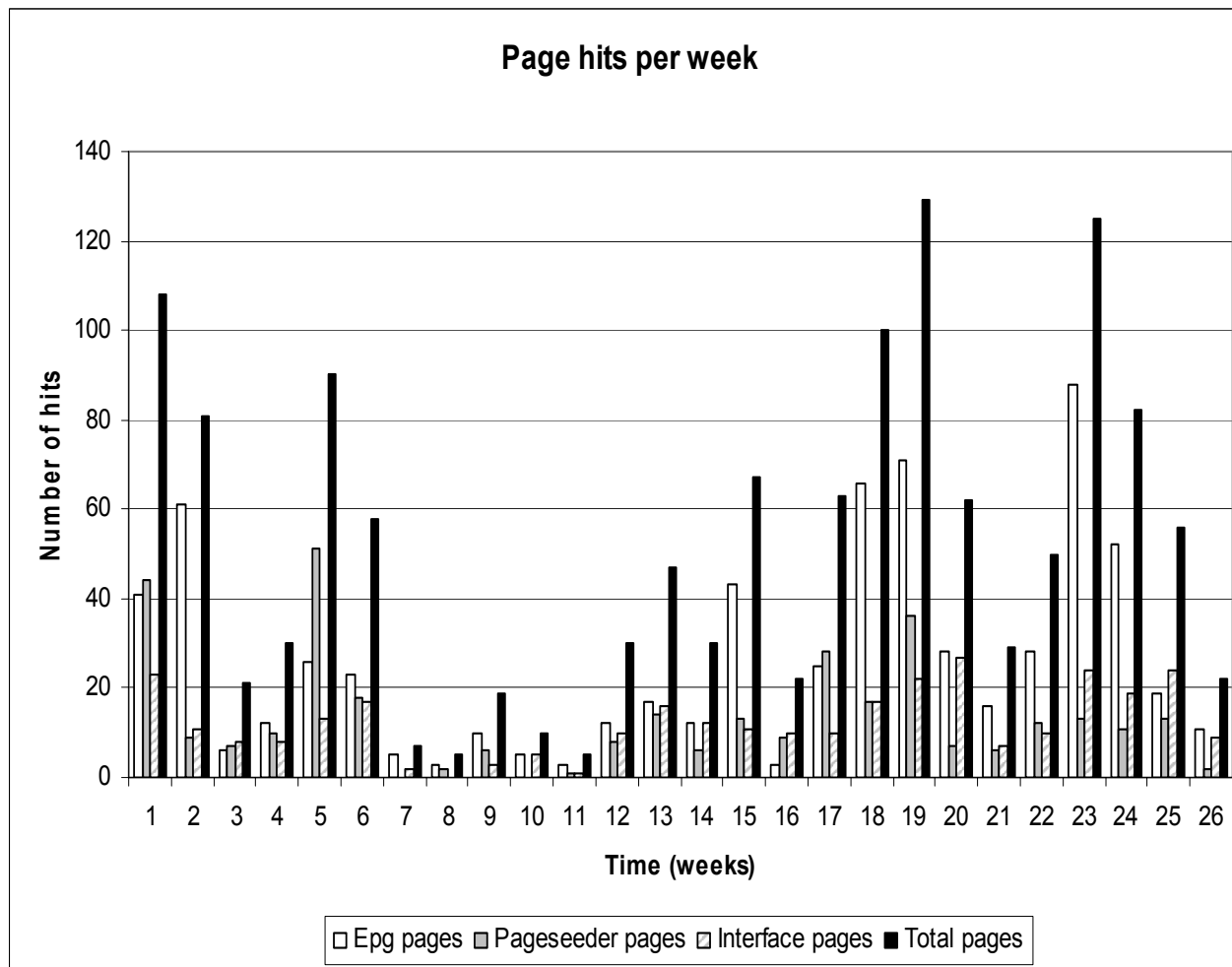
PageSeeder
Seed

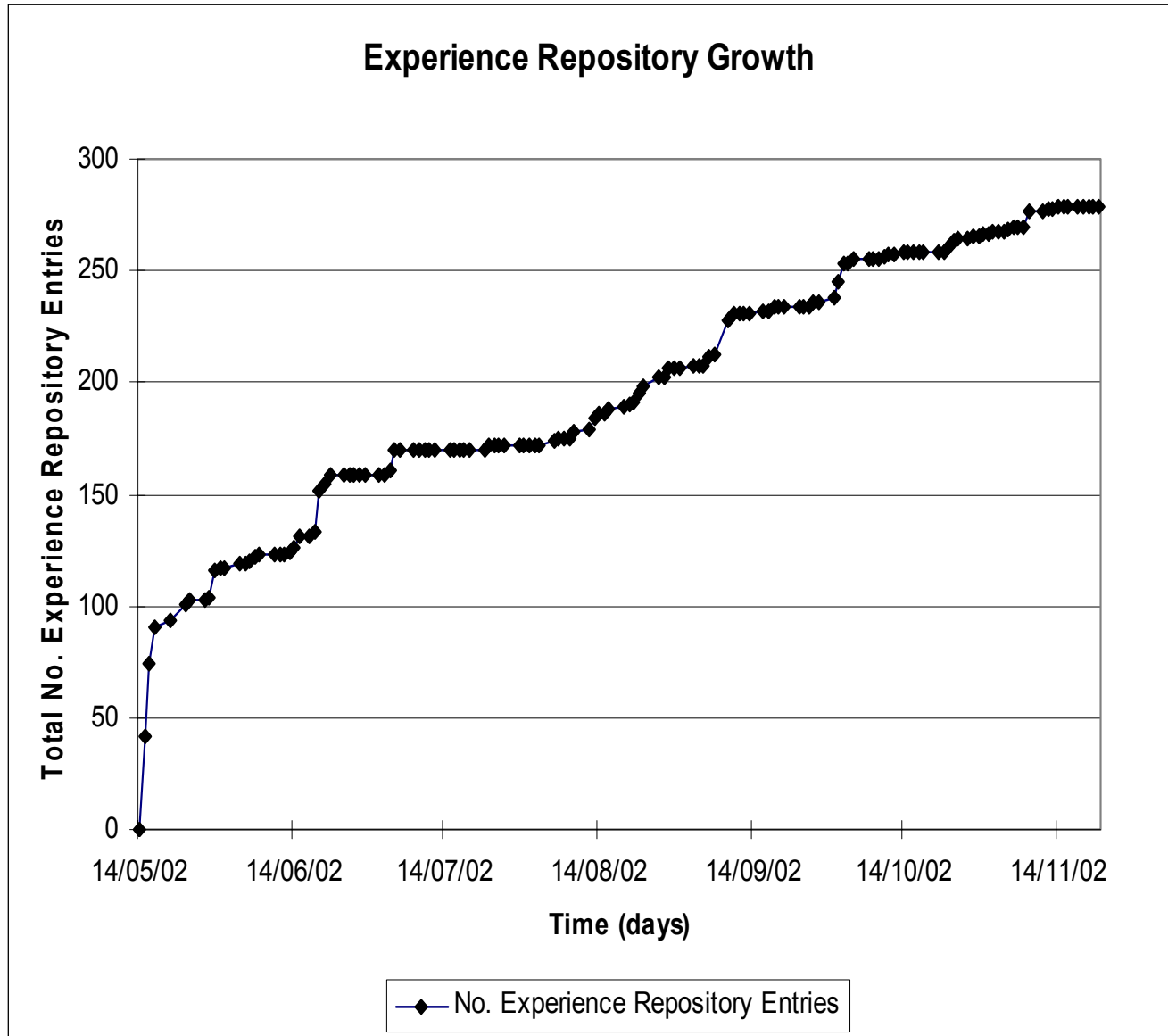
- EPG/ER Architecture



RESULTS

- Was the EPG/ER used?





A decorative graphic on the left side of the slide, consisting of three colored circles (dark teal, light teal, and grey) and a vertical black line to their right.

2. Estimation support tools



Critical Success Factors for Collaboration

- Organizational research belief model
- Importance/alignment of research goal with organizational imperatives
- Ability of the researcher to bring the potential solution to the table
- Clear deliverables and contract
- Clear technology infusion plan, training and support
- Very regular interpersonal contact