'COSMIC' - the COmmon Software Measurement International Consortium
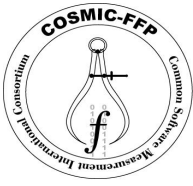
COSMIC FFP Field Trials
Aims, Progress and Interim Findings

Alain Abran, Université de Québec à Montréal, Canada

Charles Symons, Software Measurement Services Ltd, UK

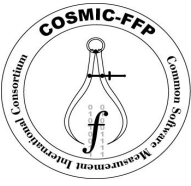**(on behalf of the COSMIC Core Team *)**

April 2000

(* Alain Abran, Charles Symons, Jean-Marc Desharnais, Peter Fagg, Pam Morris, Serge Oligny, Jolijn Onvlee, Roberto Meli, Risto Nevalainen, Grant Rule, Denis St Pierre)
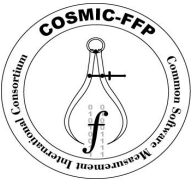
Agenda

- **COSMIC FFP project aims**

- **Field trials Aims and Status**

- **What have we learned so far?**

- **Questions to resolve**

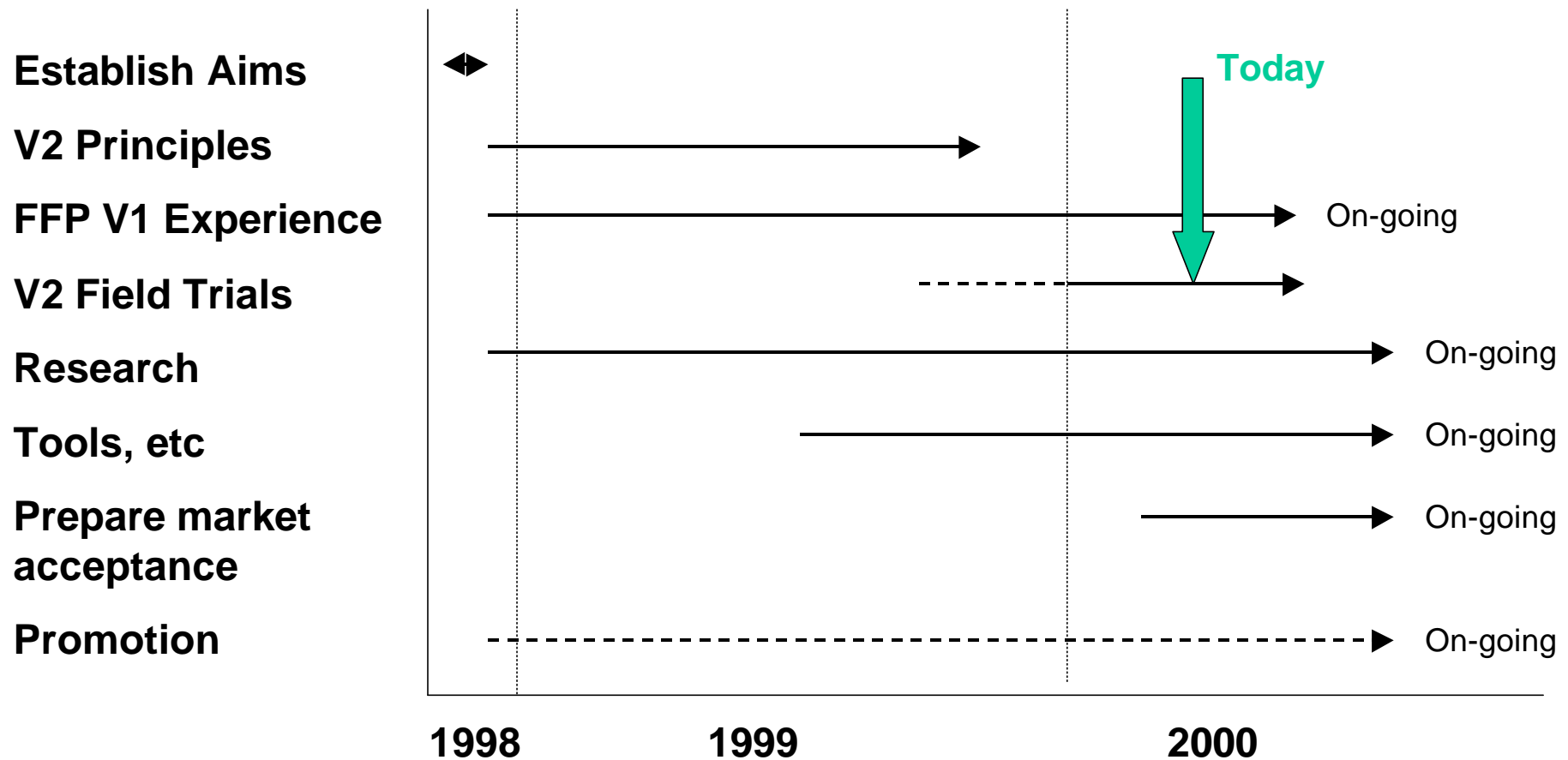- **Other Activities**

- **Conclusions**
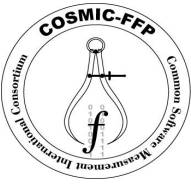
COSMIC Project Aims

COSMIC aims to develop, test, bring to market and gain acceptance as an industry standard, a new generation of software functional sizing methods which are applicable

- for performance measurement

- as a component of estimating methods from early in a software item's life

- in as wide a range of software 'domains' as possible; priority to be given to business and real-time software (e.g. process control, operating systems, telephony, embedded, etc.)

The overall evolution of COSMIC FFP V2

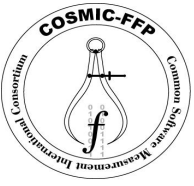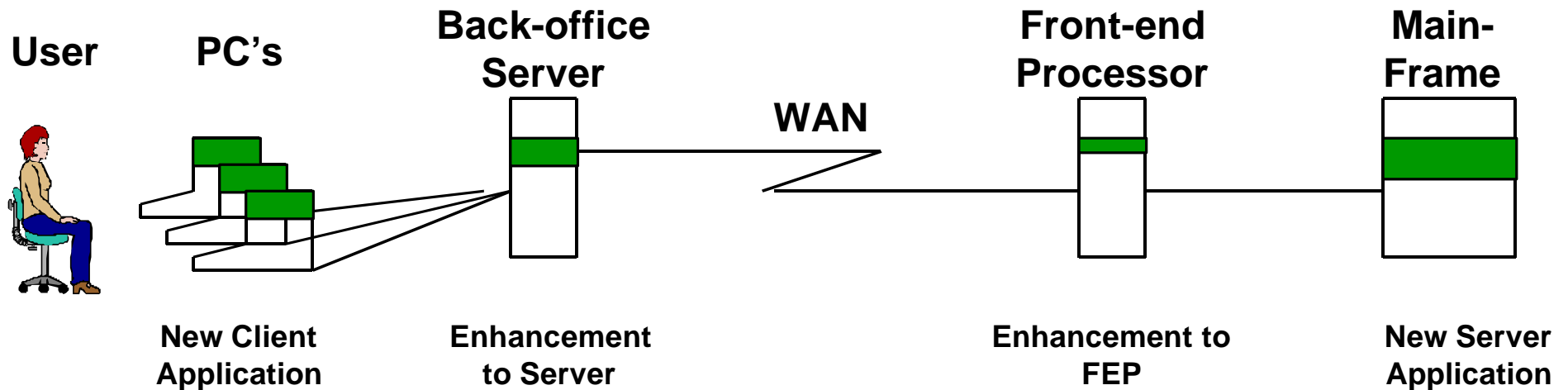|	1998	1999	2000	
Establish Aims				
V2 Principles				
FFP V1 Experience				On-going
V2 Field Trials				
Research				On-going
Tools, etc				On-going
Prepare market acceptance				On-going
Promotion				On-going

Today
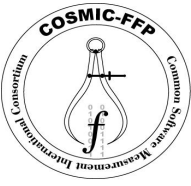
COSMIC aims to be able to measure the size-impact of requirements on software in any layer and gives guidance for recognising layers

Example: impact of requirements for Software Item 'X'

User

Application Software — The principal Software Item 'X' to be built

'Middleware' — New utility

Operating System — Modification to the OS

Device Drivers — New device driver

Hardware
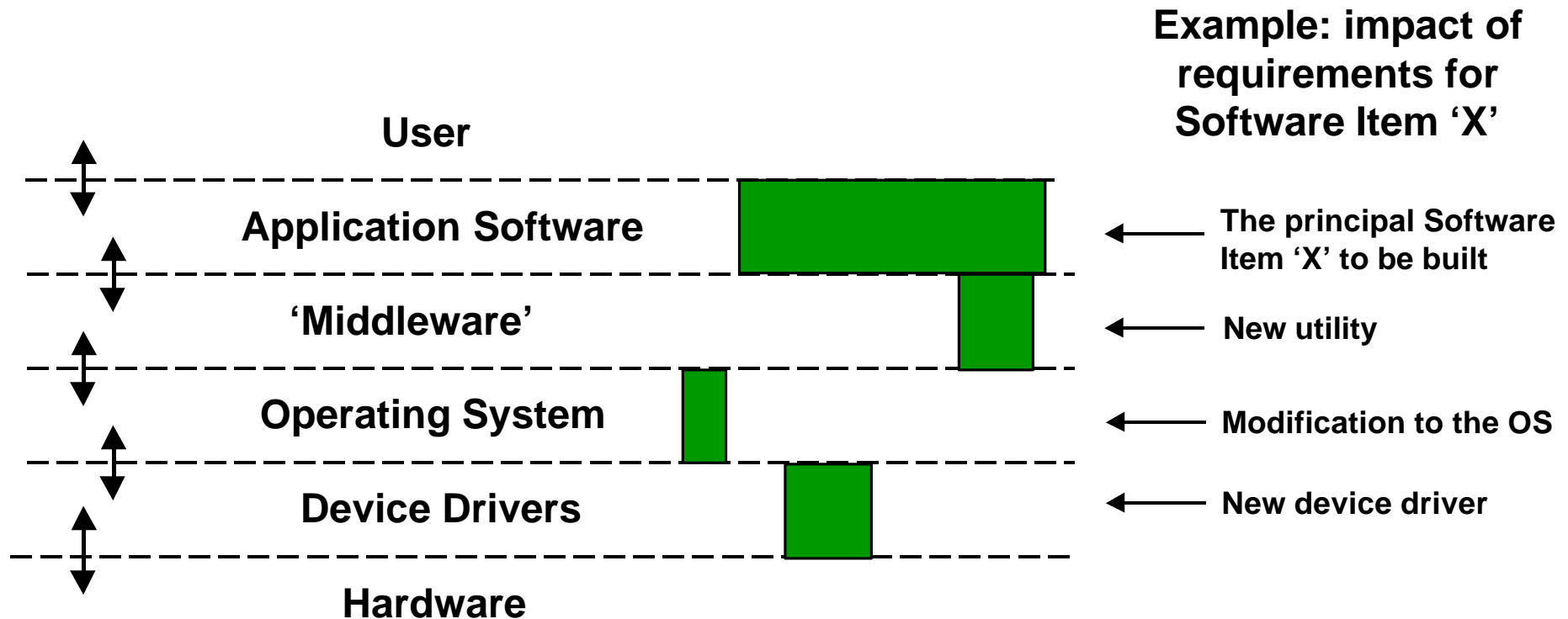
COSMIC must also recognise the size of requirements for 'peer' components in a multi-level architecture

User **PC's** **Back-office Server** **WAN** **Front-end Processor** **Main-Frame**

New Client Application

Enhancement to Server

Enhancement to FEP

New Server Application

An example of a server process providing synchronous communications
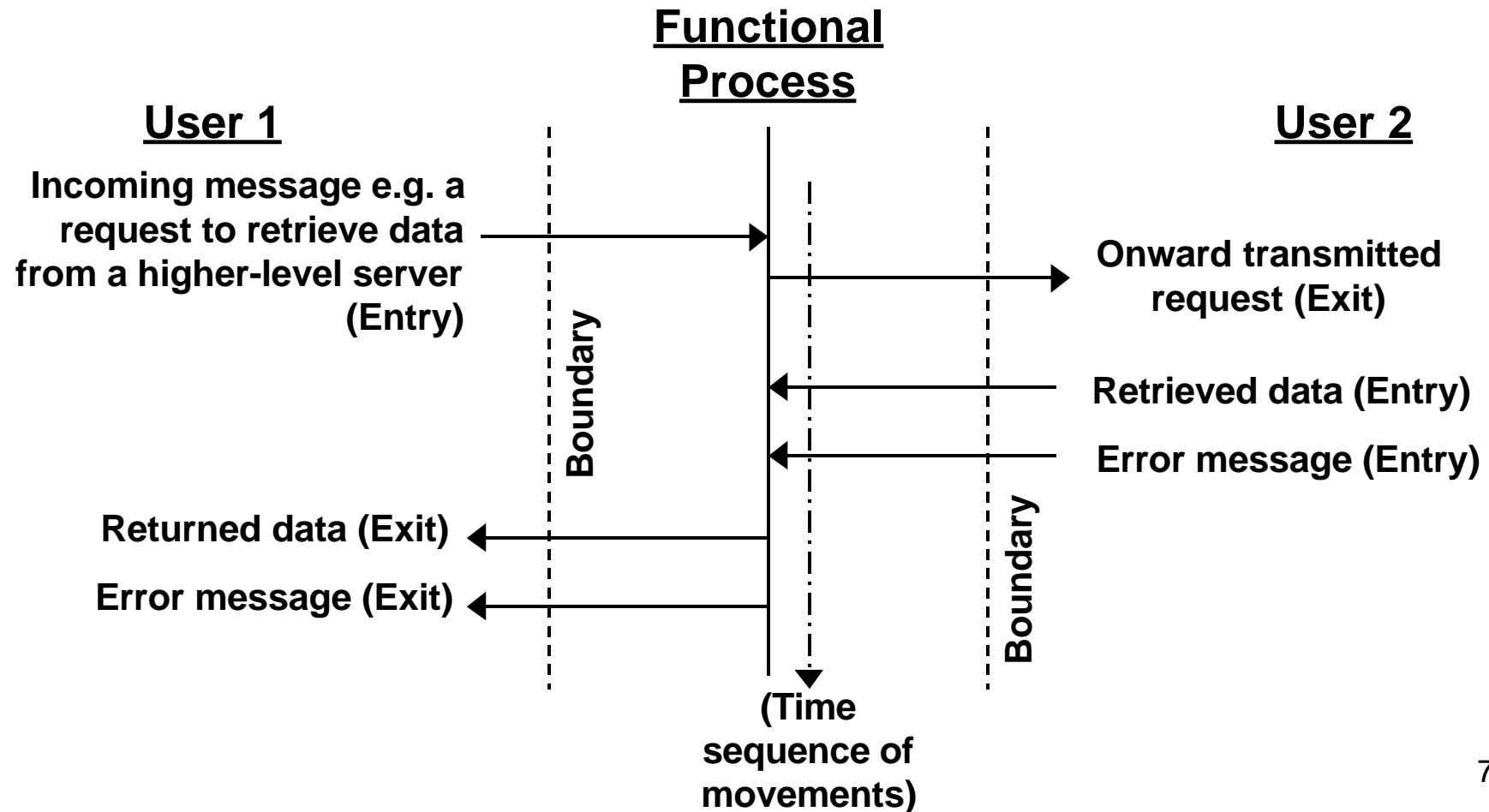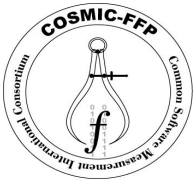
Functional Process

User 1

Incoming message e.g. a request to retrieve data from a higher-level server (Entry)

Boundary

Returned data (Exit)

Error message (Exit)

User 2

Onward transmitted request (Exit)

Retrieved data (Entry)

Error message (Entry)

Boundary
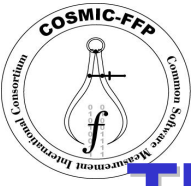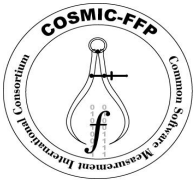
(Time sequence of movements)

7

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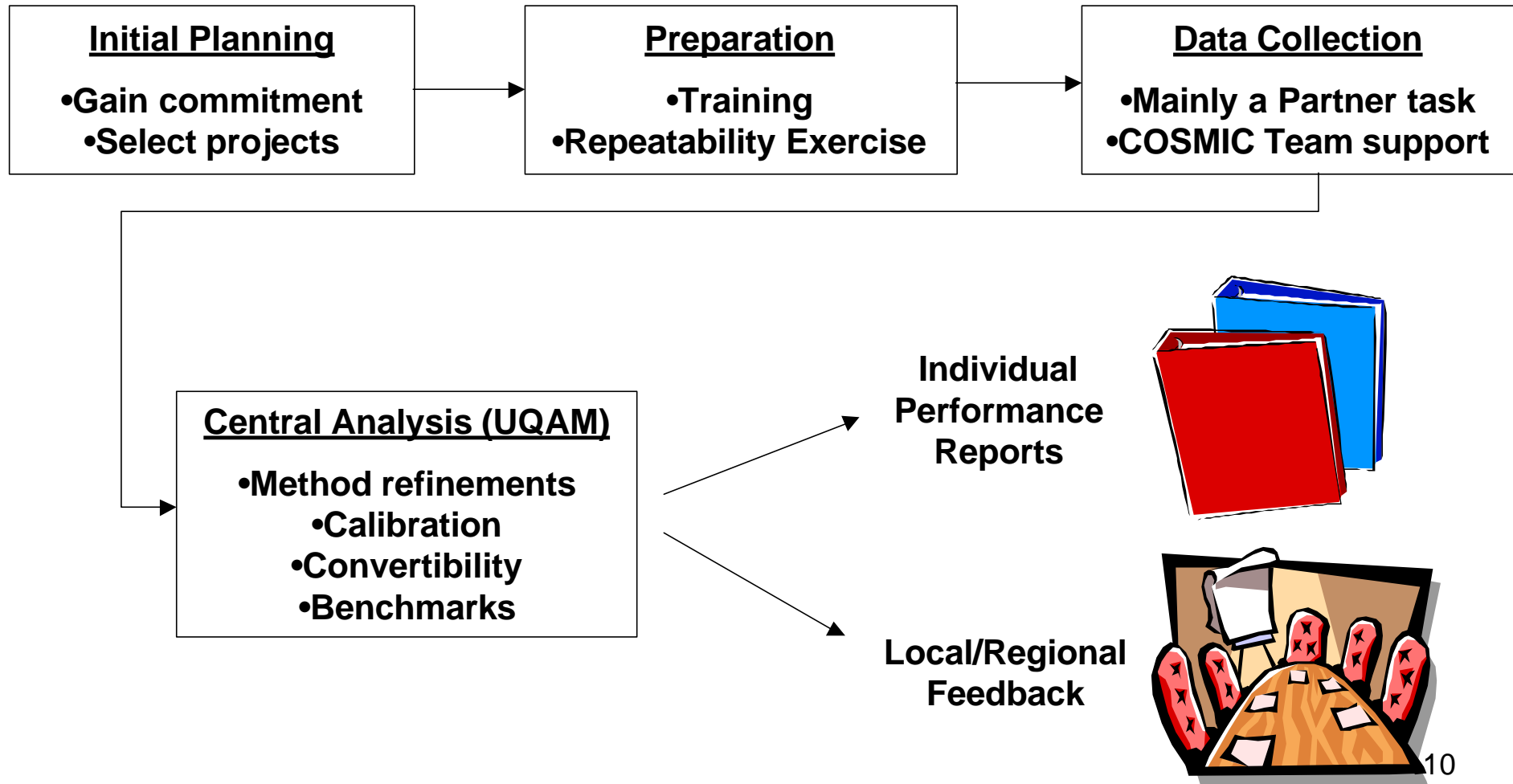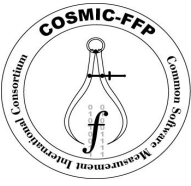- **Other Activities**

- **Conclusions**

The Field Trial aim: to advance the Method's status from 'proposal' to 'proven'

- to test for a common, repeatable interpretation of the V2 Measurement Manual under widely-varying conditions (organisations, domains, development methods, etc).

- to establish the detailed procedures, where necessary to ensure repeatable interpretation

- to test that the measures properly represent functionality and/or correlate with development effort

- to enable a full transfer of technology to the trial 'Partners'

The Field Trials process

Initial Planning	**Preparation**	**Data Collection**
•Gain commitment •Select projects	•Training •Repeatability Exercise	•Mainly a Partner task •COSMIC Team support

Central Analysis (UQAM)

•Method refinements
•Calibration
•Convertibility
•Benchmarks

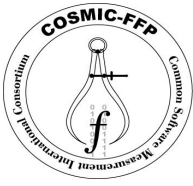**Individual Performance Reports**

Local/Regional Feedback

COSMIC FFP V2 Field Trials Participation (as at April 2000)

Started via Graduate students

- **Hydro Quebec (Canada, power utility, process control)**
- **Client of Büren & Partner Software Design (German telecoms software)**

Started or starting

- **European Aerospace Co. and maybe a N American (avionics software)**
- **UK Bank (MIS systems)**
- **Two European telecommunications manufacturers**
- **European Telecomms Operator**
- **Canadian software house**
- **Two Australian organisations(?); Japanese (?)**

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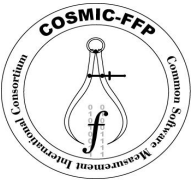
The COSMIC FFP method seems to be equally applicable to real-time software as to MIS software

- **IFPUG: classifying Elementary Processes as External Inputs, Outputs or Inquiries is OK in the MIS world, but often difficult for real-time software; the weights do not seem appropriate**

- **COSMIC FFP: the Measurement Model of Functional Processes decomposed into Data Movements (Sub-processes), seems equally easy to apply to MIS and real-time software**

- **Example development project(ESI Software Inc., Canada)**
  - **Bespoke software to monitor security for 100 buildings of a Schools Commission**
  - **MIS, real-time and telecoms components**
  - **Productivity measures indicate higher unit costs for real-time and telecoms software than for MIS**
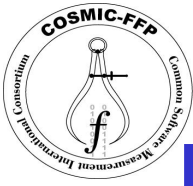
FFP (V1) measures functionality that is not normally captured by the IFPUG method

Projects from telecoms, power utility and military; Australian and Canadian

All measured by the same individual CFPS

Project	Project Type	IFPUG Size	FFP1 Size	Ratio
A	Real-Time	210	794	3.8
B	Real-Time	115	183	1.6
C	Real-Time	N/A	2604	N/A
D	Real-Time	43	318	7.4
E	Mostly MIS	764	791	1.04
F	MIS (Batch)	272	676	2.5
G	MIS	878	896	1.02

The variable size ratios imply we will not find simple conversion formulae

We are finding similar results from FFP V2
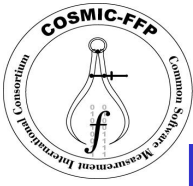
Bühren & Partner has developed a simple estimating formula based on COSMIC FFP

COSMIC FFP productivity measures fit a COCOMO-like formula:

$$\text{CFFP Productivity} = a + b * (Size)^n$$

| Estimation Method	Traditional / Expert	CFFP Prod. Function	Artemis KnowledgePlan
Absolute deviation range	-50% to +50%	-30% to +33%	-20% to +46%
Mean deviation	-14%	-2.3%	+1.2%
Standard deviation	34%	17%	26%

Notes:

Some project data used to calibrate productivity formula, which was then used to predict effort for other projects

KnowlegePlan has not been set up for CFFP measurements and its performance can be improved by better calibration

Buhren will continue to use CFFP for productivity measurement and to improve its estimating (DSMA Fall 99 Conference)

15
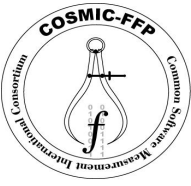
Nortel reports improved estimating from using a variant of IFPUG and FFP V1
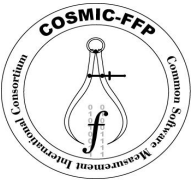
Estimating

- **Fred Bootsma analysed 100+ projects over 2 years; developed own sizing method based on IFPUG and FFP V1**

- **Applied formulae to 14 projects in 1998; mostly enhancements, some new, and significant re-use**

- **Development staff agreed the method more adequately captures the real-time project's scope**

- **Major improvement in estimating accuracy (see next slide)**

Other Benefits

- **Improved sizing resulted in better decisions on release content and time-to-market**

- **Improved estimating accuracy resulted in better planning and resource allocation**

- **Impacts of changes in project scope can now be objectively determined and managed**

- **Nortel can ill-afford cost and schedule slippage in its fast time-to-market environment**
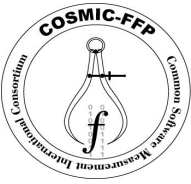
F. Bootsma, IFPUG Fall 99 Conference

16

Bootsma's IFPUG + FFP model estimating accuracy is impressive

Estimate Error Distribution
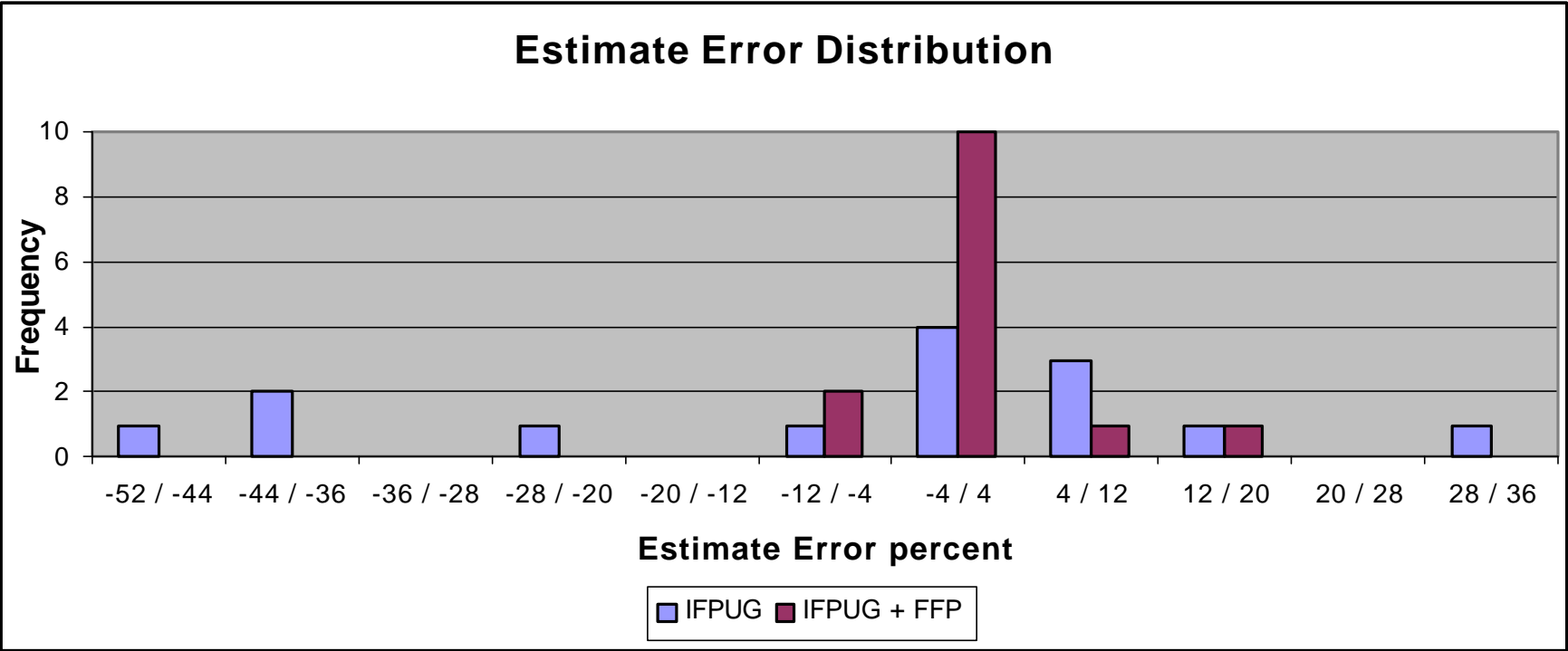
Standard deviations of Estimate Errors: IFPUG 22%: IFPUG + FFP 7%

The initial, general feedback is very positive

- 'Easy to measure without being a measurement expert'
- 'The functional sizes measured with COSMIC FFP for each of three parts (of a system) aligned with the perceived distribution of functional size'

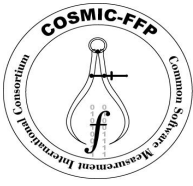(ESI Software Inc., Canada)

- 'Project Teams were able to grasp the elements of the method easily and were enthusiastic about the method'
- 'Documentation and effort needed is similar to that for applying the IFPUG method, though there is an extra step to identify layers'
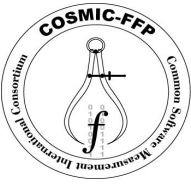
(UK Bank)

- 'Results (are) so promising, I am sure we will continue the measurements…'

(European participant)

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We need to improve the rules for distinguishing layers

- When there is an existing, well-defined physical architecture of software layers, use it.

  - Apply the CFFP model to software in each layer separately (one software layer may be the User of another software layer)

- When the software is distributed over clearly separate 'peer' components within a layer, size them separately

- When the software has evolved without a pre-defined architecture, we need better rules to define unambiguously when to separate software components into different layers which may reasonably be sized separately on the CFFP method

And we have to decide on the sizes of the Data Movements

Functional Process

Data Movement ?

Key Questions

• Do all Data Movement Types (Entries, Exits, Reads, Writes) have the same size?

• Will we need to decompose to the level of Data Element types to determine the sizes?

Analyses

• Ratio of DET's/DM. Does it vary by Data Movement Type, by Domain?

• Expert view of functionality vs CFFP size and case observations from the trials

• Do Size and Effort correlate better if Data Movement Types have different sizes or if they are all of the same size?
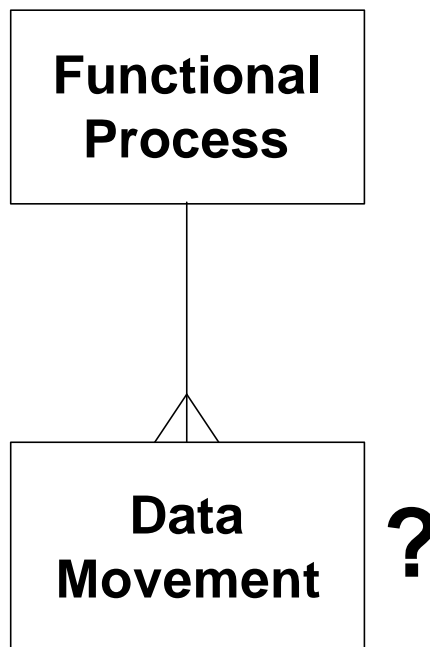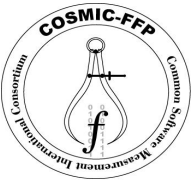
At first sight there are huge variations in the DET's/DM ratio for different Functional Processes

Case 1: Enquiry on a bank account balance via an ATM (PIN already accepted)

1 Entry (A/c No.), 1 Read (of Account), 1 Exit (Account balance)

Case 2: Input of a new Life Assurance Contract

There may be >100 DET's to be input (personal data, employment details, family details, lifestyle and health record, policy clauses, investment allocation, etc.)

**At first sight,** the Data Movements of the two cases differ hugely in size

But closer examination shows the 100 DET's are distributed over many Entries (data about different Objects) and result in many Reads to validate the data.

So maybe our starting assumption about the CFFP model will remain valid?
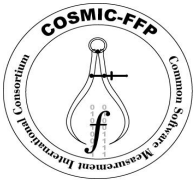
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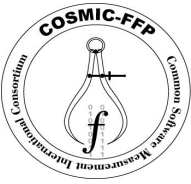- **Conclusions**
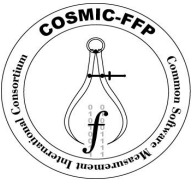
Research activities around COSMIC FFP

- **Inter-measurer consistency study (Patrice Nolin, UQAM with Hydro Quebec);**
- **Conversion from FFP V1, MkII and IFPUG (Vinh Ho,UQAM)**
- **Early COSMIC-FFP (Chapter 7) - UQAM & R. Meli (Italy)**
- **Correlation of expert view of functionality with COSMIC FFP size, using AHP (Gerhard Wittig & Eberhard Rudolph, Australia)**
- **Procedure for UML-based specifications (Valerie Bevo, UQAM)**
- **Automatic measurement from source code (Vinh Ho, UQAM)**
- **Size contribution of Technical and Quality requirements (Chris Lokan, Australian Defence Academy & UQAM)**
- **Other aspects of size - algorithmic complexity Kececi (USNRC), Bootsma, (Nortel) planning to study**
- **Supporting requirements identification with CBR approach (Jean-Marc Desharnais, UQAM)**
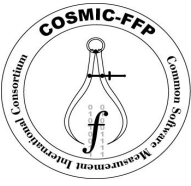
COSMIC FFP Tools, ISBSG benchmarks

- **Hierarchy Master - FFP v. 1 fully supported, V. 2 in development (Jin Ng, Australia)**

- **Sphera (Italy) - measurement support and estimating tool for V. 2 in development (Roberto Meli, Summer 2000)**

- **Commitment to deliver Field Trial results to ISBSG (and to trial participants)**
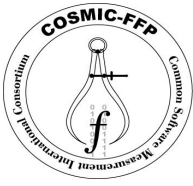
There is strong international interest

- The Measurement Manual has been translated into French, Italian, Japanese, Spanish. German to come
- The Measurement Manual has been down-loaded from over 30 countries
- We continue to present talks about COSMIC FFP at international conferences, e.g
  - ESCOM April
  - ESEPG Amsterdam, June
  - IWSS 2000, Berlin, October
  - FESMA Madrid, October
  - Australia, Japan and North America
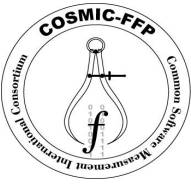- The French Association pour l'Etude de Métriques en Informatique is setting up a Study Group on COSMIC FFP

And planning further ahead…..

A proposal has been submitted by the Canadian National Body to ISO/IEC/JTC1 SC7 (Software Engineering) for a New Work Item to start putting the COSMIC FFP method through the ISO standardisation process

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COSMIC FFP method will achieve a number of 'firsts'
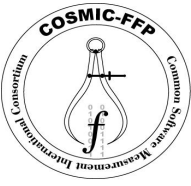
The first Functional Sizing method to:

– **be designed by an international group of experts on a sound theoretical basis**

– **draw on the practical experience of all the main existing FP methods**

– **be designed to conform to ISO 14143 Part 1**

– **be designed to work across MIS and real-time domains, for software in any layer or peer item**

– **be widely tested in field trials before being finalised**
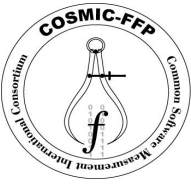
Conclusion - we're making great progress!

- **The acceptance from those who have tried the method seems good in both MIS and real-time environments**
- **All the questions that have been raised have been solved OK**
  - **more work needed on defining layers**
  - **the final weightings have to be decided**
- **Most organisations are taking longer to get started and to collect data than we had hoped, but we are getting there**
- **Our project has stimulated a great deal of research**

The COSMIC Core team would like to thank the trial participants, the researchers, especially in UQAM, and others who have helped for their support and interest.

For further information….

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