TOTAL METRICS

COSMIC

Bringing functional size measures to all software environments

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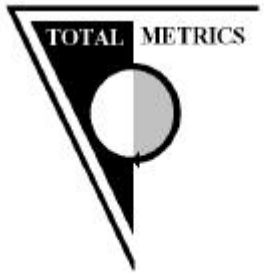


'COSMIC'

COmmon Software Measurement International Consortium

COSMIC-FFP Field Trials: 2000 Status Report

Pam Morris *(Total Metrics)*

(on behalf of the COSMIC Core Team *)

ACOSM (ASMA) Conference - Sydney Australia October 2000

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

Agenda

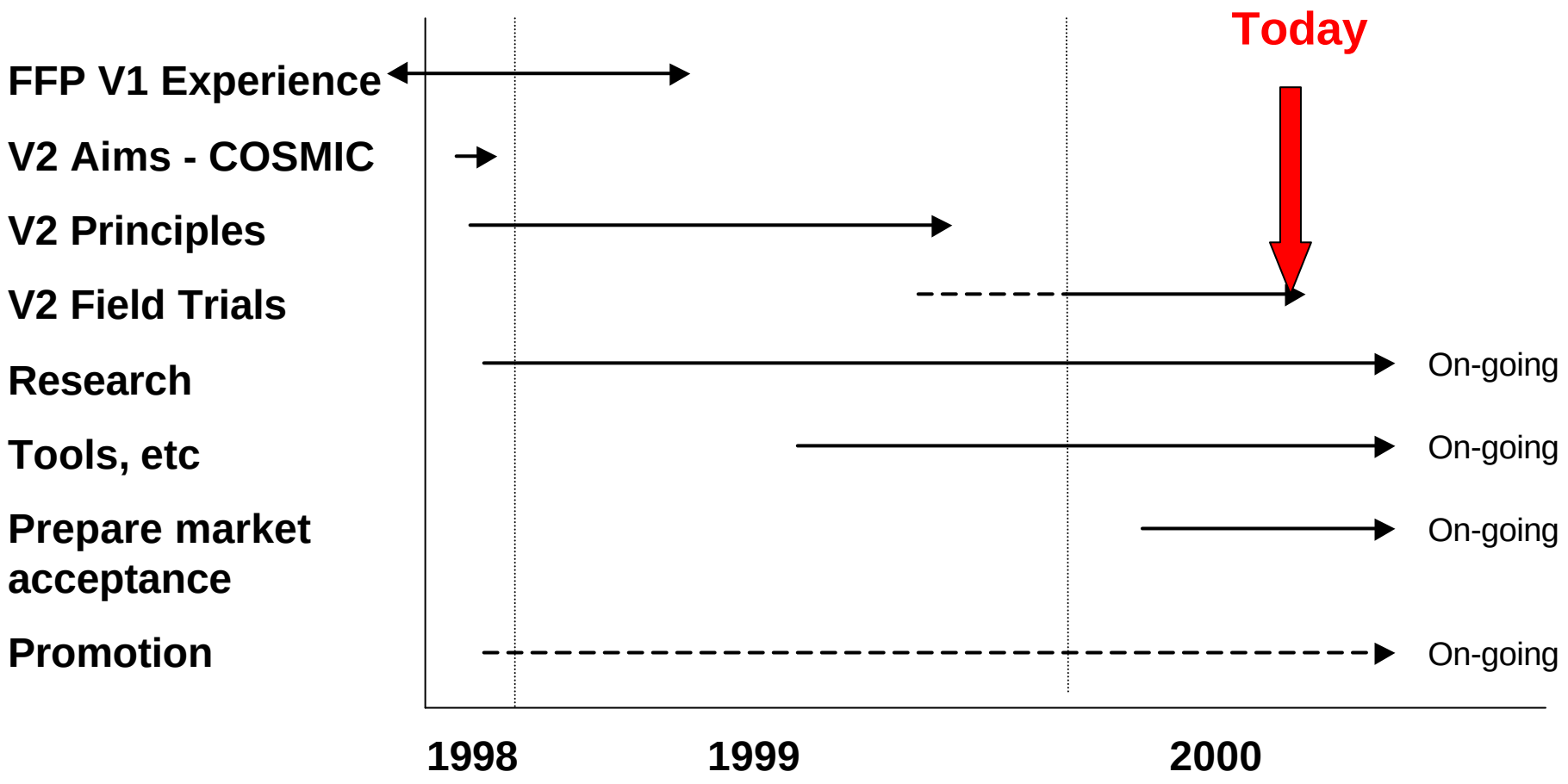
- **COSMIC FFP project aims**
- **Field trials Aims and Status**
- **Findings - overview**
- **Standards Updates**
- **Other Activities**
- **Conclusions**

COSMIC Project Aims

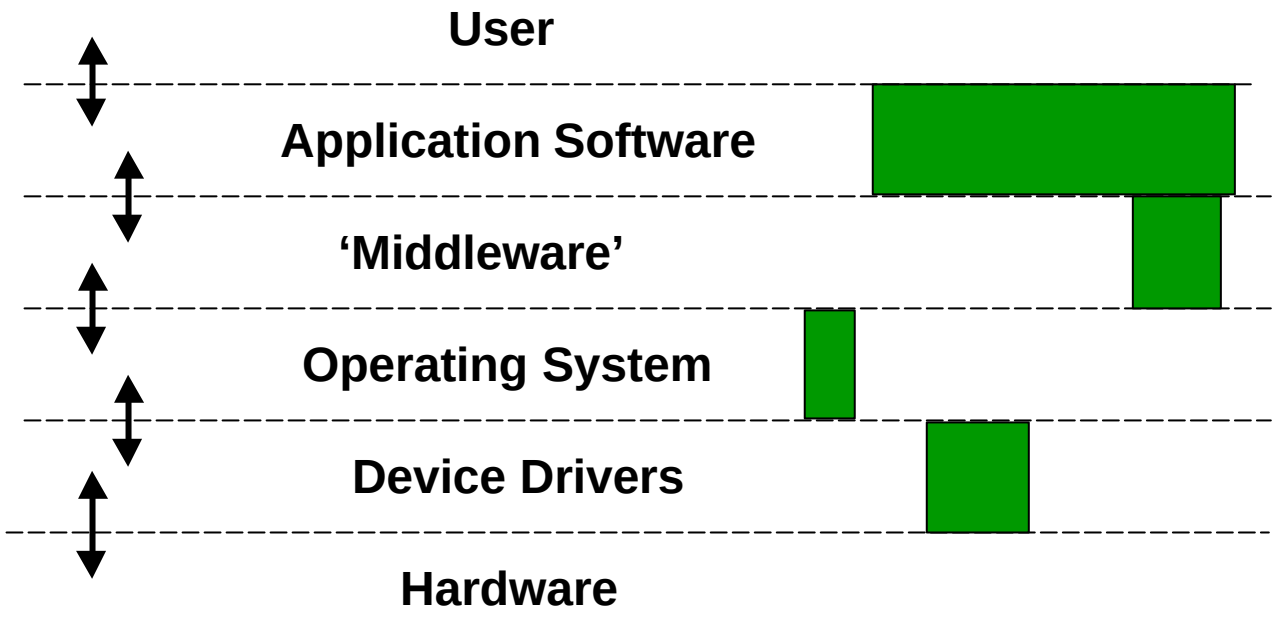
To develop, test, bring to market and gain acceptance as an industry standard, a new generation of software functional sizing methods which are applicable:

- **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.)**

Evolution of COSMIC FFP V2



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



Example: impact of requirements for Software Item 'X'

- The principal Software Item 'X' to be built
- New utility
- Modification to the OS
- New device driver

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The Field Trial Aims:

- **to test for a common, repeatable interpretation of Version 2 COSMIC 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 represents functionality**
  - **and/or correlates with development effort**
- **to enable a full transfer of FSM technology to the trial 'Partners'**

The Field Trials Process

Initial Planning

- Gain commitment
- Select projects

Preparation

- Training
- Repeatability Exercise

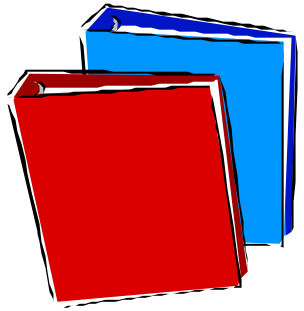
Data Collection

- Mainly a Partner task
- COSMIC Team support

Central Analysis (UQAM)

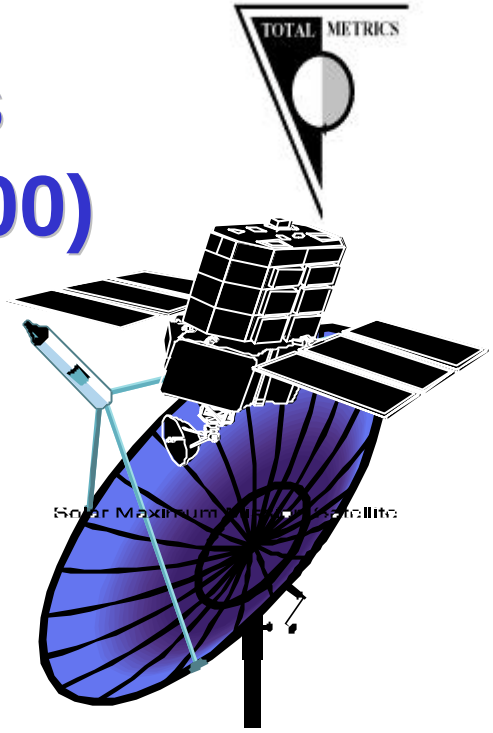
- Method refinements
- Calibration
- Convertibility
- Benchmarks

Individual Performance Reports



Local/Regional Feedback

COSMIC FFP V2 Field Trials Participationas of October 2000)

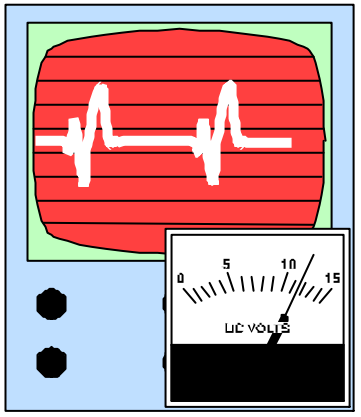


Data collection completed 5 countries in Formal contexts:

- European Aerospace Manufacturer
- UK Bank (MIS systems)
- European telecommunications manufacturer
- Australian Defence software contractor

+ Other data from:

- Australian Defence contractor
- Australian real-time software house
- Australian aerospace manufacturer
- Canadian small software house
- Canadian Defence contractor
- Canadian Energy Transportation organization



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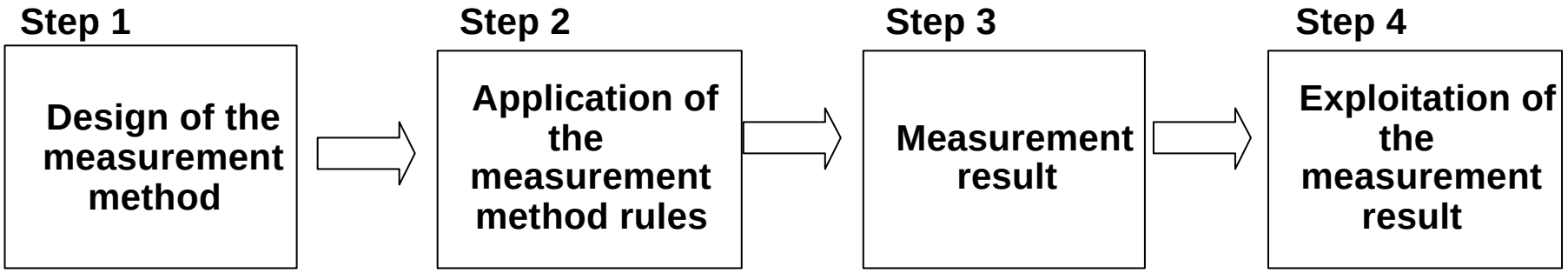
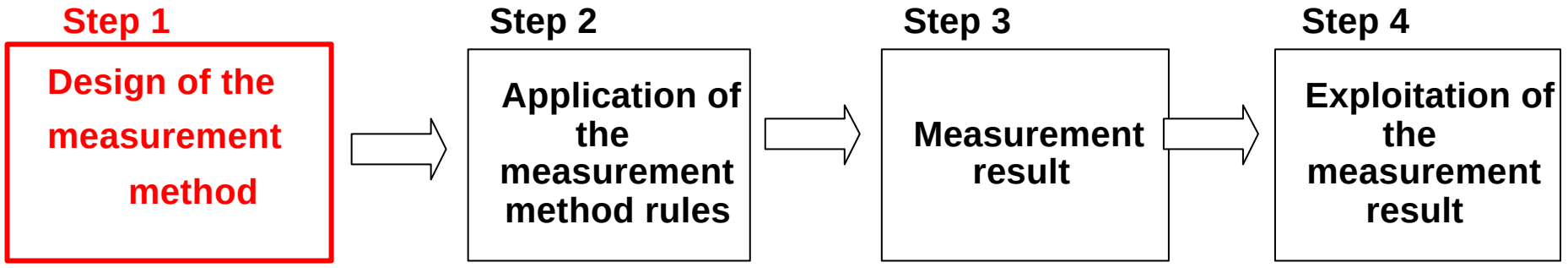
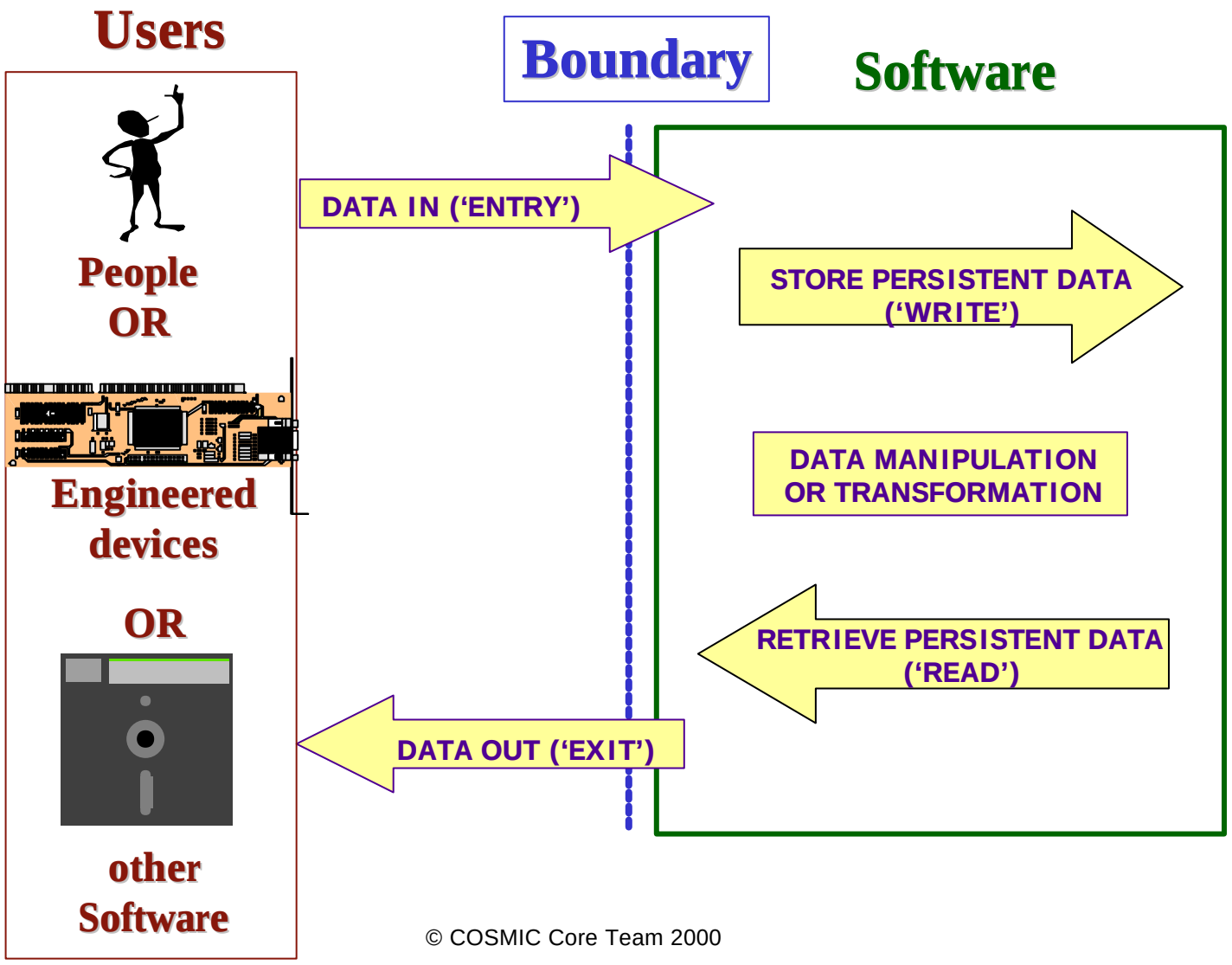
Experimental Model: Measurement Method and Its Use



Experimental Model: Measurement Method and Its Use



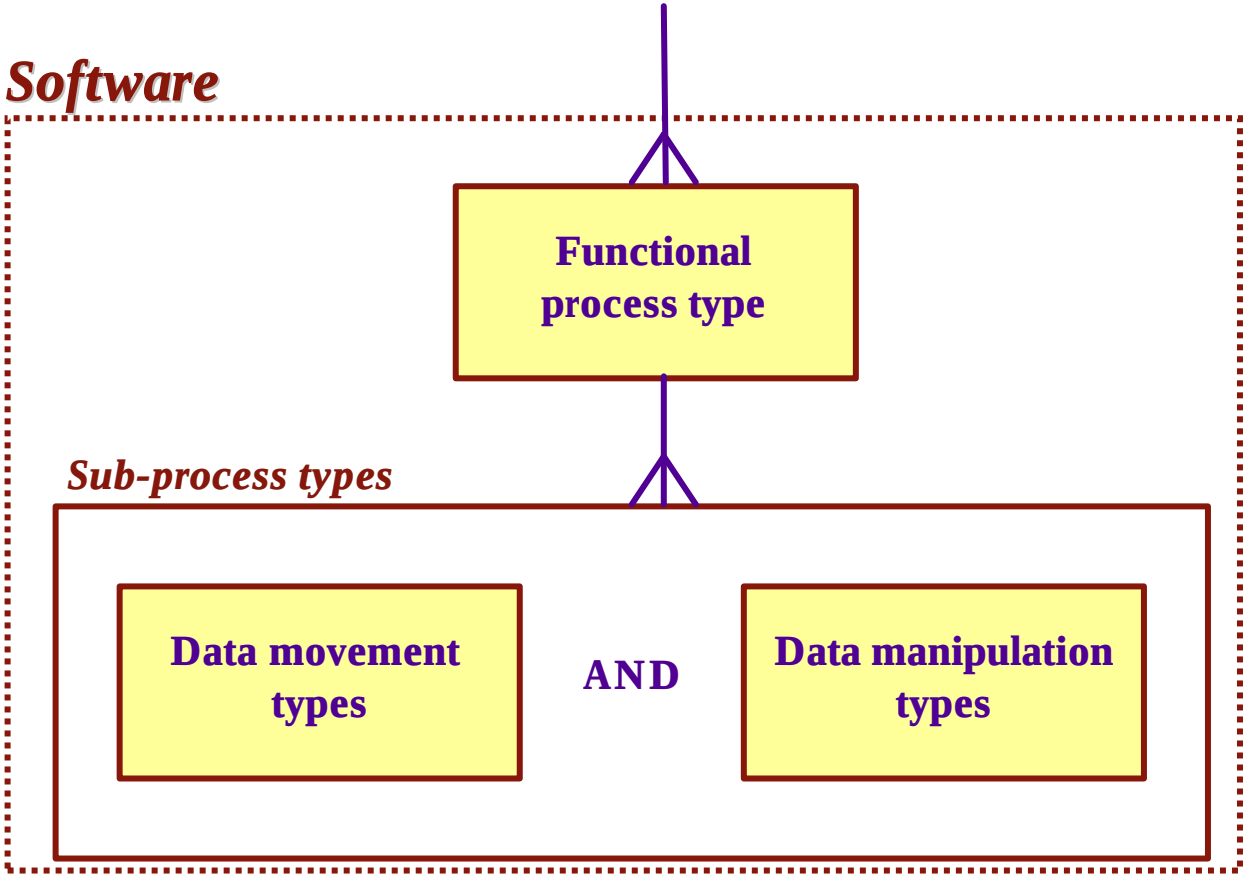
User view of software functional requirement components



COSMIC Model of Software

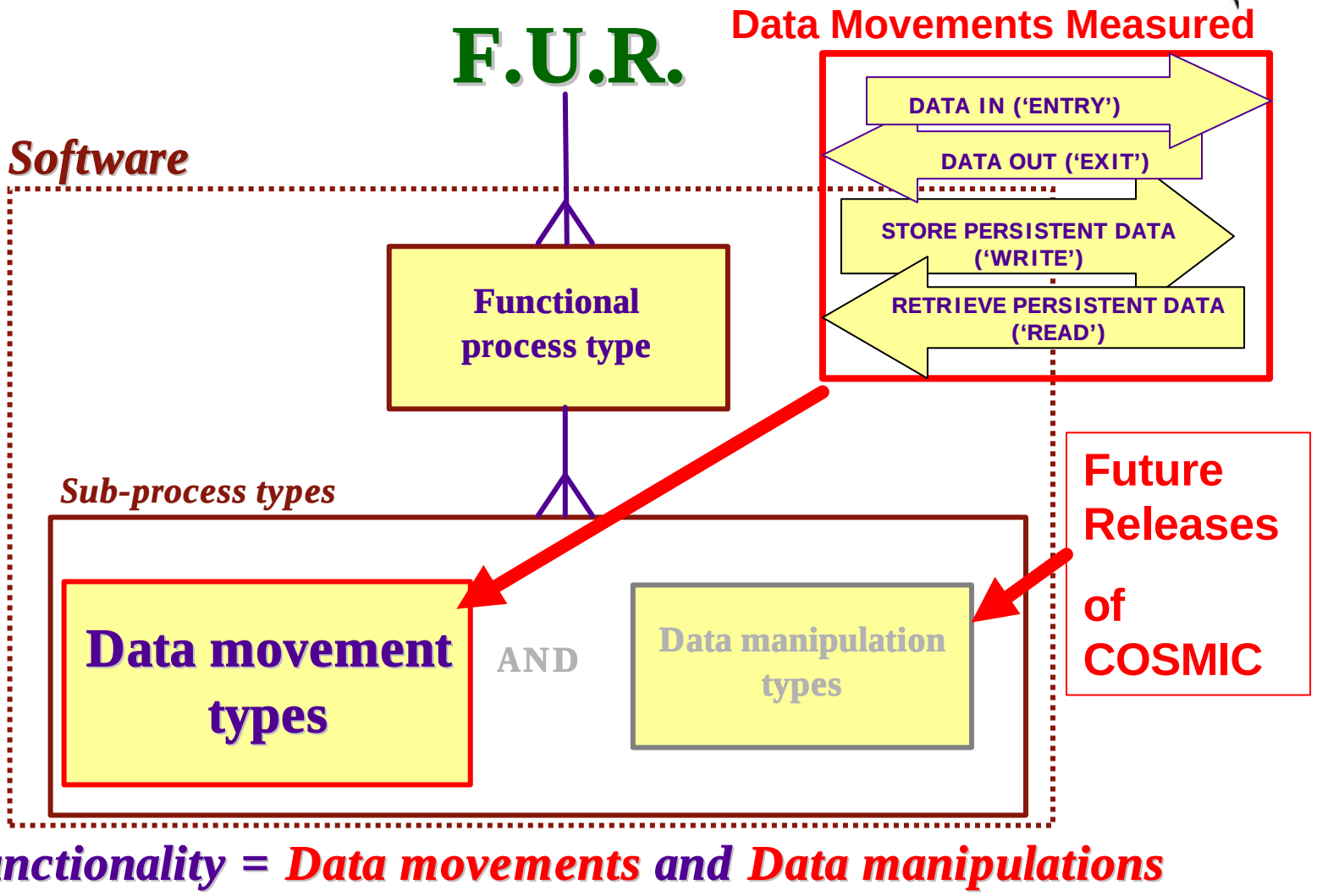
Functional User Requirements

F.U.R.

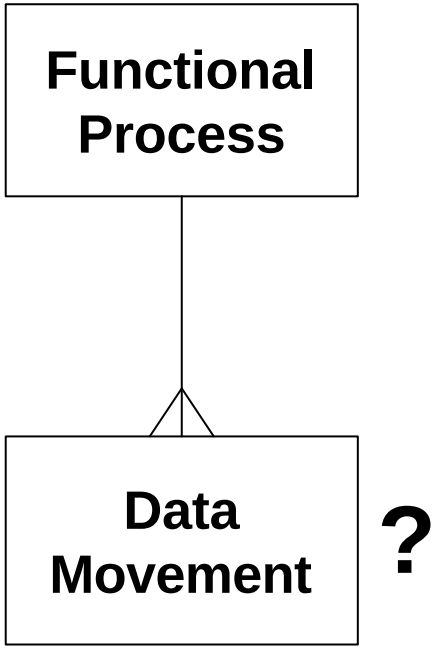


Functionality = Data movements and Data manipulations

COSMIC Model - *Version 2*

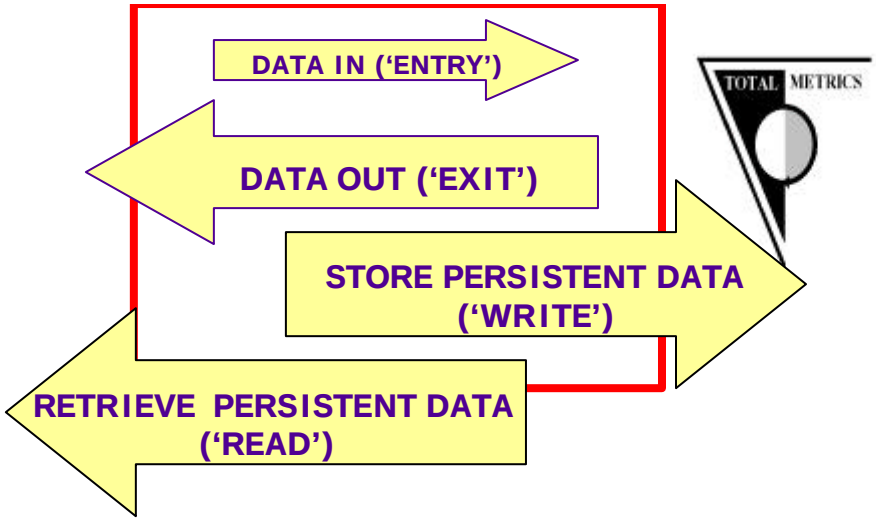


Field Trials - Decision required on the *size units* of the Data Movements



Key Questions

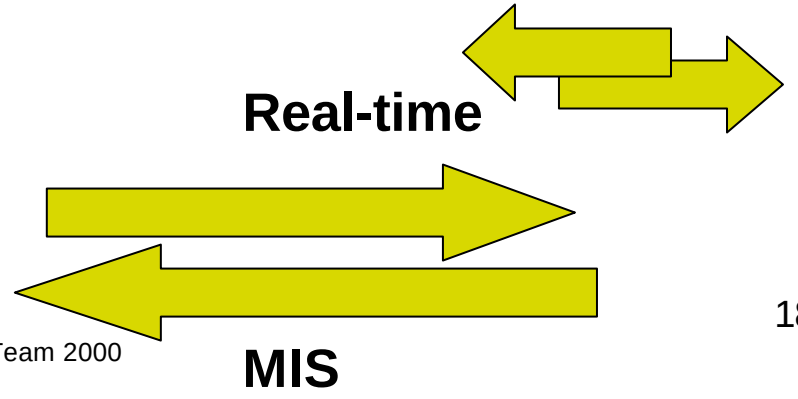
Are all Data Movement Types (Entries, Exits, Reads, Writes) the same size?



Will we need to decompose to the level of Data Attributes to determine the sizes?

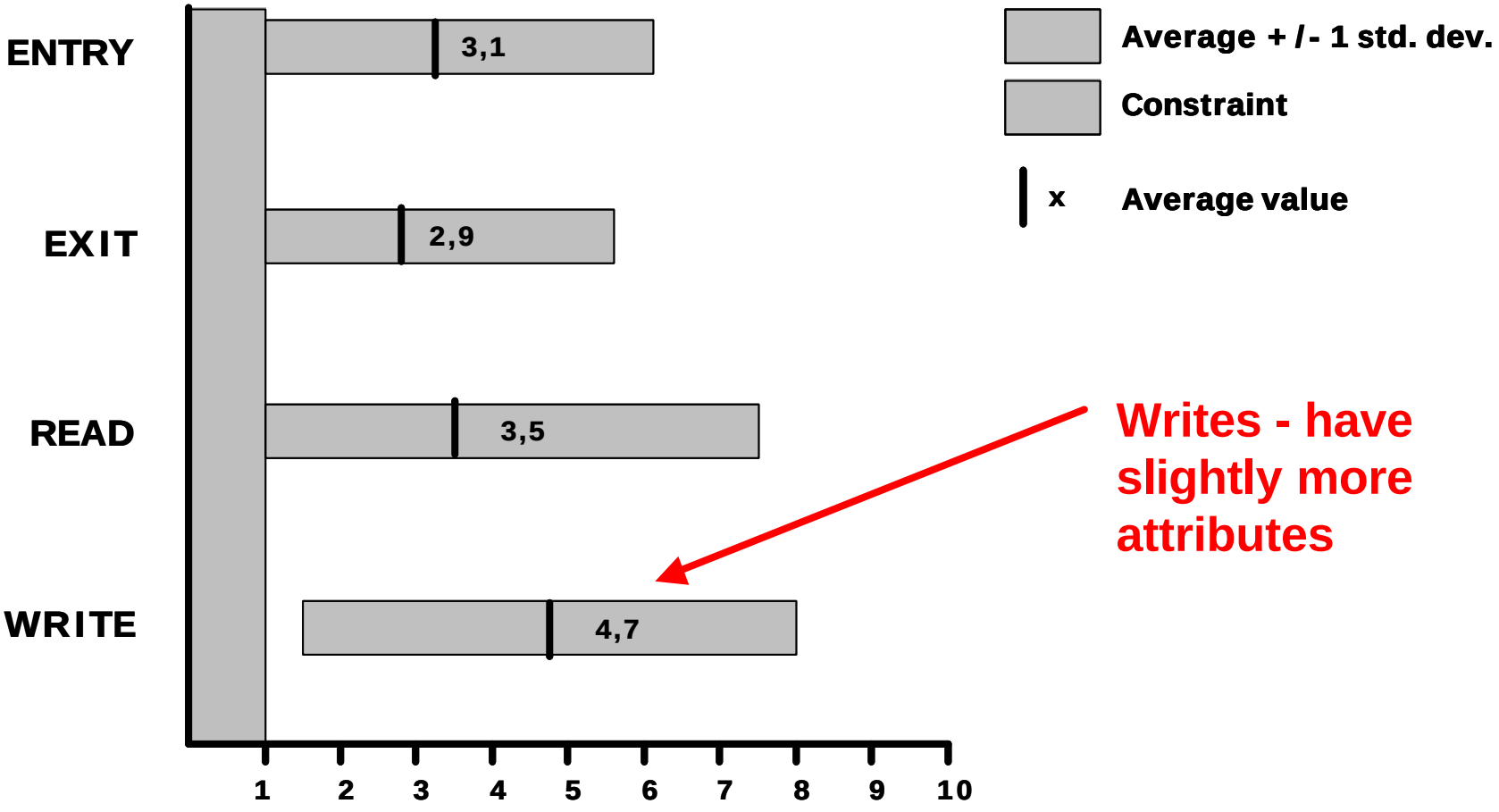
Does the ratio (Data Attributes /Data Movement) vary by data Movement Type?

Does the ratio (Data Attributes /Data Movement) vary by Domain?

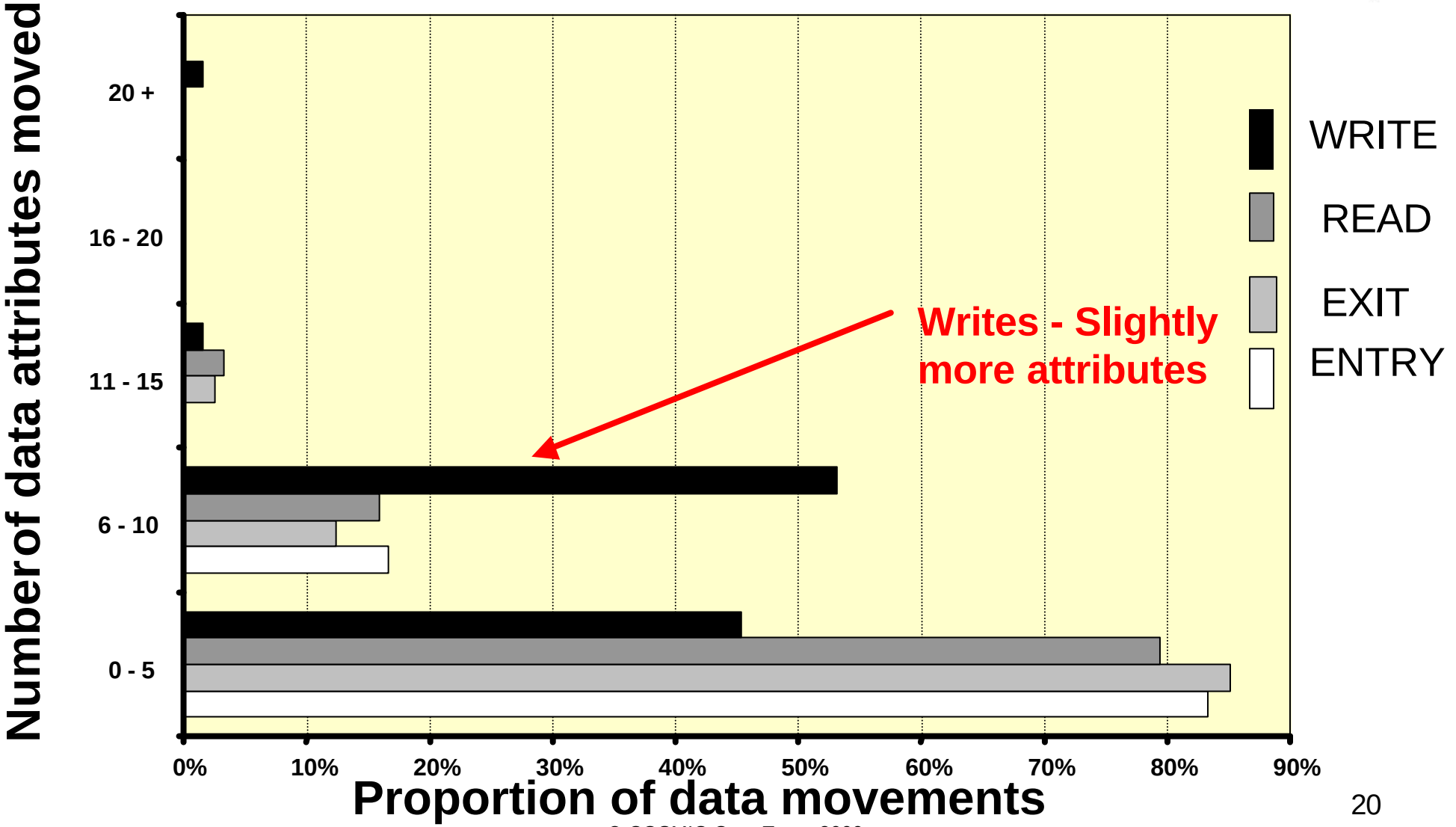


Some Initial Results

Data movements and their Data Attributes



Some Initial Results



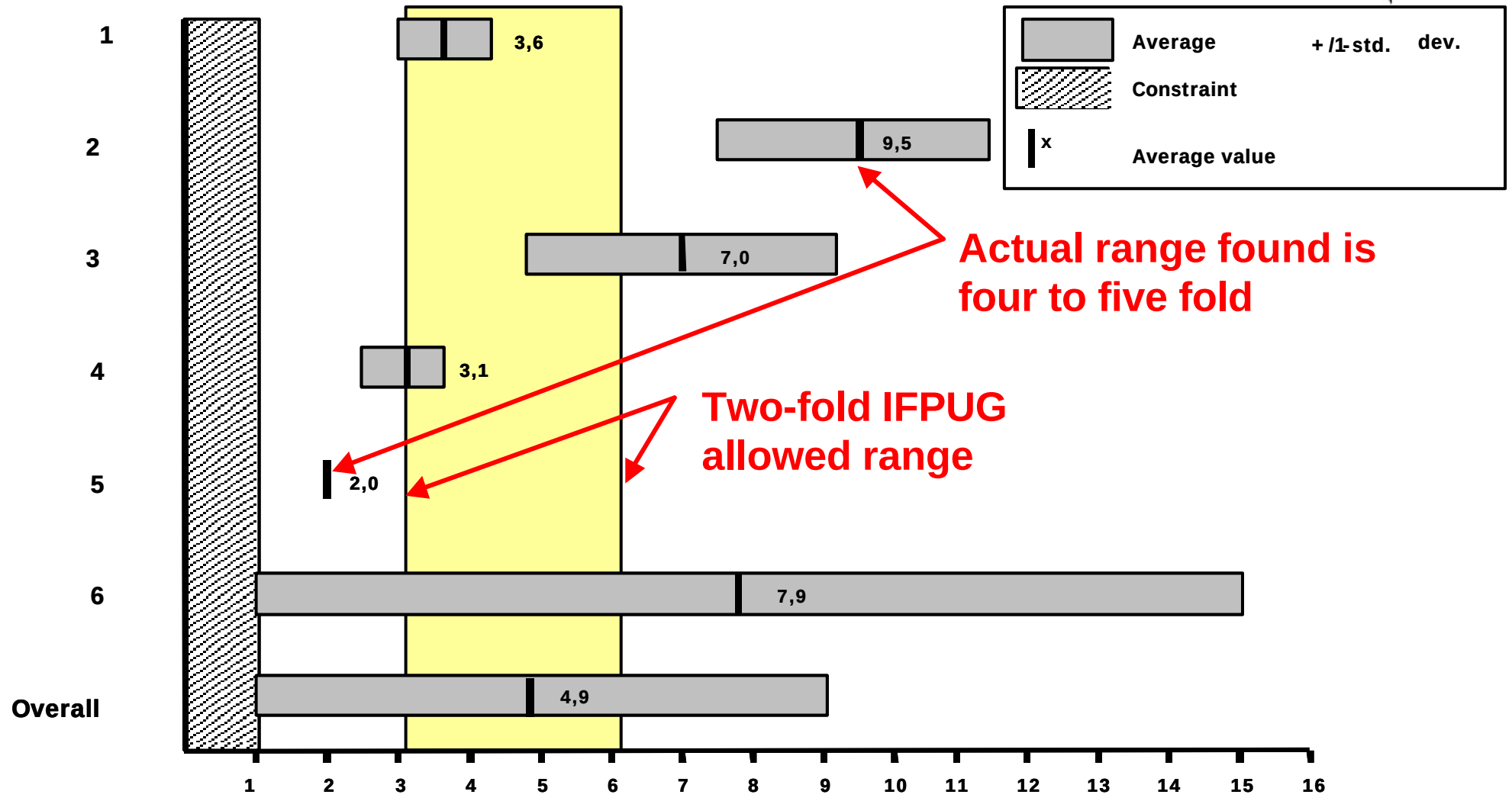
Some Initial Results

Average Size of Functional Processes

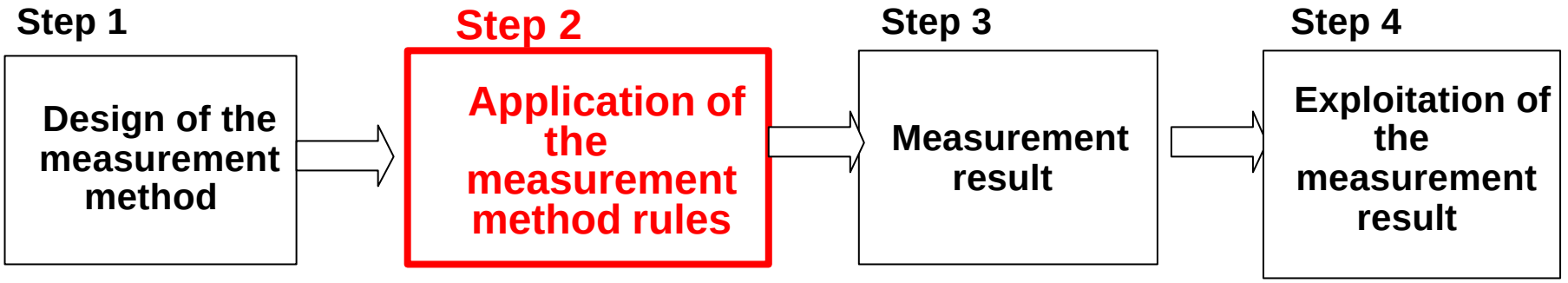
Project ID	No. of Func.	TOTAL Software size (Cfs units)	Average Size of Functional Process (Cfs units)	Standard deviation
1	9	32	3,6	0,5
2	8	76	9,5	1,9
3	8	56	7,0	2,1
4	46	142	3,1	0,7
5	4	8	2,0	0,0
6	18	142	7,9	7,1
Overall	93		**4,9**	4,1

Some Initial Results

Size of Functional Processes: Average & Distribution



Experimental Model: Measurement Method and Its Use



Measurement Method Application

PARTICIPANTS FEEDBACK:

'The Measurement Model of Functional Processes decomposed into Data Movements is equally easy to apply to MIS and real-time software'

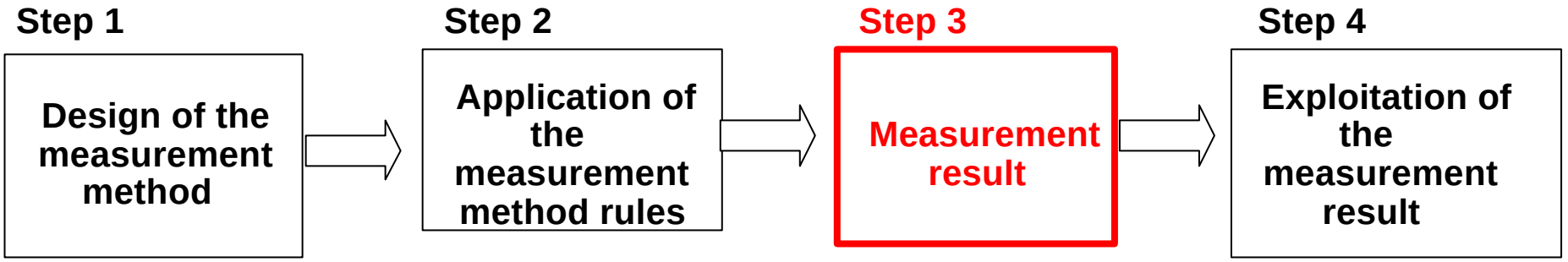
- *'Easy to measure without being a measurement expert'*
- *'Project Teams were able to grasp the elements of the method easily and were enthusiastic about the method'*
- *'Documentation and effort needed is similar to that for applying the IFPUG method, though there is an extra step to identify functional layers'*

Measurement Method Application

Comparisons with IFPUG parallel measurements:

- **classifying Elementary Processes as External Inputs, Outputs or Inquiries is OK in the MIS world, but often difficult for real-time software:**
  - **incorrect classification**
  - **has impact on size ('|weights') assigned (in IFPUG, different weights by function type)**
  - **restricts maximum size for process with a large number of sub-processes**
- **Repeatability and Reproducibility**

Model: Measurement Method and Its Use



Trial Data - Project Profile
Productivity Data Sets

Development projects : 15 projects from 4 organizations:

- **13 New Developments & 2 Enhancements**
- **Platforms: 7 PC, 4 DEC, 2 HP and 1 Compaq**
- **Completed between March 1999 and May 2000**
- **Duration: from 5 to 75 months**

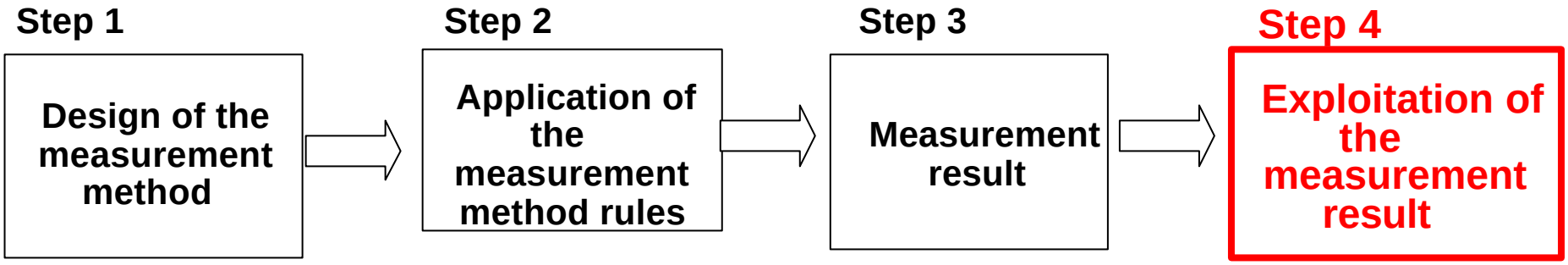
Trial Data - Project Environment Profile

Project ID	Hardware	Operating system	Prog. language
A	Hewlett-Packard	Unix 11	SLEL
B	Personal computer (PC)	MS Windows NT (4.0)	C++
C	Personal computer (PC)	MS Windows NT (4.0)	C++
D	Hewlett-Packard	HP - UX	C
E	Not available	HP – UX	C
F	Personal computer (PC)	MS Windows NT	C
G	Pentium PC	MS Windows NT 4.0	C++
H	DEC Vax	VMS	Ada
I	DEC Alpha	Unix	Ada
J	Compaq Alpha	Unix	Ada 95
K	DEC Vax	VMS	Ada
L	Dec Vzx	VMS	Ada
M	Pentium III	Windows NT	VB6
N	Pentium III	Windows NT	VB6
O	Pentium III	Windows NT	VB6

Trial Data - Project Effort Profile

Project ID	Plan & Track	Specify	Build	Test	Implement	TOTAL
A	n.a.	n.a.	252	n.a.	n.a.	252
B	220	381	1457	401	n.a.	2459
C	89	68	487	335	n.a.	979
D	n.a.	136	643	n.a.	n.a.	779
E	n.a.	115	116	n.a.	n.a.	231
F	4400	2060	1487	5055	n.a.	13002
G	1526	468	11382	254	556	14186
H	1718	n.a.	15815	1372	n.a.	18905
I	536	1304	10903	4548	n.a.	17291
J	n.a.	n.a.	20808	6772	n.a.	27580
K	32000	49000	66000	93000	55000	295000
L	10000	32000	66000	93000	55000	103500
M	9	388	64	7	29	146
N	9	5	37	17	14	82
O	9	7	88	50	52	205

Model: Measurement Method and Its Use



Trial Data - Project Delivery Rate (PDR)

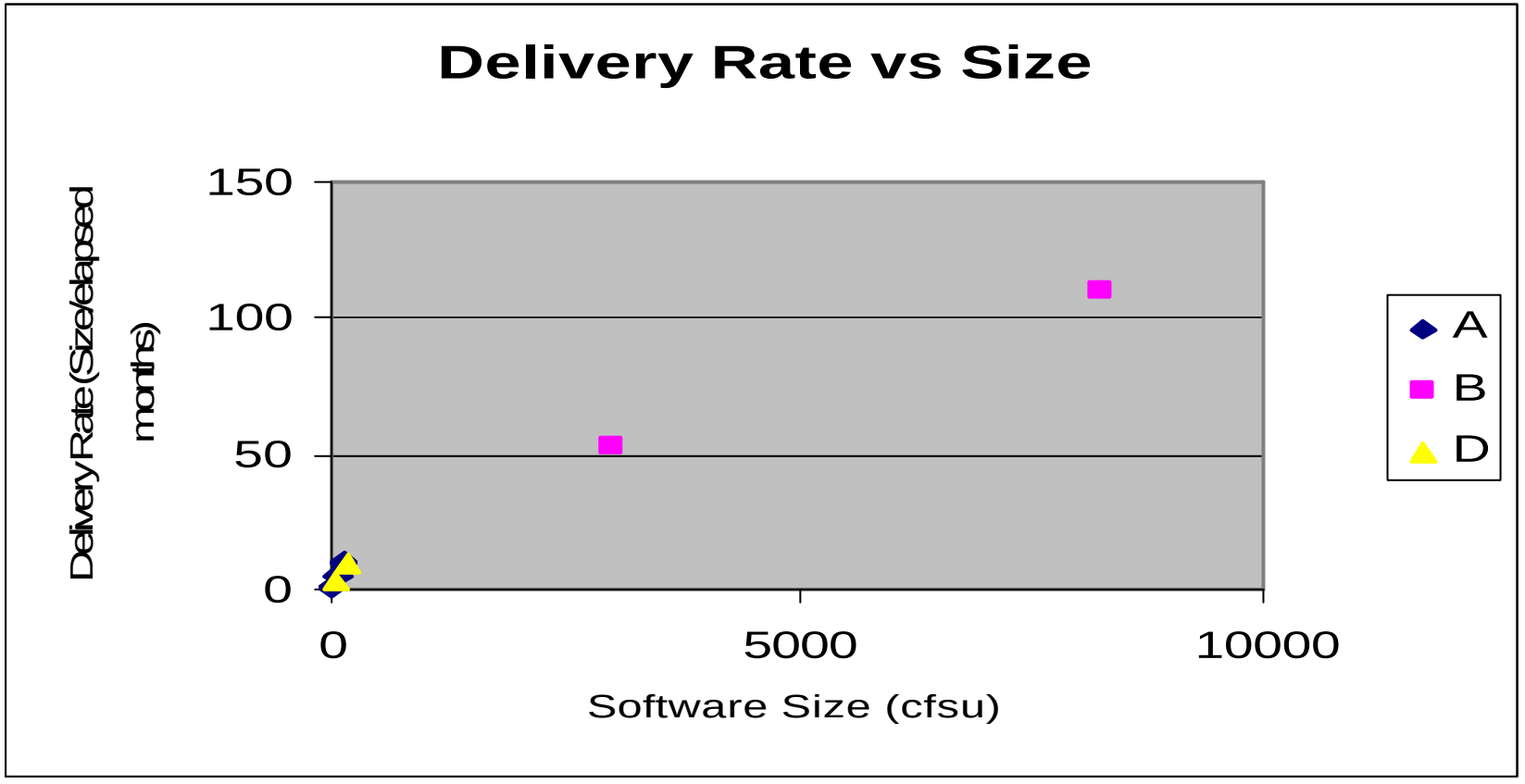
Project Delivery Rate = Effort Hours per COSMIC Functional Size Unit

Project ID	Hardware	Size - C_{fsu}	Ratio Hrs / C_{fsu}	Prog. language
A	Hewlett-Packard	32	8	SLEL
B	Personal computer (PC)	75	29	C++
C	Personal computer (PC)	56	16	C++
D	Hewlett-Packard	46	5	C
E	Not available	4	29	C
F	Personal computer (PC)	18	61	C
G	Pentium PC	97	36	C++
H	DEC Vax	150	27	Ada
I	DEC Alpha	213	21	Ada
J	Compaq Alpha	89	57	Ada 95
K	DEC Vax	713	25	Ada
L	Dec Vzx	279	64	Ada
M	Pentium III – MIS	751	1	VB6
N	Pentium III	44	1	VB6
O	Pentium III	35	4	VB6

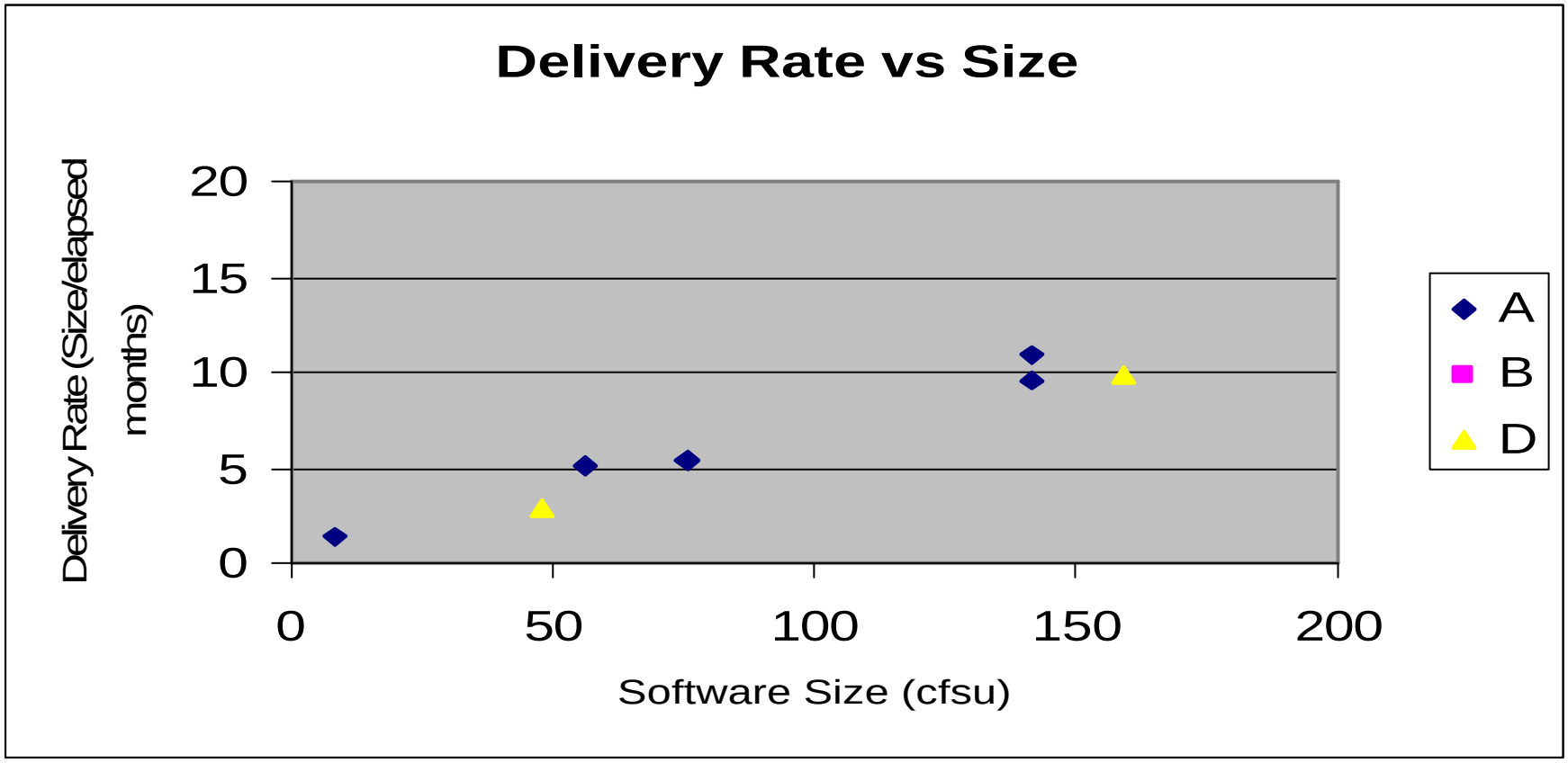
*Analysis of Project Duration - Some European Data

Delivery rate data				
Partner	**Size**	**A**	**B**	**D**
A	76	5,4		
A	56	5,1		
A	142	10,9		
A	8	1,3		
A	142	9,5		
D	48			2,8
D	159			9,9
B	8251		110,0	
B	3004		52,7	

*Duration - Delivery Rate and Size Some European Data



*Duration - Delivery Rate and Size Some European Data



Bühren & Partner have developed a simple estimating formula based on COSMIC FFP

COSMIC FFP productivity measures fit a COCOMO-like formula:

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)

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Other Updates

- **COSMIC meeting held in Montréal September 2000 to review and discuss change requests to standards**
- **Change requests will be circulated in November 2000 for final review and approval**
- **Estimated % of changes: 1% to 2%**

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Research Activities - On-going

- **Convertibility - ISO 14143-3: FFP V1,MarkII and IFPUG** *(Fetcke, Abran, Vinh Ho,UQAM)*
- **Early COSMIC-FFP** *(Meli & Santillo - Italy and UQAM)*
- **Correlation of expert view of functionality with COSMIC FFP size, using AHP** *(Wittig & Rudolph, Australia and UQAM)*
- **Procedure for UML-based specifications** *(Bevo, UQAM)*
- **Other aspects of size - algorithmic complexity and quality** *(Dé Desharnais & Kececi UQAM)*
- **Functional Reuse** *(UQAM and Bell Canada)*
- **Supporting requirements identification with Computer Based Reasoning - CBR approach** *(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, Fall 2000)**
- **Commitment to deliver Field Trial results to ISBSG (and to trial participants)**

There is strong international interest

- Translated into French and Spanish.
- Soon: Italian and Japanese.
- Measurement Manual has been down-loaded from over 30 countries
- Talks about COSMIC FFP at international conferences:
  - ESCOM April
  - ESEPG Amsterdam, June
  - IWSM 2000, Berlin, October
  - EURO-SPI, Copenhagen, October
  - FESMA Madrid, October
  - COCOMO, Los Angeles, October
  - Ericsson World-wide workshop, Montreal, October
  - ASCOM, Melbourne, Australia, October
  - French Association pour l'Etude de Métriques en Informatique training in November
  - Japanese study group - on-going

Training

Training Class (2 days with Case Study)

- **Developed at UQAM**
- **Reviewed by COSMIC members**
- **Tested at Trial Partners sites + others (Europe, North America, Japan and Australia)**
- **Ready for deployment**

Case Studies:

- **MIS**
- **Real-time**
- **ISO 14143-4**

And planning further ahead…..

Proposal submitted to ISO/IEC/JTC1 SC7 (Software Engineering) for a New Work Item to include the COSMIC FFP method through the ISO standardisation process:

Approval rate = > 90% countries

(July 2000)

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COSMIC FFP method has achieved 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 have made great progress!

- The acceptance from those who have tried the method is good in both MIS and real-time environments
- All the questions that have been raised have been solved OK
- Most organisations are taking longer to get started and to collect data than we had hoped, but got there
- COSMIC-FFP has matured significantly and is ready for ISO seal of approval

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

For further information….

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Pam.Morris@Totalmetrics.com