Application Software Maintenance and Support

An initial analysis of new data

This report provides an initial insight into the new ISBSG Maintenance & Support data, the M&S data collection standard and the initial set of M&S derived metrics produced by the ISBSG.

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Purpose of this Report

This report provides an initial analysis of the fledgling ISBSG Maintenance and Support data with the aim of publicising its existence and encouraging further contributions of applications' data.

The Need for M&S Data

Managers responsible for software portfolio Maintenance & Support need answers to the following questions:

- How do we compare to other organisations in the same industry?
- What productivity rates are being achieved?
- What proportion of time is spent on maintenance and what on support?
- What percentage of time is being spent on the different categories of maintenance: Support; Corrective & Preventative; Perfective & Adaptive?
- What defect densities are being experienced?

As the M&S repository grows the ISBSG will be able to provide answers to these and other questions.

Maintenance & Support – What are good metrics?

With the cooperation of its international members the ISBSG has defined the metrics that it expects will be most useful in the management of software maintenance and support activities[1]. This has resulted in an initial set of derived metrics from the data that the ISBSG collects on its maintenance & support data collection questionnaires. These derived metrics have supplied guidance for the initial analysis of the data and for a principle set of M&S metrics (refer to Appendix 1). These suggested principle M&S metrics are:

For the Organisation

i. Overall productivity

ii. Maintenance proportion

iii. Minor enhancement proportion

iv. Staff capacity

v. Organisation defect density

vi. Organisation call rate

For the Application

i. Application productivity

ii. Application maintenance proportion

iii. Application minor enhancement proportion

iv. Application defect density

[1] These initial derived metrics were prepared by the UKSMA Metrics Practices Committee and the ASMA SIG

v. Effort per defect

vi. Programming language proportions

vii. Database proportion

viii. Effort per location

ix. Effort per distinct user

x. Effort per concurrent user

xi. Effort per installation

xii. Effort per available hour

xiii. Effort per change

xiv. Effort per available hour of development

First Analysis of M&S Data

1. Introduction

The ISBSG has established a Software Maintenance and Support, (M&S), Repository. It has begun to be populated with data.

It is timely to begin analysing the data in the M&S. One reason is to learn from the data collected already. Perhaps a more important reason at this early stage is to publicise the existence of the Repository and encourage further contributions.

This document provides an initial analysis of the 54 applications that have been submitted to the M&S Repository.

Given the relatively small size of the data set, extreme caution should be exercised in using the results of this analysis.

2. What data is available?

Sample sizes

The M&S Repository presently contains 54 applications.

The applications were submitted in several blocks: 1 of 1 application, 1 of 2 applications, 1 of 3 applications, 2 of 6 applications, 1 of 7 applications, 1 of 9 applications, and 1 of 20 applications.

In the discussion that follows we refer to these 8 blocks as 8 “organizations”.

Data demographics

Benchmark Period: Two thirds of the applications meet the ISBSG’s recommendation that they come from a benchmark period of at least 12 months; three quarters of the applications were measured in benchmark periods that ended in 2002 or 2003.

Industry Type: Communications, Finance and Business Services, and Manufacturing are the industries best represented in the data (10, 8, 7 applications respectively).

Portfolio size and staff size are only reported for three organizations, which come from communications, financial and business services, and community services industries. Those organizations reporting this data have over 100 Full-Time-Equivalent, (FTE) maintenance and support staff.

Application Type: The applications cover a wide range of types. The most represented are financial transaction processing and accounting (8 applications), logistic planning and control (7 applications), catalogues of events/things (5 applications), network management (4 applications).

Programming Languages: Over 30 programming languages are used across the applications, with 3GLs dominant. Most applications involve at least three different languages.

Platforms: There are four different hardware/operating system platforms: IBM mainframe (27 applications), IBM PC (10 applications), small Unix platform (8 applications), VAX/VMS (3 applications).

3. Base Measures

Organisations: 100+ M&S staff, 100+ apps, 140000+ FP

Applications:

- 300–6500 FPs, median 3400, mean 3000
- 25–63000 KLOC, median 730, mean 5700
- 1–150 staff, median 12, mean 24
- 600–170000 Hrs, median 11000, mean 23000
- 1–2900 defects, median 180, mean 425
  - Hours, defects scaled to 12 month period

4. What do the numbers say?

Caution: *The following is a best effort to report genuine picture from the available data, but do not take what follows as necessarily representing the M&S norm.*

- The samples are small (2 to 54 data points)
- Sometimes different samples
- The data reflect the proportions of submissions that happen to come from different organisations

Derived Measures

Efficiency:

- 500–8500 FP/FTE, median 1600
- 10–1200 KLOC/FTE, median 300

Quality, service:

- 2–60 defects /1000FP, median 9.3, mean 16
- .01–.95 defects/KLOC, median .02, mean .18
- Median 15 hours/defect
- Turnaround about 2 days

Proportions

Defects:

- 2% extreme, 13% major, 85% minor

Support:

- Not enough data to break down the proportions

Corrective maintenance:

- Full range: 0–100%, P25–P75: 8–51%
- Median 34%, mean 38%

Preventive maintenance:

- Full range: 0–100%, P25–P75: 0–23%
- Median 0.2%, mean 16%

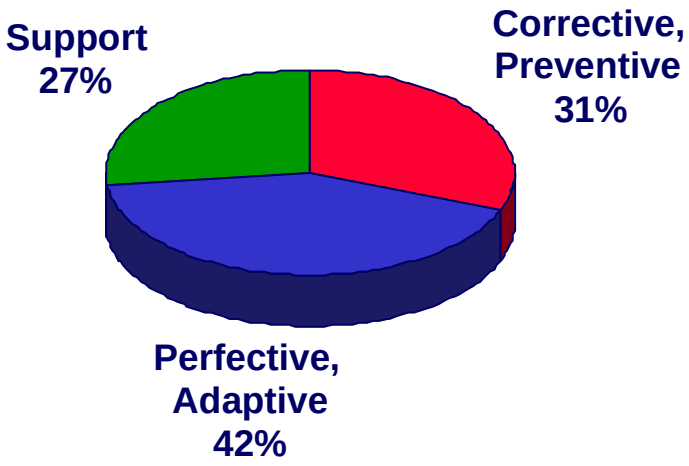
Adaptive maintenance:

- Full range: 0–70%, P25–P75: 0-0%
- Median 0%, mean 5%

Perfective maintenance:

- Full range: 0–100%, P25–P75: 0–69%
- Median 41%, mean 40%

Balance of activities



Key application indicators

A few key indicators (Application size (FP), Application size (KSLOC), Total maintenance and support effort (Hours) and Team size are summarised here:

	N	Min	P10	P25	Median	P75	P90	Max	Mean	StDev
FPs	15	300	468	1413	3410	4193	5654	6534	3016	2028
KSLOC	23	25	170	521	732	3878	5775	63580	5712	14337
Hours	54	406	1066	2452	8520	31600	69584	131880	23539	30869
Team	54	1	1	3	12	31	61	155	24	32

5. Future Analysis

As the M&S repository grows the ISBSG will broaden its analyses and will include:

- Distinct groups
- Best in class
- Organisation-level
- Representative statistics
- Factors influencing M&S costs

What to Collect

Data is collected with a Data Collection Questionnaire which is available from www.isbsg.org/usefuldoc.html The data collection questionnaire contains 4 questions about the submitter, 23 questions about the organization, and 48 questions about individual software applications. The ISBSG has identified 8 of the organization questions and 15 of the application questions as particularly important. The ISBSG has also proposed a set of 24 “derived metrics”, which may be indicators or drivers of software maintenance and support performance

When you submit your applications’ data to the ISBSG the administrator will remove your organisation identification and issue unique identification numbers so that your anonymity is protected but you can identify your applications in the repository.

Once we have a reasonable number of applications in the Repository we will send each submitter a benchmark report that compares the submitted applications with similar ones in the Repository.

The International Software Benchmarking Standards Group

The International Software Benchmarking Standards Group, (ISBSG), is a not-for-profit organisation that was established in 1997. Its formation was built upon several years of cooperation by a group of national software metrics associations that were trying to develop and promote the use of measurement to improve software processes and products for the benefit of both business and government.

The mission of the ISBSG is:

To help improve the management of IT resources by both business and government

through

the provision and exploitation of public repositories of software engineering knowledge which is standardised, verified, recent and representative of current technologies.

Body-of-Knowledge

To meet its mission, the ISBSG has established standards to measure software maintenance & support, (M&S), and software development, enhancement & re-development performance. These standards are designed to provide a “common language” of standard terms that can be understood by all practitioners. Using

these standards the ISBSG has created two data repositories; a new repository of M&S applications' data and an established software development/enhancement repository.

Development, Enhancement & Re-development

The ISBSG has, over a ten year period, established and grown a repository of data on software development, enhancement and redevelopment projects. This repository now exceeds 3,000 projects and is used by organisations worldwide for estimating, benchmarking, risk minimisation, research and infrastructure planning.

Maintenance & Support

Using its data collection standard for M&S the ISBSG has established an initial data set that will grow over time to provide valuable information to the large section of the IT industry that is responsible for M&S.

How to submit your application data

To submit your M&S application data to the repository, visit:
http://www.isbsg.org/html/usefuldoc.html
Download the Maintenance & Support Collection Package
Then, for submission information select "Submit A Project" from the vertical menu.

Incentives

In order to provide added benefits to organisations that submit multiple applications, we are pleased to offer the following:

- Submit 1-4 applications - get an Application Benchmarking Report* for each application
- Submit 5+ applications - get a free copy of the current Benchmark or Compendium book, see: "products and Services" on www.isbsg.org.
- Submit 50+ applications - get all of the above plus:
  · 5 publications of your choice
  · a free copy of the current Data Disk
  · a free, tailored Organisational Benchmark report.

* Available once there are sufficient applications in the repository to benchmark against.

Appendix 1 – Derived Metrics

1. Overall Productivity

Derivation: (Q10/Q20 adj) Portfolio Size / M&S Effort for the organisation expressed as FP/Staff Year or KSLOC/Staff Yr effort.

Definition: This is a measure of the cost effectiveness of the support & maintenance function. The measure will be expressed as FP/Total Staff Effort (TSE) per year or SLOC/TSE per Year. Depending upon the sizing measure reported by the organisation submitting the data.

Impact: None; productivity will however be a significant data item in benchmark comparisons between and within organizations.

2. Maintenance Proportion

Derivation: (Q15/Q20) Maintenance Effort / M&S Effort for the organisation expressed as a percentage.

Definition: This is the proportion of staff effort devoted to maintenance activities.

Impact: Not known – this will be a useful field for comparison and analysis. Following analysis of data a relationship may emerge.

3. Minor Enhancement Proportion

Derivation: (Q14+Q11/Q20)Adaptive + Perfective Maintenance Effort / M&S Effort for the organisation expressed as a percentage.

Definition: This is the proportion of M&S effort devoted to Minor enhancements.

Impact: Not known – this will be a useful field for comparison purposes. Following analysis of the data, a relationship between this field and cost may emerge.

4. Staff Capacity

Derivation: (Q8*Q7/Q20?)Team size * Hours per FTE staff yr / M&S Effort?

Definition: This measure will indicate the staff capacity being employed by a support and maintenance organization, but which is being utilized for some other purpose. It is likely that there will be an optimum spare capacity, which allows rapid response to problems while minimizing costs; this may be revealed by analysis of the database.

Impact: If this figure is too large, costs will be higher than necessary.

5. Organisation Defect Density

Derivation (Q21/Q10 adj) Number of Defects/Year / Portfolio Size expressed as errors/1000Fp or errors/KSLOC.

Definition: The number of errors per 1000 function points discovered in the collection year within the organizations software portfolio.

Impact: The higher the error density, the greater will be the effort and hence costs required for maintenance and support.

6. Organisation Call Rate

Derivation (Q22/Q10 adj) Number of Calls / Portfolio Size expressed as #calls/1000FP or #calls/KSLOC.

Definition: The number of calls handled during the collection year related to the portfolio size of the organization.

Impact: The expectation is that the higher the number of calls the greater will be the effort required for M&S activities.

7. Application Productivity

Derivation (Q32/Q41 adj) Application Size / Effort for the application expressed as 1000FP/FTE Staff.

Definition: This field captures the productivity of the M&S function associated with a particular application.

Impact: The lower the productivity, the higher the costs. More interesting will be the results of data analysis, which may reveal factors that have an influence on the productivity figure.

8. Application Maintenance Proportion

Derivation (Q35/Q41) Maintenance Effort / Effort for the application expressed as a percentage.

Definition: This field expresses the percentage proportion of effort expended on maintenance as opposed to minor enhancement activity

Impact: Not known. Subsequent analysis of the data may reveal some relationships.

9. Application Minor Enhancement Proportion

Derivation (Q35d+Q35a/Q41) Adaptive + Perfective Maintenance Effort / M&S Effort for the application expressed as a percentage.

Definition: This field expresses the proportion of effort expended on minor enhancements for the application.

Impact: Not known. Analysis of the data may reveal some relationship.

7. Application Defect Density

Derivation (Q49/Q32 adj) Detected Defects per year / Application Size expressed as errors/1000Fp or errors/KSLOC.

Definition: The number of errors in each of the categories for the year in which the data was collected related to the size of the application.

Impact: The higher the error density, the higher will be the cost of M&S activities for this application. This will be an important measure for comparison between organizations and within organizations between applications.

8. Effort per Defect

Derivation (Q35c/Q49) Corrective Maintenance / Detected Defects per year

Definition: This field will reveal the average effort of rectifying errors within an application.

Impact: This field is expected to be a significant driver of overall M&S costs.

9. Primary Language Code Proportion

Derivation (Q47a2/Q48 or Q47a3) Primary language KSLOC / Size of Application expressed as a percentage.

Definition: This is simply a measure that reveals the proportion of the primary programming language used to construct the application.

Impact: Not Known. Analysis may reveal some relationship.

10. Secondary Language Code Proportion

Derivation (Q47b2/Q48 or Q47b3) Secondary language KSLOC / Size of Application expressed as a percentage.

Definition: This is simply a measure that reveals the proportion of the primary programming language used to construct the application.

Impact: Not known though analysis may reveal some relationship

11. Tertiary Language Code Proportion

Derivation (Q47c2/Q48 or Q47c3) Tertiary language KSLOC / Size of Application expressed as a percentage.

Definition: This is simply a measure that reveals the proportion of the primary programming language used to construct the application.

Impact: Not Known. Analysis may reveal some relationship.

15 Database Proportion

Derivation (Q59/Q48) Database size / Size of Application expressed as a percentage.

Definition: This field in its SLOC variant is the same as the field defined as DATA within the COCOMO model.

Impact: The COCOMO model observes a relationship between this field and development effort. It seems likely that the proportion of data to code will also be a cost driver for the M&S function.

12. Effort per Location

Derivation (Q41/Q60b adj) Effort for the application / Number of user locations

Definition: This field expresses the average cost per location at which support effort must be deployed.

Impact: None. This is a statement of the position, which may be a useful comparator.

13. Effort per User

Derivation (Q41/Q60c adj) Effort for the application / Number of distinct end users expressed as hours/user

Definition: The average effort deployed to support each user.

Impact: None. This is a statement of the current position.

14. Effort per Concurrent User

Derivation (Q41/Q60d adj) Effort for the application / Number of concurrent end users expressed as hours/user

Definition: The average effort deployed to support each concurrent user.

Impact: None. This is a statement of the current position, though it may prove to be a useful comparator.

19. Effort per Installation

Derivation (Q41/Q60a adj) Effort for the application / Number of distinct installations

Definition: The average effort per installation which must be maintained.

Impact: None. This is a statement of the current position; this may prove a useful comparator.

15. Effort per Available Hour

Derivation (Q41/Q63 adj) Effort for the application / System availability

Definition: This is a measure of the effort and hence cost devoted to maintaining the system as an average for each of its hours of availability.

Impact: None. This is a statement of the current position, however it seems likely that the higher the required system availability then the greater will be the cost per hour.

16. Effort per Change

Derivation (Q65/Q41 adj)Size of changes / Effort for the applicationexpressed as FP changed/FTE staff or KSLOC changed/FTE staff.

Definition: This measure expresses the average cost of the changes to the application.

Impact: None. This is a statement of the current position which will be a useful; comparator.

17. Effort per Available Hour of Development

Derivation (Q41/Q69 adj) Effort for the application / Availability of development environment
expressed as hours/hour.

Definition: This is a measure of the effort required for M&S activity related to the availability (to the M&S function) of a development environment.

Impact: Not known. Analysis may reveal a relationship, it seems possible that the greater the availability the lower the cost.

Appendix 2 - Members of the ISBSG

The current membership of the ISBSG is:

Australia
ASMA Australian Software Metrics Association www.asma.org.au

China
Beijing SPIN Richard Wong +86-10-82327085
E-mail: blueheart2000@163.net

Finland
FiSMA (Finland Software Metrics Association) www.fisma-network.org

Germany
DASMA (Deutschsprachige Anwendergruppe fur Software Metrik and Aufwandschatzung) www.dasma.de

India
NASSCOM (National Association of Software and Service Companies) www.nasscom.org

Italy
ISMA-GUFPI (Gruppo Utenti Function Point Italia - Italian Software Metrics Association) www.gufpi.org

Japan
JFPUG (Japan Function Point User Group) www.jfpug.gr.jp

Korea
KFPUG (Korean Funtion Point User Group) www.kfpug.or.kr

Netherlands
NESMA (Netherlands Software Metrieken Gebruikers Associatie) www.nesma.nl

Spain
AEMES (Asociacion Espanola de Metricas de Software) www.aemes.org

Switzerland (Associate)
SwiSMA (Swiss Software and Service Metrics Association) www.swisma.ch

United Kingdom
UKSMA (UK Software Metrics Association) www.uksma.co.uk

USA
IFPUG (International Function Point Users Group) www.ifpug.org