# Software Metrics "State of the Art" - 2000

Peter Kulik, **KLCI**
December 2000

## Summary

This paper reports the results of **KLCI**'s worldwide survey of software metrics practices, conducted in the fourth quarter of 2000. Software metrics considered are both traditional "quality" metrics as well as process and project metrics. Based on survey responses, the most commonly used metrics (used by at least 35% of respondents) are summarized in Table 1:[1]

| |
|---|
| • Schedule Metrics (55%) |
| • Lines of Code (46%) |
| • Schedule, quality, and cost tradeoffs (38%) |
| • Requirements Metrics (37%) |
| • Test Coverage % (36%) |
| • Overall Project Risk % (36%) |

**Figure 1 - Most Commonly Used Metrics**

Of the 256 organizations that participated in our research, 37% rated software metrics as an important or integral part of their software projects, as shown in Figure 2; these organizations are considered to represent "Best Practices" for software metrics.

Best practices organizations differ from other software organizations in several key areas:

- Keep more metrics
- Select metrics that provide project insight and are consistent across multiple projects
- Are more tool-oriented
- Undertake more process improvement initiatives
- Have senior managers and QA organizations who are more involved in software metrics
- Are more likely to be located in India, Australia / New Zealand, or the US.

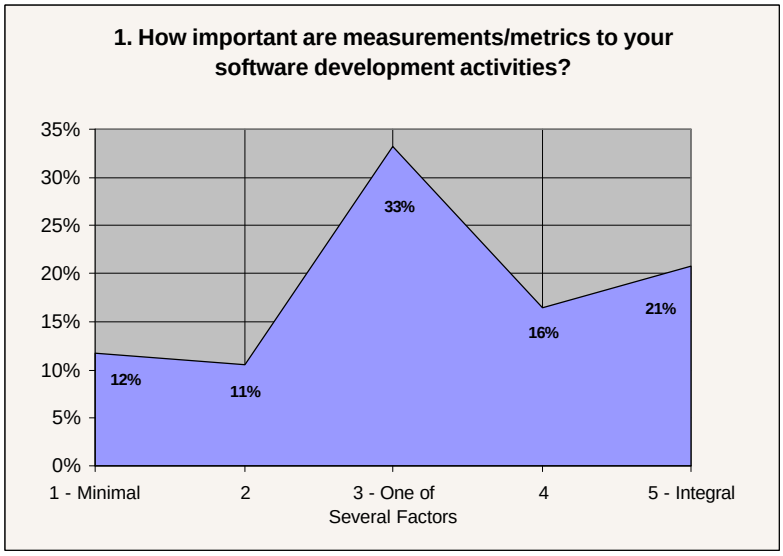


**Figure 2 – Importance of Software Metrics**

These findings are discussed in more detail in the following sections.

[1] For all tables, numbers in parentheses indicate the percent of respondents choosing the item listed.

## Demographics

256 software development organizations worldwide participated in this study. As shown in Figure 3, respondents represented a variety of organizations - from less than 15 to more than 100 developers, developing a wide variety of software, both US-Based and non-US-based. Further, 80% of respondents have some level of management responsibility.

The study was conducted using electronically distributed questionnaires, sent to individuals registered at **KLCI**'s website (http://www.klci.com), and posted in relevant Usenet newsgroups. Respondents were self-selecting; survey results include data from large companies such as Raytheon, Siemens, and Intel; government agencies such as NASA; and a variety of medium and smaller companies such as Collective Wisdom and Computer Generation.

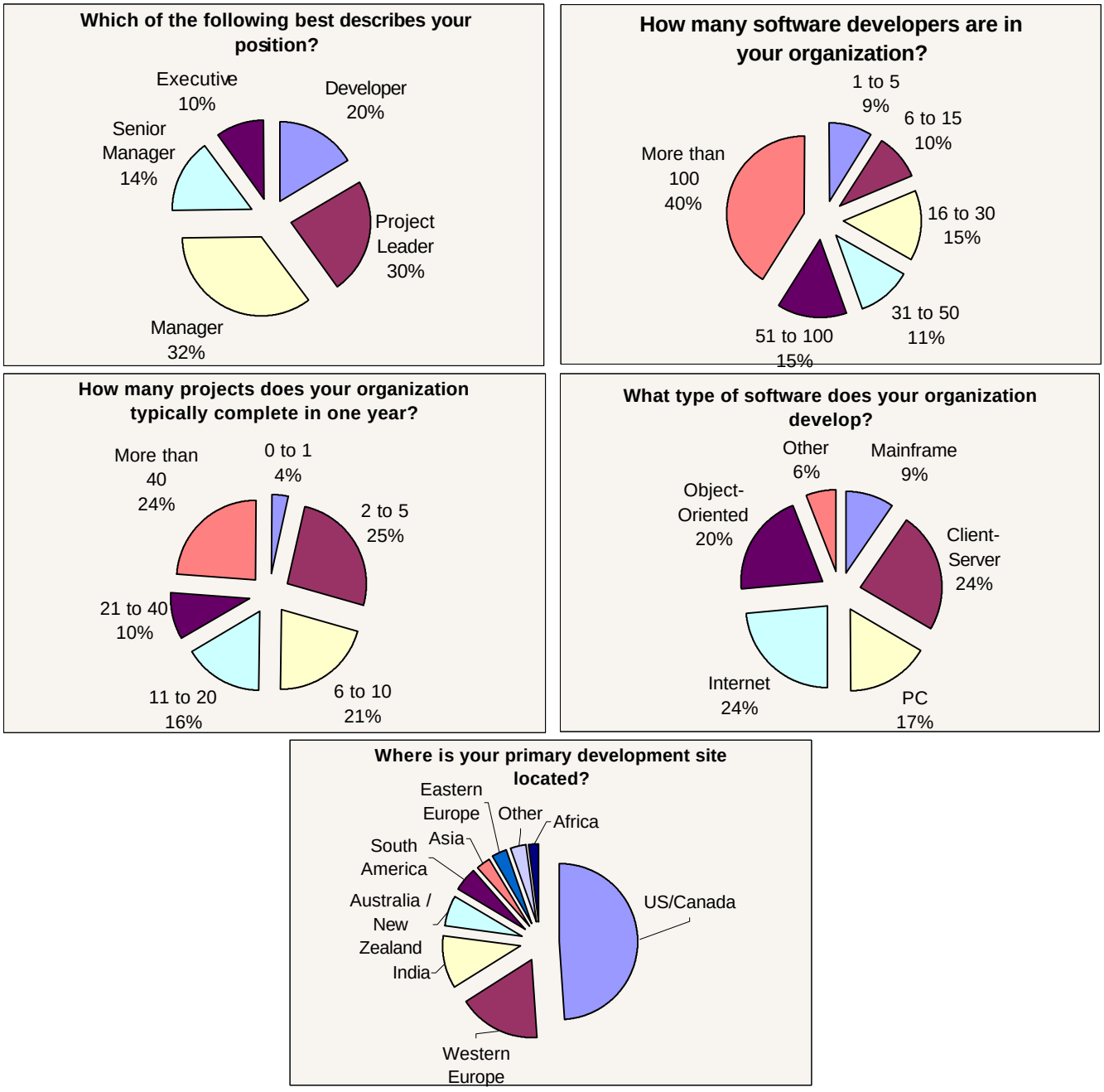


**Figure 3 - Survey Demographics**




http://www.klci.com
888-664-0484 (+1-937-433-5502)

## Profile of Metrics Practices

For the purposes of this study, best-practice organizations are defined as those who reported that software metrics are an important or integral part of their software projects, as shown in Figure 2 (page 1). The metrics kept by best-practice organizations and others are shown in Figure 4.

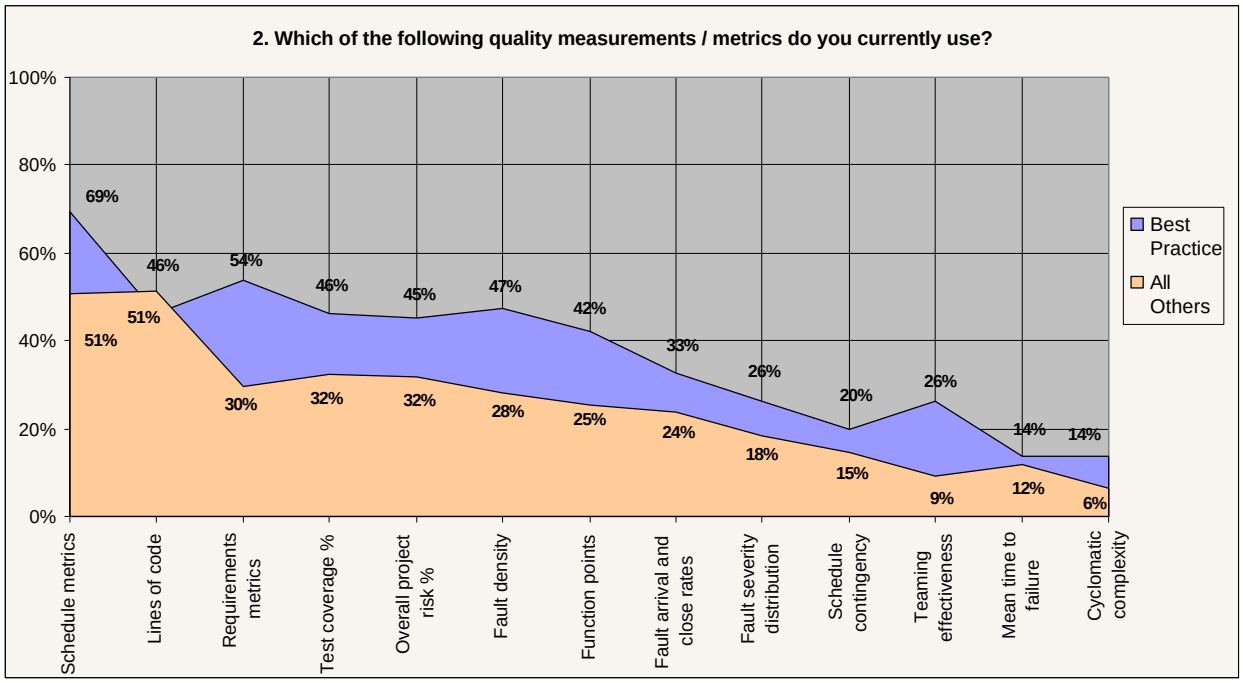


**Figure 4 - Metrics Practices**

As summarized in Figure 5, the metrics kept by best practice organizations span both traditional QA metrics and process metrics such as requirements and project risk. Best practice organizations also typically keep more metrics than others – an average of 7 metrics per organization, compared to an average of 4.5 metrics for all others.

| "Best Practice" Organizations | Other Organizations |
|---|---|
| • Schedule metrics (69%) | • Lines of code (51%) |
| • Requirements metrics (54%) | • Schedule metrics (51%) |
| • Fault density (47%) | • Test coverage % (32%) |
| • Lines of Code (46%) | • Overall project risk % (32%) |
| • Test coverage (46%) | • Requirements Metrics (30%) |
| • Overall project risk % (45%) | |
| • Function points (42%) | |
| • Fault arrival and close rates (33%) | |

**Figure 5 - Comparison of Top Metrics for "Best Practice" and "Other" Organizations**




http://www.klci.com
888-664-0484 (+1-937-433-5502)

## Criteria for Choosing Metrics

When asked why the specific metrics identified were chosen, participants responded as shown in Figure 6.

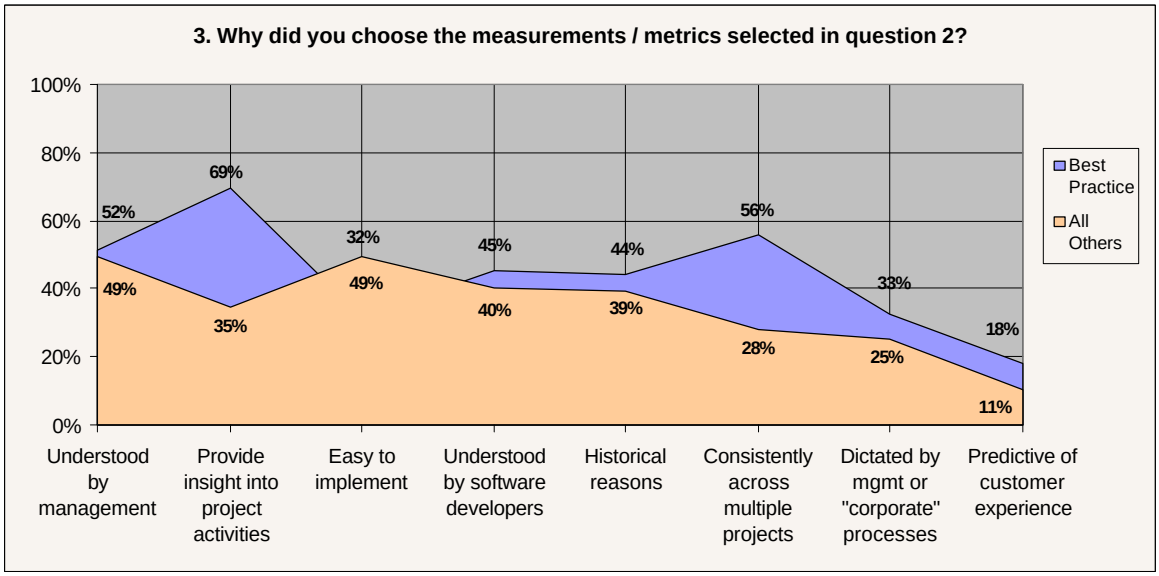


**Figure 6 – Metrics Criteria**

Best practice organizations choose metrics using criteria different from those used by other organizations. While best practice organizations prioritize insight into project activities and consistent application across multiple projects, other organizations' top criteria are ease of implementation and understanding by management.

As shown in Figure 7, senior managers in best practice organizations are more involved in choosing metrics, while other organizations tend to leave this decision to QA organizations and individual software teams.

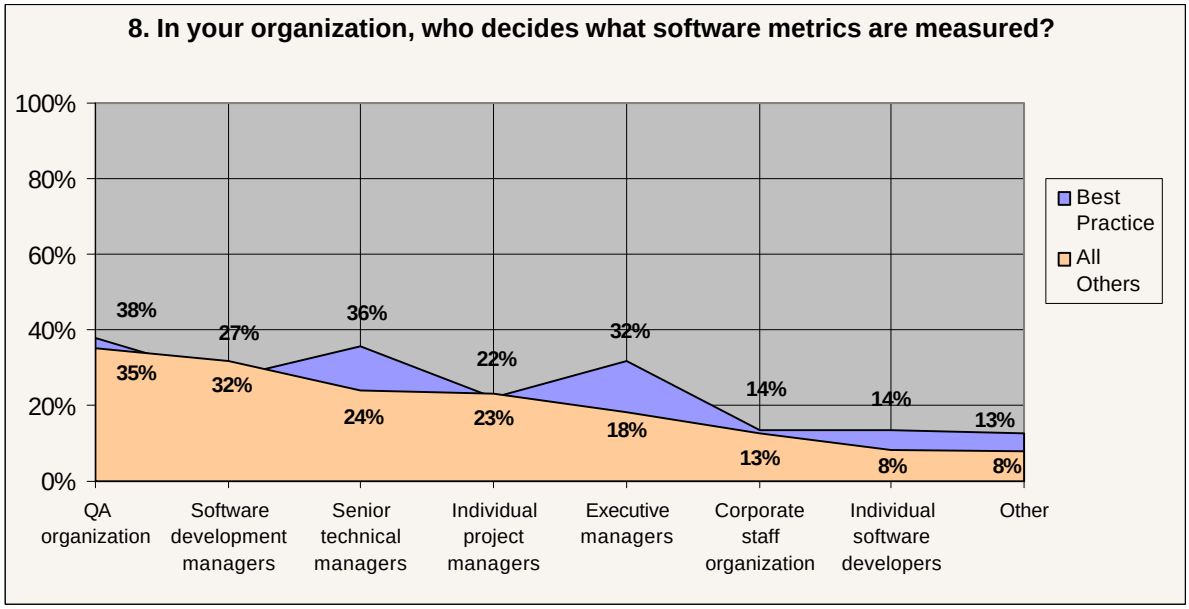


**Figure 7 – Metrics Decision-Makers**




http://www.klci.com
888-664-0484 (+1-937-433-5502)

## Metrics Tools

As shown in Figure 8, best practice organizations are more likely to use tools to assist with software metrics than are other organizations. Best practice organizations also use more tools – an average of nearly 2 tools each, compared to 1.3 tools for each other organization.

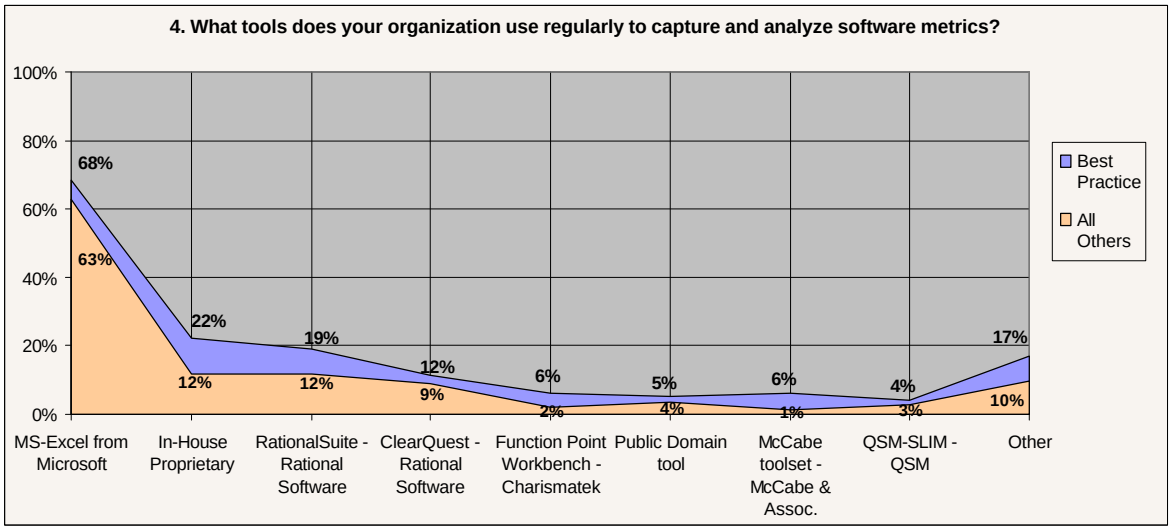


**Figure 8 – Metrics Tool Usage**

Overall satisfaction with metrics tools was low, averaging just 2.6 (i.e. somewhat dissatisfied) on the scale of one to five. Users of a greater number of tools reported generally higher satisfaction, suggesting that a portfolio of tools is better suited to their needs than any single tool. Responses are shown in Figure 9:

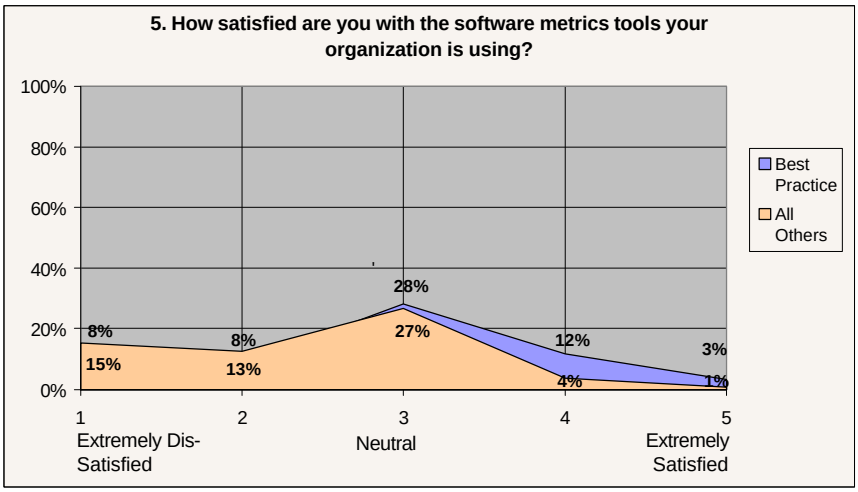


**Figure 9 – Metrics Tool User Satisfaction**

While the most common tools are MS-Excel-based and in-house proprietary tools, users of packaged metrics tools generally reported higher satisfaction. Function Point Workbench scored the highest level of user satisfaction, at 3.9 (i.e. somewhat satisfied) on a scale of one to five, while MS-Project had the lowest level of user satisfaction, scoring 2.0 (i.e. somewhat dissatisfied). Users of the most common commercial packaged tools reported levels of satisfaction of approximately “Neutral”, which is the same level of satisfaction as reported by users of public domain tools.




http://www.klci.com
888-664-0484 (+1-937-433-5502)

## Year-Over-Year Comparison

Little change was seen year-over-year in the importance of metrics in software development, as shown in Figure 10.

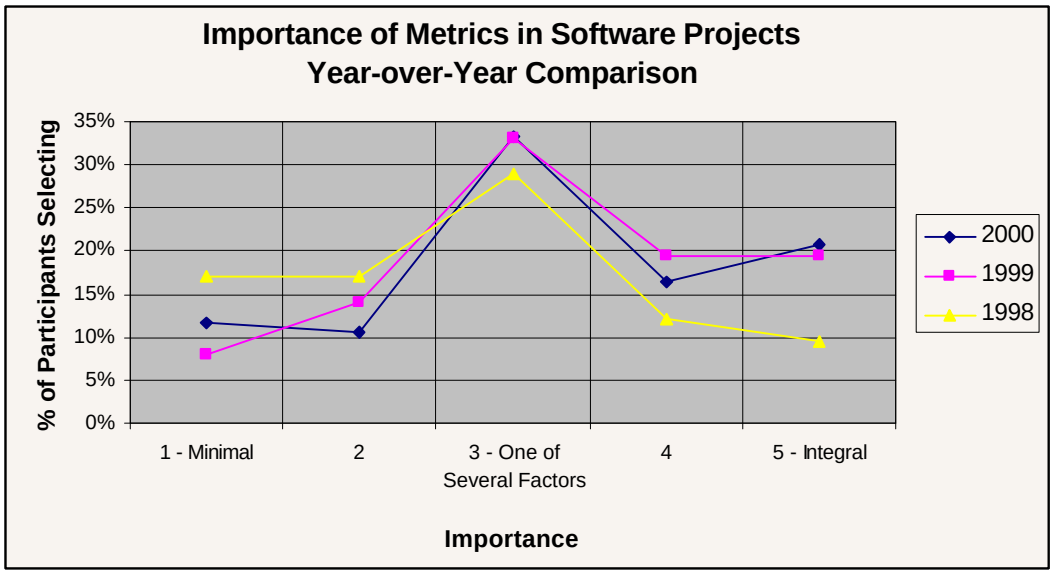


**Figure 10 – Year-over-Year Comparison**

The top process improvement initiatives undertaken by participants in 1999 were reported to include:

- Improve project management (49%)
- Better manage software processes (40%)
- Increase use of metrics (31%)

These initiatives have driven some changes in the mix of metrics kept by software organizations, as shown in the following comparison for best practice organizations:

| Metric – Best Practice Organizations | Change in Usage |
|---|---|
| Schedule Metrics | ↑ +5% |
| Lines of Code | ↓ -10% |
| Requirements Metrics | ↑ +4% |
| Test coverage % | ↑ +5% |
| Overall project risk % | ↑ +9% |
| Fault density | ↑ +11% |
| Function Points | ↑ +3% |
| Fault Arrival and Close Rates | ↓ -3% |

**Table 11 - Changes in Individual Metrics**

The general trend among best practice organizations appears to be towards capturing an increasing number of metrics, which is consistent with the improvement initiatives identified above.




http://www.klci.com
888-664-0484 (+1-937-433-5502)

## Conclusion

Software metrics can be used as a key part of software project management to improve the performance of software development groups. "Best practice" organizations are those that use metrics as an important or integral part of their software projects.

Whether improving a current metrics program or establishing a new one, all organizations can learn from the practices of these "best practice" organizations:

- Ensure that metrics programs support your organization's business objectives
- Choose metrics that provide insight into project activities and can be used across multiple projects.
- Use metrics in project management decision-making
- Involve senior management
- Link metrics and process improvement initiatives

## About the Author

Peter Kulik works with software organizations and project teams to implement software process improvement initiatives, especially in the areas of Requirements Management, Software Metrics, and Software Risk Management. As Managing Director of **KLCI** (http://www.klci.com), he has published widely on various software project management topics. Some recent clients have included ABP, Compaq, Guide Datakonsult AB, Halifax plc, NCR, Royal Bank of Canada, and Siemens.

## Resources

Recent articles:

- Kulik, Peter J., "A Practical Approach to Software Metrics," IEEE *IT Professional*, Jan/Feb 2000.
- Chikofsky, Elliot, and Rubin, Howard, "Using Metrics to Justify Investment in IT", IEEE *IT Professional*, Vol. 1 No. 2, March/April 1999.
- Dekkers, Carol A., "Tame your Process with Metrics", *Enterprise Development*, Vol. 1 No. 7, June 1999.
- Kulik, Peter J., "Software Metrics Best Practices", *Software Q/A Magazine*, Vol.5 No.2, April/May 1998.
- Payne, Jeffery E., "Quality meets the CEO", *Software Testing & Quality Engineering*, Vol. 1 No. 3, May/June 1999.
- Weigers, Karl, "A Software Metrics Primer", *Software Development*, Vol. 7 No. 7, July 1999.

Classic texts:

- Grady, Robert B., and Caswell, Deborah L., Software Metrics: Establishing a Company-Wide Program, Prentice-Hall, Inc., 1987.
- Putnam, Lawrence H., and Myers, Ware, Measures for Excellence, Prentice Hall - Yourdon Press, 1992




http://www.klci.com
888-664-0484 (+1-937-433-5502)