

LIST OF SUCCESS INDICATORS AND METRICS

The following sections (B1 – B5) show the list of success indicators and their corresponding metrics. The list is taken from the output of a systematic review on evaluating SPI initiatives.

B1: Process measures

Success Indicator	Commonly Used Metrics
Efficiency	<ul style="list-style-type: none"> i) Rework efficiency = No. of defect / defect fixing effort ii) Defect removal efficiency, $DRE = E/(E+D)$ <ul style="list-style-type: none"> - E is the number of errors found before delivery - D is the number of errors found after delivery iii) Process efficiency (%) = No. of <Phase> category defects detected by <Phase> review / Total no. of <Phase> category defects <Phase> := SRS, Design, Code Review and Unit Test iv) Inspection efficiency = Number of real defects found per hour v) Fault Handling Efficiency (FHE) = Number of incoming fault events / number of events recorded as trouble report vi) Fault Finding Efficiency (FFE) = Number of incoming fault events not recorded as trouble report because reason is an internal fault / number of events recorded as trouble report vii) Test efficiency = No. of bugs found up to and including system testing / No. of bugs found during and after testing
Effectiveness	<ul style="list-style-type: none"> i) Total Defect Containment Effectiveness (TDCE) = Number of pre-release defects / (number of pre-release defects + number of post-release defects) ii) Phase Containment Effectiveness for Phase i (PCEi) = Number of phase i errors / (number of phase i errors + number of phase i defects) iii) Inspection Effectiveness = Identified real defects / the number of seeded defects (in inspection) iv) Fault Handling Effectiveness (FHEff) = Number of incoming fault events not recorded as trouble report because there was no fault at all + number of incoming fault events not recorded as trouble report because duplication of an issue v) Fault Finding Effectiveness (FFEff) = Number of trouble reports which were not approved for correction vi) Defect detection effectiveness = Individual defect detection rate (IDDR) = Number of real defects reported by individual subjects vii) Fault-slip-through (FST) = Number of defects not found when it was most cost-effective

B2: Project measures

Success Indicator	Commonly Used Metrics
Defects	<ul style="list-style-type: none"> i) Defect density, $DD = \text{No. defects} / \text{size}$ <ul style="list-style-type: none"> - No. defects according to development phase - Size in LOC, FP, etc ii) Defect distribution (%) = $\text{No. of } \langle \text{Phase} \rangle \text{ category defects} / \text{Total No. of defects}$ $\langle \text{Phase} \rangle := \text{Analysis, Requirement, Design, Code, Document, Others}$ iii) Yield (% of defects found and fixed before compilation and testing) iv) Fault-slip through (FST) = $\text{Total no. of faults in late verification} / \text{total no. of fault in the project}$ v) Number of defects found per $\langle \text{Phase} \rangle$ $\langle \text{Phase} \rangle := \text{Analysis, Requirement, Design, Code Review, Unit Test, Others}$ vi) No. of injected defect / $\langle \text{Phase} \rangle$ $\langle \text{Phase} \rangle := \text{Analysis, Requirement, Design, Code Review, Unit Test, Others}$ vii) Defect Injection Rate (DIR) of requirements, design, coding and testing activities = $\text{Defects injected at the activity} / \text{all defects of the project}$
Cost	<ul style="list-style-type: none"> i) Cost / Size <ul style="list-style-type: none"> - Size in LOC, FP, etc ii) Cost of rework iii) Rework effort in person-hour, staff-hour, etc iv) Effort * cost per staff-hour v) Person-month, person-hour, staff-hour, etc vi) Rework index = % project effort spent in rework vii) Avoidable Fault Cost (AFC) = Determined by FST and the average estimated cost of finding a fault in a specific phase of the software life-cycle
Schedule	<ul style="list-style-type: none"> i) Project cycle time (days, months, etc) ii) Cycle time normalized by size iii) Project duration = Time of gating review that decides to release the project to the customer or market - time of gating review which kicks off the project iv) Relative integration time = $(\text{Integration time} / \text{overall project time}) \%$, time is calculated in months v) X factor = The amount of calendar time for the baseline project to develop a product divided by the cycle time for the new project
Productivity	<ul style="list-style-type: none"> i) Size / effort <ul style="list-style-type: none"> - Size in LOC, FP, etc - Effort in person-month, person-hour, hour, etc ii) Effort / size <ul style="list-style-type: none"> - Effort in person-month, person-hour, hour, etc - Size in LOC, FP, etc iii) Number of tasks solved per time unit iv) Actual productivity = $\text{No. of written code} / \text{person hours}$ v) Apparent productivity = $(\text{No. written code} + \text{no. of reused code})$

	<p>/person-hours</p> <p>vi) Rate of delivery = No. of projects delivered per year</p> <p>vii) Productivity = (Number of features in project / total effort in minutes) * (2,400 minutes / week)</p>
Estimation	<p>Schedule:</p> <p>i) Schedule variance = (Actual duration- planned duration) / planned duration</p> <p>ii) No. of days ahead of schedule/behind schedule of release</p> <p>iii) Schedule performance index (SPI) = Earned value / planned value</p> <p>iv) Schedule Estimation Accuracy (SEA) = Actual project duration / estimated project duration</p> <p>v) Schedule overruns = 100 * (actual value - estimated value) / estimated value</p> <p>Effort:</p> <p>i) Effort variance = (Actual effort - planned effort) / planned effort</p> <p>ii) Project Visibility Index (PVI) = Planned person-months / actual person-months</p> <p>iii) Effort Estimation Accuracy (EEA) = Actual project effort / estimated project effort</p> <p>iv) 100 * (actual effort - estimated effort) / estimated effort</p> <p>Cost:</p> <p>i) Cost performance index (CPI) = Earned value / actual cost</p> <p>ii) Variance in the planned vs. actual cost for projects</p> <p>Size:</p> <p>i) Size variance = (Planned size - actual size) / planned size</p> <p>ii) Error rate of size estimate = (LOC estimated – real LOC developed) / real LOC developed.</p> <p>iii) 100 * (actual LOC - estimated LOC) / estimated LOC</p> <p>Others:</p> <p>i) Productivity variance = Estimated vs. actual LOC / hour</p> <p>ii) Cumulative Earned Value vs. Cumulative Planned Value</p> <p>iii) Actual no. of defects removed per phase vs. estimated no. of defects removed per phase</p>

B3: Product measures

Success Indicator	Commonly Used Metrics
Quality	<p>General:</p> <p>i) No. of reported failures in operation</p> <p>ii) Post-release fault density = No. of faults / size</p> <p>iii) No. of User-reported deficiencies (URD)</p> <p>iv) New Open Problems (NOP) = total new post-release problems opened during the month</p> <p>v) Total Open Problems (TOP) = total number of post-release problems that remain open at the end of the month</p> <p>vi) Changed Ratio of customer request = (No. of actual changed request / no. of customer request) * 100(%)</p> <p>vii) No. of customer calls</p>

	<p>Reliability:</p> <ul style="list-style-type: none"> i) Failure Rate (FR) = Number of failures / execution time ii) Mean Time Between Failure (MTBF) = (Downtime –uptime) / no. of failures iii) Mean Time To Failure (MTTF) iv) Defect density by Configuration Mgmt build (DDb) <p>Maintainability:</p> <ul style="list-style-type: none"> i) McCabe's Cyclomatic complexity ii) Maintainability product (MP) = Change scope * effort * 100 Note: The Change scope measure examines what percentage of the program's components were added or modified to implement a change. iii) LOC/subroutine iv) Stability index = Percent of the code that has changed in a week, number of developers that made changes in a week, average number of LOC per developer, average time spent by a developer on the project <p>Reusability:</p> <ul style="list-style-type: none"> i) Reuse percent = Part of baseline against which projects are evaluated ii) Reusability = Uses of delivery package = Amount of project specific development done in the context of the delivery package
Cost	<ul style="list-style-type: none"> i) Cost = Effort * cost per staff-hour (measured in base cost, addition cost for tool, saving through insertion of tool for varying project size calculated in features and for two aspect regular process to advance process and advance process to complete process) ii) Cost = Training Cost + implementation cost iii) Cost = cost of conformance + cost of non-conformance; cost non-conf. is direct and indirect cost with reworking a product / service. Conformance cost is appraisal and prevention cost. Appraisal is evaluating the product for faults. Prevention is action to reduce or eliminate rework. iv) Support cost = % of total effort for customer support v) Relative cost of software testing = (Testing effort / overall project effort)%, effort is calculated in man hours vi) Investment cost = The quantity of the project-related investment costs (training and initial tool usage problems) was obtained through a questionnaire where each developer estimated how much of the reported time they put on different activities (where training and initial tool usage problems where two of those) vii) Development support effort = Number of days effort expended by the development team on defect investigation and resolution during the system test period.
Time-to-Market	<ul style="list-style-type: none"> i) Time to deliver (days, months, etc) ii) Time-to-market = The elapsed time between system conception and deployment iii) (Delivery date(days) – Contract Date (Days) / 30) iv) No. of validation cycles (code/test/re-code) before customers' requirements are met

B4: Organization measures

Success Indicator	Commonly Used Metric
Economics	<ul style="list-style-type: none"> i) Cost benefits ratio = Benefit / cost ii) $ROI = Profit / Investment = (Throughput - Operation Expense) / Investment$; Throughput = Value Output = Sales Price - Direct Costs iii) ROI = Cost of improved defect introduction - cost of action learning initiative iv) $R = I / (P * N)$, where R = number of months to regain the investment I, I = invested capital, P = price to correct an error, N = reduction in number of errors / month. v) Business value of software-process- improvement investment = value returned on each dollar invested vi) $(Benefits - Cost) / Cost * 100\%$ vii) Investment cost on project which has SPI initiative = Percentage of base staffing needed more for process improvement activities * no. of people * months * hours * cost/hour (\$/hr)
Employee	<ul style="list-style-type: none"> i) No. working hours per week ii) Employee turnover rate iii) No. of projects the employee works on in parallel iv) No. of expired vacation days v) No. of unscheduled work at weekends vi) No. of sickness days vii) Amount of bonuses <p>Note: The usual way of measuring the employee satisfaction is through survey / questionnaires. The above are some metrics which can be used to infer the employee satisfaction.</p>
Growth	<ul style="list-style-type: none"> i) Product sales revenue growth ii) Operating profit growth iii) Innovation = $Throughput\ New\ Product / Throughput * 100\%$ (Throughput = No. of implemented idea) iv) Margin of sales
Communication	<ul style="list-style-type: none"> i) Improved communication between customers and software engineers / developers ii) Improved communication between users and software engineers / developers iii) Improved co-operation between quality assurance and the software engineers / developers iv) Improved organization communication <p>Note: The above are not really metrics and the usual way of measuring the employee communication is through survey / questionnaires.</p>

B5: External measures

Success Indicator	Commonly Used Metric
<p style="text-align: center;">Customer</p>	<ul style="list-style-type: none"> i) Operation productivity ii) Product quality iii) Process efficiency iv) Product sales revenue v) Net profit vi) Improved in business operations* vii) Improved in employee satisfaction* <p>Note: The above are some general success indicators that can be used to measure the impact of SPI on the customer side. In fact, all the other success indicators listed in the Process, Project, Product and Organization can be used depending on how and where the product is being used in the customer's organization. The ones marked with * not really metrics and the can be measured using survey / questionnaires.</p>
<p style="text-align: center;">Society</p>	<ul style="list-style-type: none"> i) Environmental pollutions / hazards ii) Public safety iii) Public health iv) Job opportunities v) Quality of life vi) Other social, economic and political benefits. <p>Note: The above are some general areas that we can measure the impact of the SPI to the society. The exact metrics are depending on the specific product that is directly / indirectly used by the people.</p>