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Qualitative Productivity

A new approach to evaluate performance

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1. Purpose :-

The purpose of this white paper is to establish is a co-relation between the test execution productivity and testing quality for software industry. This paper also explains why it is important to build a correlation between these two factors. In Software testing, both productivity and quality are captured or calculated separately to measure the efficiency and effectiveness of a testing team. And nowadays a lot of emphasis is to improve productivity but most of the times we overlook quality or impact of increased productivity on quality. This only gets noticed once the quality gets severely reduced or impacted.

There has never been a connection or link between Productivity and Quality. The two parameters are always calculated separately and when analyzed individually do not give a complete picture of the performance. There is no point in recognizing a team for its high productivity when the quality of the products produced is poor and vice versa. There has to be an optimum value of measurement for evaluating the performance.

Hence the main purpose of the paper is to bridge the two biggest measurements of software industry and come out with a Qualitative Productivity which helps in evaluating the performance at one glance for a team. The paper describes the way to determine how effectively with respect to the time, a team can produce efficient and quality products.

2. Introduction :-

Productivity has always been the prime factor of any industry as increase in productivity is directly related to the cost. One can easily save good amount of money by increasing their productivity number. But we sometime overlook the impact of productivity on the final quality of the product.

As far as software testing is concerned, the test execution productivity is measured in terms of unit size executed in one hour. The unit of size could be number of test cases, function points, use case points, test case points or raw test steps. This paper derives the relationship between quality and productivity independent of the unit of size. We will be considering number of raw test step executed per hour as productivity.

The quality of any software testing is directly related to number of defects. The main purpose of any testing team is to prevent the defects from getting leaked to the next phase. This could be measured SIT versus UAT or UAT versus production depending on the need.

3. Test Execution Productivity and Testing Quality :-

a) Test Execution Productivity :-

As explained earlier, test execution productivity is number of units executed in one hour, where number of unit is raw test step.

A **raw test step** is the most unit level size of a test case. It is defined as single action step followed by the verification of the action step. It could be as simple as clicking on link to launch an application or navigating to a next page.

$$\text{Test Execution Productivity} = \frac{\text{No. of Raw Test Steps Executed}}{\text{Total Effort in Hrs}}$$

b) Testing Quality :-

The quality or effectiveness of testing effort is measured by defect prevention which means number of defect being protected from getting leaked to the next phase.

$$\text{Defect Prevention} = \frac{\text{Defects found in phase N} \times 100}{\text{Defects found in phase N and (N+1)}}$$

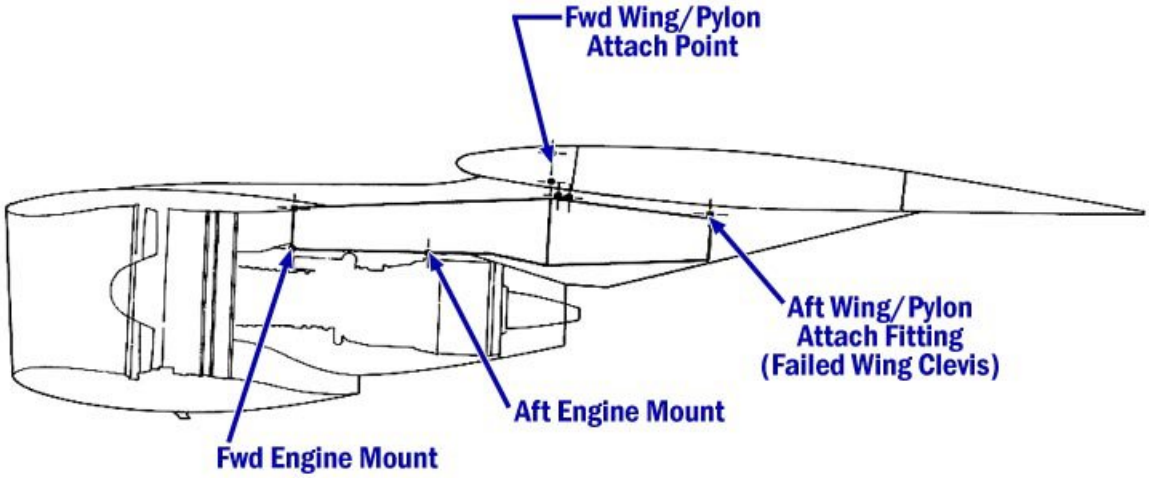
4. Qualitative Productivity – Why it is needed :-

There have been instances in the industry when people tried to improve productivity and overlook its impact on the quality. The below 2 examples would clearly explains the impact of productivity increase on Quality –

a) American Airlines Flight 191

A McDonnell-Douglas DC-10 aircraft, crashed on May 25, 1979, at around 15:04 CDT, after taking off from O'Hare International Airport in Chicago, Illinois. Flight 191 was destined for Los Angeles International Airport in Los Angeles, California, with 271 passengers and crew onboard. All 271 on board were killed, along with two persons on the ground. Flight 191 was the deadliest airplane crash on U.S. soil until the September 11, 2001 attacks.

Root Cause – The findings of the investigation by the National Transportation Safety Board (NTSB) were released on December 21, 1979. It revealed the probable cause to be attributable to damage to the left wing engine pylon that occurred during an earlier engine change at American Airline's aircraft overhaul facility in Tulsa, Oklahoma. Evidence came from the flange, a critical part of the pylon assembly. It was revealed to be damaged before the crash, and investigators looked at the plane's maintenance history and found it was serviced eight weeks before the crash.

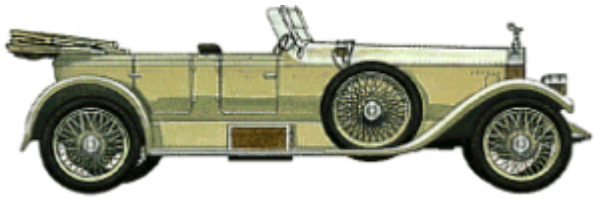


The pylon was damaged due to an ill thought-out engine removal procedure. The original procedure called for removal of the engine prior to the removal of the engine pylon. To **save time and costs,** American Airlines, without the approval of McDonnell Douglas, had begun to use a faster procedure. They instructed

their mechanics to remove the engine with the pylon all together as one unit. A large forklift was used to support the engine while it was being detached from the wing. This procedure was extremely difficult to execute successfully, due to difficulties with holding the engine assembly straight while it was being removed. **This caused cracks in the pylon which eventually got damaged while take off and resulted ending 273 lives.**

b) Rolls-Royce VS Ford:

The Rolls-Royce Silver Ghost (1922; Great Britain) was one of the most successful models of this famous luxury automobile. The Silver Ghost was considered as the most valuable car in the world in the times of 1920s



This model was produced from 1907 to 1926. The aluminum color varnishing and silvered accessories on its body gave it its name. It was the 12th 40/50 hp to be made. A plaque with the words "Silver Ghost" adorned the bulkhead. An open-top body by coachbuilder Barker was fitted, and the car readied for the Scottish reliability trials of 1907 and, immediately afterwards, another 15,000-mile test which included driving between London and Glasgow 27 times.

The aim was to raise public awareness of the new company and to show the reliability and quietness of their new car. This was a risky idea: cars of this time were notoriously unreliable, and roads of the day could be horrendous. Nevertheless, the car set off on trials, and with press aboard, broke record upon record. Even after 7,000 miles (11,000 km), the cost to service the car was a negligible £2 2s 7d. (£2.13). The reputation of Rolls-Royce was set, and the 40/50 very successful.

The Productivity of this car was four cars per week, one of the lowest when compared to the other big players. The Silver Ghost is considered the most valuable car in the world; in 2005 its insured value was placed at USD$35 million.

Ford cars – Productivity in 1920s:

Ford's $5 day sent shockwaves through the auto industry. Many business people including stockholders in the Ford Motor Company regarded the pay increase as crazy. Many thought the company would soon go out of business. But Ford believed that retaining more skilled, satisfied employees would increase productivity and lower production costs. He was right! Turnover and absenteeism

disappeared almost overnight. In addition, Ford greatly increased the size of his plants by adding new and additional equipment to further raise the productivity of his workforce.

- In 1914, 13,000 workers at Ford made 260,720 cars. By comparison, in the rest of the industry, it took 66,350 workers to make 286,770 cars.
- Between 1914 and 1916, the company's profits doubled—from $30 million to $60 million.

Ford was producing cars at a record-breaking rate. In the early days of Model T production, completing one vehicle required 12 hours. By 1914, vehicles rolled out of the Highland Park Plant at the rate of one every 93 minutes. In 1920, Ford turned out one car every minute, and one out of every two automobiles in the world was a Model T. At one point, the pace picked up to one Ford being manufactured every 24 seconds!

So much importance was given to the productivity rate that the quality of the deliverable was forgotten. There were many defects in the manufacturing of cars and a **huge list of customer complaints**. Few of the noted defects are given below for your reference.

Defects:

1) Cooling systems did not work efficiently
2) Problems with carburetors and brakes
3) Fuel system defects
4) Even a case where steering gear was installed backwards.

Ford dominated automobile production, with 55% of output in 1921 but the sales of the cars produced went down by 20% later on due to various manufacturing defects and quality compromise.

5. Qualitative Productivity :-

A) The Approach :-

This section explains the approach for deriving the correlation between Test Execution productivity and Defect prevention. The main problem in defining the correlation between test execution productivity and defect prevention is that both the factors are measured on a different scale. Defect prevention is measured as a percentage i.e. how much percentage of total defects found in both phases (phase N and phase N+1) has been prevented from getting leaked to next phase.

On the other hand, productivity is measured as number of RTS executed per hour which is a numeric value. To overcome this problem, we have considered both the factors in percentage or percentage change from the benchmark value.

There is one more reason for considering the percentage change from the benchmark values. Productivity is a relative term and the inferences could not be drawn by looking at the independent value or the value of a single release. It has to be compared with the prior releases or rather to a benchmark value in order to draw inferences whether a particular productivity number is good or bad. And generally a testing organization should have the benchmark values for Defect prevention and productivity. This also could be set at a team level by consulting the customer.

B) Weightage :-

In order to align the correlation with the customer needs, both productivity and defect prevention are assigned a weightage factor to signify the importance. After collecting data from different testing teams, the conclusion says that in a scale of 0 to 100%, Defect Prevention has weightage of 70% and Test Execution productivity has weightage of 30%.

C) Qualitative Productivity table :-

The below table shows the final correlation and figures in terms of Qualitative Productivity with respect to the organization benchmark. It is the mean value of the percentage change of both the factors with the weightage taken into consideration. The table showcases the qualitative productivity of different releases (Release 1, 2, 3 and so on) with respect to the benchmark.

	Test Execution Productivity (RTS/Hr)	Defect Prevention (%)	Change in Productivity (%)	Change in Defect Prevention (%)	Weighted change in Productivity (%)	Weighted change in Defect Prevention (%)	Qualitative Productivity w.r.t. benchmark (%)
Organization Benchmark	50	80					
Release 1	60	78	20	-2.5	26	-4.25	10.88
Release 2	75	40	50	-50	65	-85	-10.00
Release 3	40	90	-20	12.5	-26	21.25	-2.38
Release 4	45	85	-10	6.25	-13	10.625	-1.19
Release 5	55	75	10	-6.25	13	-10.625	1.19
Release 6	65	72	30	-10	39	-17	11.00
Release 7	40	95	-20	18.75	-26	31.875	2.94

Qualitative Productivity table

The Columns are explained below –

Change in Productivity = Percentage change in Productivity with respect to the benchmark productivity

Change in Defect Prevention = Percentage change in Defect Prevention with respect to the benchmark defect prevention

Weighted Change in Productivity = 1.3 x Change in Productivity

Weighted Change in Defect Prevention = 1.7 x Change in Defect Prevention

Qualitative Productivity w.r.t benchmark (%)

$$= \frac{(\text{Weighted Change in Productivity} + \text{Weighted Change in Defect Prevention})}{2}$$

6. References

http://www.answers.com/topic/productivity?cat=biz-fin
http://en.wikipedia.org/wiki/Productivity
http://en.wikipedia.org/wiki/American_Airlines_Flight_191
http://en.wikipedia.org/wiki/Rolls-Royce_Silver_Ghost