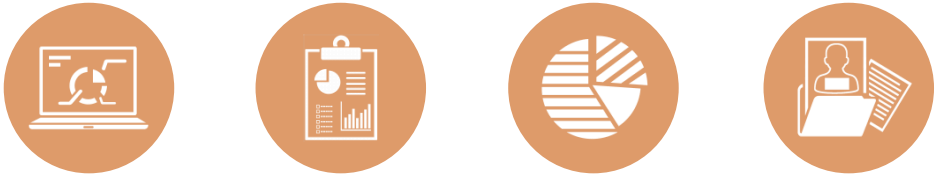
PMI®—Agile Certified Practitioner (PMI-ACP)®

Agile Metrics



Objectives

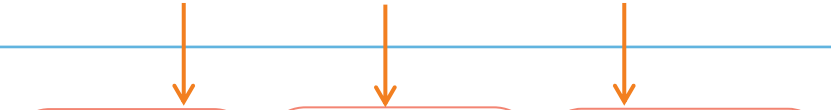
After completing this lesson, you will be able to:

- Identify different types of metrics and their purpose
- Define and apply velocity in projects
- Explain different types of burn charts
- Apply earned value management to Agile projects
- Explain various EVM metrics and terminologies

The definition of Metrics and Measure are as follows:

A metric is a standard for measuring or evaluating something.

A measure is a quantity, a proportion, or a qualitative comparison.



Quantity:
"There are 25 open defect reports on the application as of today".

Proportion:
"This week there are 10 percent fewer open defect reports than last week".

Qualitative:
"The new version of the software is easier to use than the old version".

Importance of Metrics

Metrics are important for a successful project. The benefits of metrics are as follows:

- It is of great help for retrospectives
- It provides continuous feedback
- It helps in maintaining a healthy code base (unit tests to methods)
- It helps to refactor code (code complexity)
- It supports frequent releases
- It identifies issues early

Types of Metrics

Different types of metrics can be used in projects. Some of the most commonly used metrics are as follows:

Business Metrics

- Running tested features (RTF)
- Earned business value (EBV)
- Net present value (NPV)
- Return on investment (ROI)
- Internal rate of return (IRR)

Process Metrics

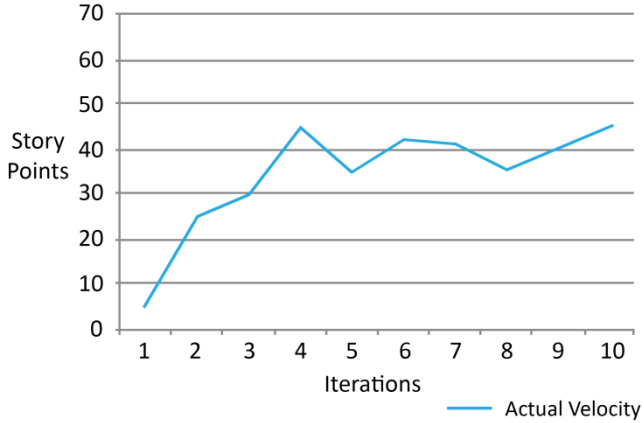
- Impediments cleared per iteration
- Impediments and user stories carried over the next iteration
- User stories done per iteration
- Defects carried over the next iteration
- Team member loading
- Velocity
- Backlog size

Project Testing Metrics

- Acceptance tests per story
- Defects count per story
- Escaped defects per cycle
- Time to run tests
- Tests run per frequency
- Time to fix tests

Velocity is a measure of a team's rate of progress in an iteration.

- Velocity is an empirical observation of the team's capacity to complete work per iteration and not an estimate or a target to aim for.
- Velocity is based on the team's sizing of work items in reference to estimated time and not on the time dictated or imposed by anyone other than the team members.
- Velocity is comparable across iterations for a given team on a given project and not comparable across teams or projects.



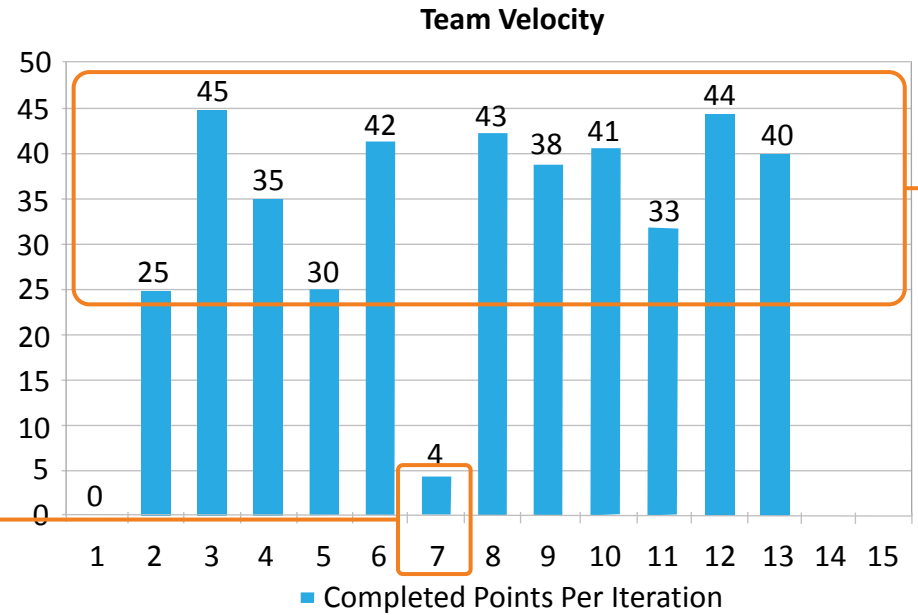
The unit of measure for velocity is determined by the unit of measure used during estimation.

Condition	Units of Measure
If the team plans to commit to user stories based on relative sizing	Story Points
If the team plans to commit to user stories based on hours/days	Ideal Time

The following points need to be considered:

- Only completed work is counted towards velocity.
- Velocity corrects estimation errors.
- Velocity tracks customer satisfaction.
- Velocity tracks early and continuous delivery.

The bar chart below shows the velocity of a team over 13 iterations.

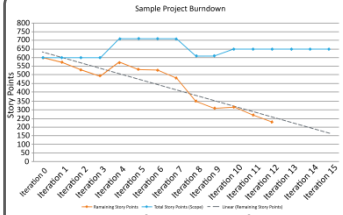


Velocity of the team varies largely between 25 and 45.

One outlier observation is in iteration 7.

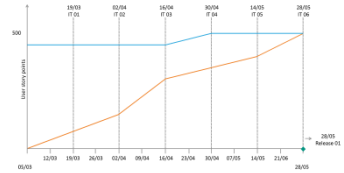
Velocity at Work—Burn Charts

Velocity is visualized in the form of the burn charts in Agile projects. These charts help the team track the project progress.



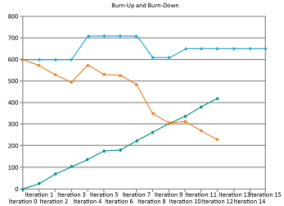
Burndown Chart

Shows how much work is yet to be completed.



Burnup Chart

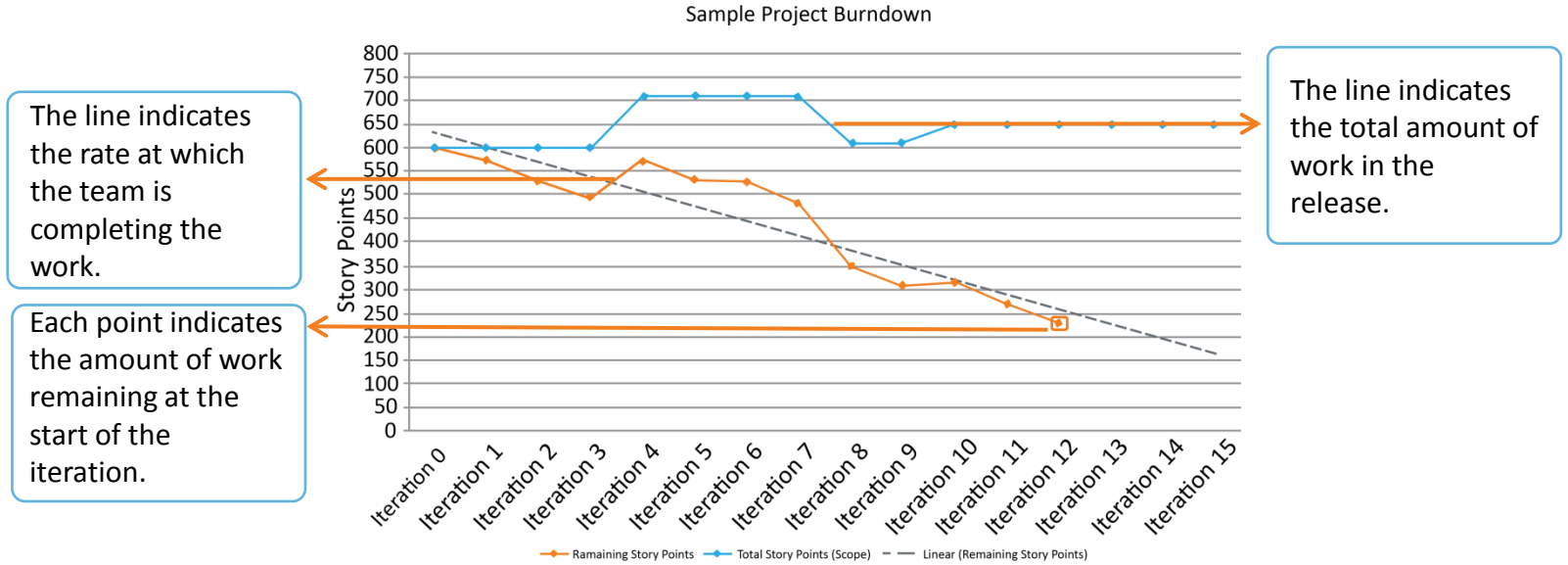
Shows how much work has been completed.



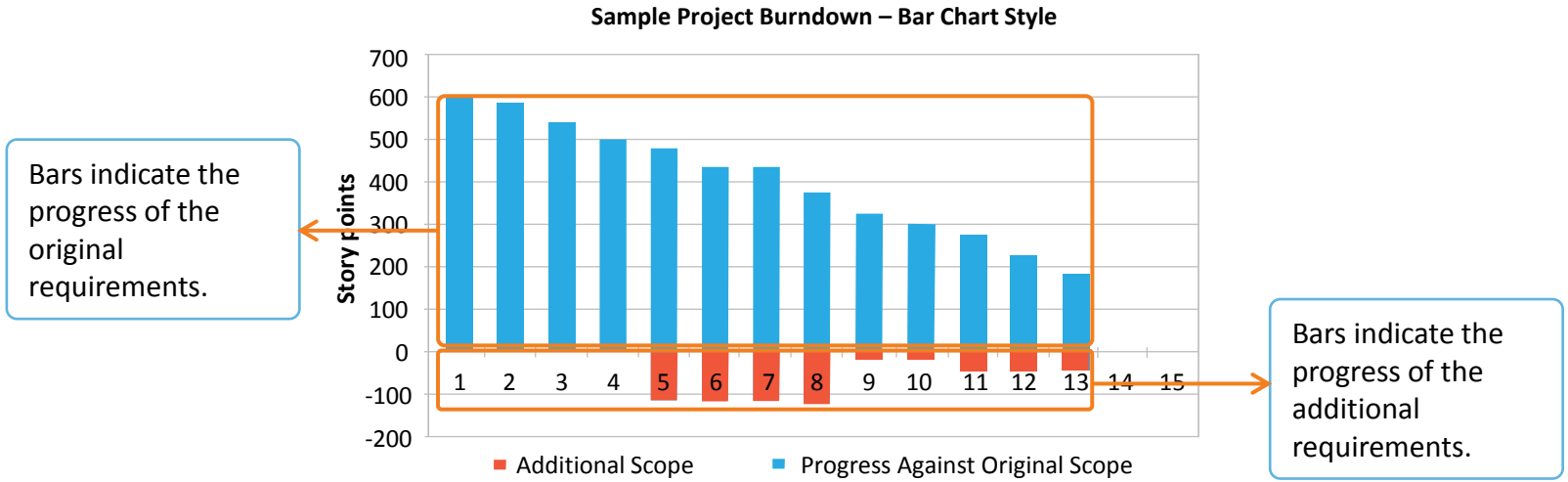
Combined Burn Chart

Shows how much work has been completed and how much work remains.

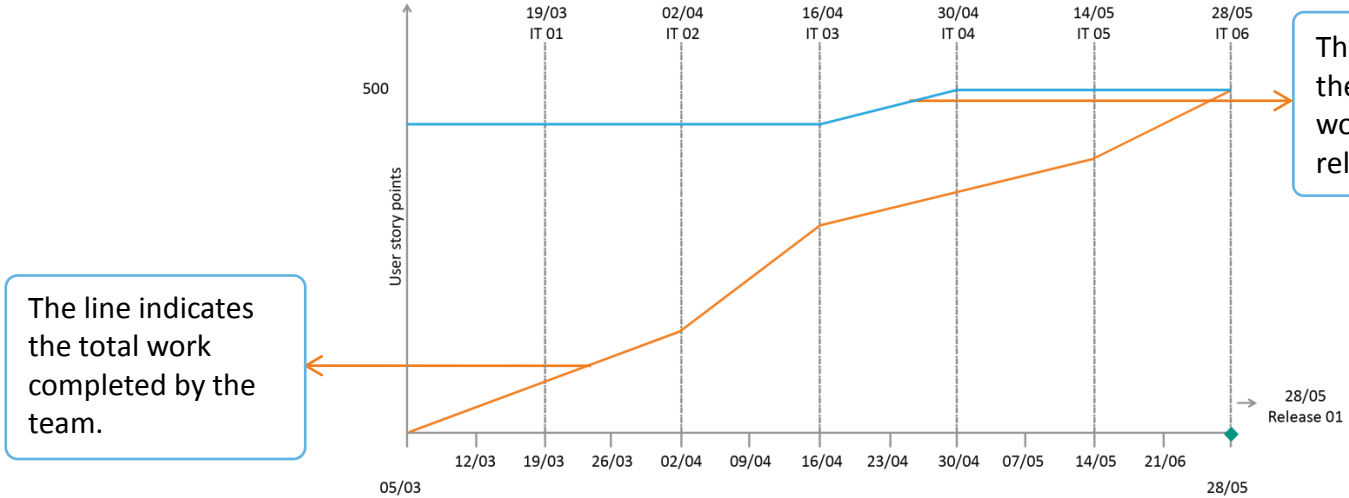
The horizontal axis of the project burndown chart shows the iterations; the vertical axis shows the amount of work remaining at the start of each iteration.



Burndown charts can also be represented as a bar graph. This type of graph also indicates the new requirements that have been added to the project.

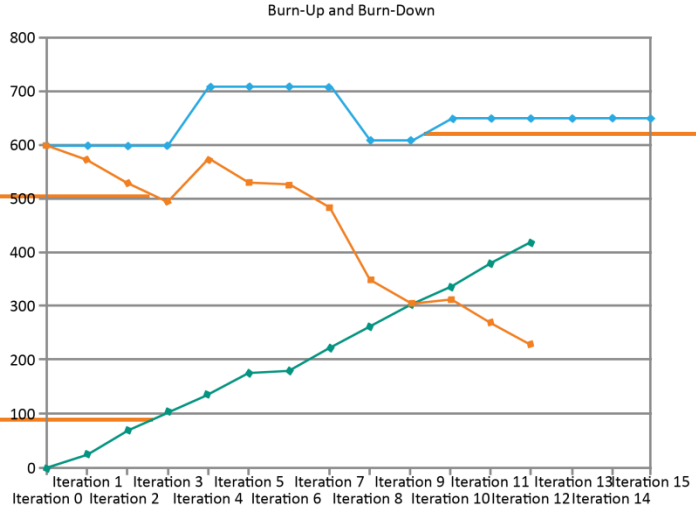


Burnup chart has two lines, a total work line and a work completed line. When the work completed reaches the total work line, the project is complete.



Combined Burn Chart

Burndown and burnup charts combine as one chart showing both the work completed and the work remaining. Combined charts contain a lot of valuable information; often, it is difficult to interpret.



The line represents the burndown line or the work remaining.

The line represents the burnup line or the work completed.

The line indicates the total work in the release.

Cycle Time

In lean, cycle time is the average time between deliveries of completed work items.

Cycle time for software development is measured by the number of days needed between feature specification and production delivery, also known as Software In Process (SIP).

Earned Value Management (EVM) is a technique that shows project progress using ratios and metrics.

In Agile, the definition of EVM includes the following:

- Story point is used as the measure of work planned and work performed.
- Each sprint boundary is established as the 'measuring point' to re-baseline any changes (i.e., work added or removed from the plan) and re-evaluate the earned value results.

EVM Terminologies

Following are some of the important terminologies used in EVM:

Planned Value (PV)	The value of work planned to be accomplished based on the budget (in dollars or hours).
Earned Value (EV)	The integrated value of work actually accomplished based on the budget (in dollars or hours).
Actual Cost (AC)	Actual cost incurred for that increment of work.
Budget at Completion (BAC)	The budget assigned to complete the work.

Following are some of the important terminologies used in EVM:

Estimate to Complete (ETC)	The forecasted amount to complete the remaining work based on past performance (in dollars or hours)
Estimate at Completion (EAC)	The forecasted total amount for all the work in the project plan based on past performance
Planned Story Release Point (PSRP)	Story points are defined at the product backlog level for the release
Expected Percent Complete (EPC)	Current Sprint(n) / Total planned Sprints
Actual Percent Complete (APC)	Story points completed / Total planned story points

Earned Value Metrics with Formulae

Formulae for calculating EVM are given in the following table:

Metric	Formula	Metric Analysis
Planned Value	BAC * Planned Percent Complete	The planned value indicates how much value was planned to have been generated by a particular milestone or point in time.
Earned Value	BAC * Actual Percent Complete	The earned value indicates how much value has actually been generated at a particular milestone or point in time.
Cost Performance Index (CPI)	EV/AC	This metric indicates how many cents have been earned out of every dollar spent. It measures cost efficiencies.
Schedule Performance Index (SPI)	EV/PV	This metric measures schedule efficiency. It indicates how fast you are progressing against the rate of progress planned.
ETC	(BAC - EV)/CPI	This metric is the forecast amount to complete the remaining work.
EAC	BAC/CPI or AC+ETC	Forecasted cost for the total planned work.

Budget calculations can be made using the Agile parameters as follows:

- Budget at completion can be calculated by multiplying the product backlog and the total cost to deliver each story point.

BAC = Product Backlog * Cost Per point

- Planned number of iterations is calculated by dividing the product backlog by the team's velocity.

Planned Number of Iterations =
Product Backlog / Baseline Velocity

Agile projects often focus on the following key EVM definitions:

Product Backlog in Points

The total scope of development for the project, presented as a number of points.

Baseline Velocity

Planned value of the total number of points planned to be delivered or completed during each iteration.

Cost Per Point

An estimated cost for delivering a single point. This would normally be based on past performance of the delivering organization.

Baseline Metrics

Baseline metrics are the calculations that result in the baseline data for a project. Some of the baseline measures used for comparison are as follows:

- The number of planned sprints in the release
- The length of each sprint in calendar days
- The number of story points planned for the release
- The budget planned for the release
- The start date of the project

Measuring metrics (or actuals) are the observations that need to be compared against the baseline.

Measures that can be used are as follows:

Expected percent complete	Number of sprints / Total number of sprints planned
Actual cost to date	All costs incurred by the project to the latest iteration
Cumulative story points completed	This measures the total amount of work completed for the release as of that sprint boundary.
Net story points added	The total of new story points added minus any story points removed

Agile Earned Value Metrics—Example

Q

Given the following project information, calculate the budget at completion, number of iterations required, planned percentage complete per iteration, and planned value per iteration:

- Total product backlog—200 points,
- Velocity of the team—25 story points,
- Cost required to deliver a story point—$1,600

A

Budget at completion = Cost required to deliver a story point * Total product backlog

= $1600 * 200 = $320,000

Number of iterations = Total product backlog / Velocity of the team

= 200/25 = 8

Planned percentage complete per iteration = Velocity of the team / Total product backlog

= 25/200 = 12.5%

Planned value per iteration = Planned percentage complete per iteration * Budget at completion

= 12.5% x $320,000 = $40,000

Result Interpretation

Q

At the end of the first iteration, the following were reported:

- Actual costs (AC) = $30,000
- Points completed = 20 (i.e., 10% of total backlog)

A

EV = Backlog * BAC

= 10% x $320,000 = $32,000

CPI = EV / AC

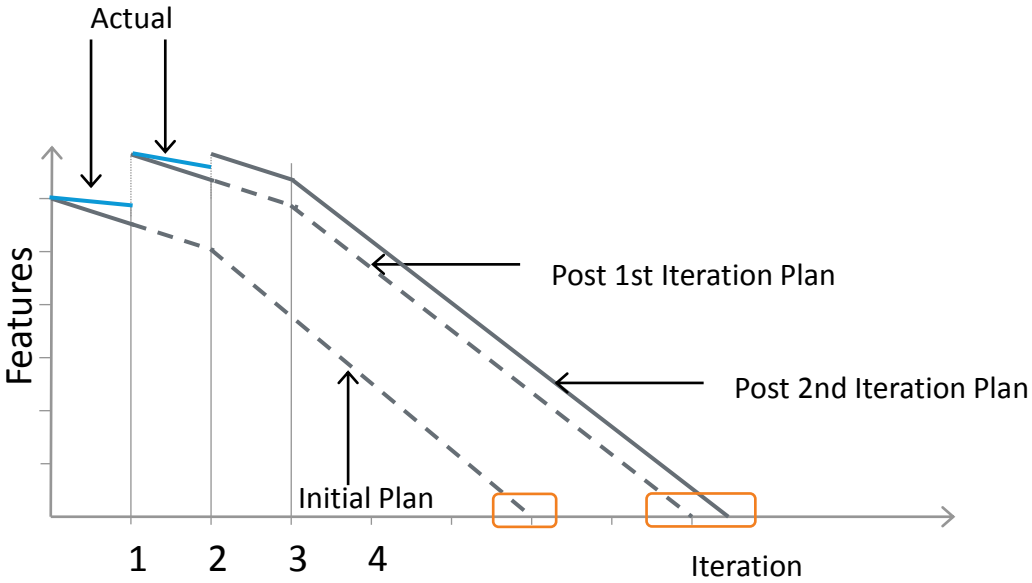
= $32,000/$30,000 = 1.07

SPI = EV / PV

= $32,000/$40,000 = 0.80

With current performance, the project can be completed within the budget, but will not be meeting the project's scheduled completion date.

In Agile projects, scope change will be reflected in project's backlog.



The velocity after Iteration 1 and 2 was not as high as expected. Based on this velocity, the project completion date was adjusted.

Managing Scope Change (contd.)

Q

Following additional information about the project is available:

- Backlog has increased from 200 to 250 points

A

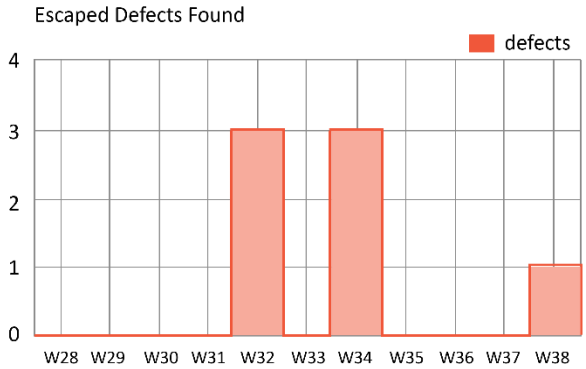
Total number of iterations will change to 10 (250/25)

Budget baseline will increase to $400,000 (250 * $1600)

Escaped Defects

Escaped defects are those which were not found by, or the ones that escaped from, the quality assurance team. These issues are found by end users after release version has been made available to them.

- These are the most expensive defects to correct and should be avoided.
- The impact of escaped defects is more than just the work required to fix them. It affects ‘brand’ and reputation.
- ‘Escaped defects found’ counts the number of new escaped defects found over a period of time (day, week, month).



Following are the best practices for the use of metrics in projects:

- Measure outcomes, not outputs
- Measure results, not activity
- Measure work items done, not time spent per task
- Follow trends, not numbers

Quiz

QUIZ 1	Which of the following is an estimated cost for delivering a single point based on past performance of the delivering organization?

a. Cost per point

b. Baseline velocity

c. Product backlog in points

d. Planned value

QUIZ 1

Which of the following is an estimated cost for delivering a single point based on past performance of the delivering organization?

a. Cost per point

b. Baseline velocity

c. Product backlog in points

d. Planned value

Answer: a.

Explanation: Cost per point is the estimated cost for delivering a single point based on past performance of the delivering organization.

QUIZ 2	Which of the following metrics captures the number of escaped defects found over a period of time?

a. Live defects

b. Escaped defects

c. Cycle time

d. Story defects

QUIZ 2	Which of the following metrics captures the number of escaped defects found over a period of time?

a. Live defects

b. Escaped defects

c. Cycle time

d. Story defects

Answer: b.

Explanation: Escaped defects counts the number of new escaped defects found over a period of time.

QUIZ 3	Which of the following is the average time between delivery of completed work items?

a. Velocity

b. Lead time

c. Cycle time

d. Lag time

QUIZ 3

Which of the following is the average time between delivery of completed work items?

a. Velocity

b. Lead time

c. Cycle time

d. Lag time

Answer: c.

Explanation: Cycle time is the average time between delivery of completed work items.

QUIZ 4	If the planned value is 300 and earned value is 280, what is the SPI?

a. 580

b. 20

c. 1.07

d. 0.933

QUIZ 4

If the planned value is 300 and earned value is 280, what is the SPI?

a. 580

b. 20

c. 1.07

d. 0.933

Answer: d.

Explanation: SPI = EV/PV= 280/300 = 0.933

QUIZ 5	What is the one important metric that Burnup charts show that Burndown charts do not?

a. Burnup charts show velocity

b. Burnup charts show the number of iterations

c. Burnup charts show total work

d. Burnup charts show project duration

QUIZ 5	What is the one important metric that Burnup charts show that Burndown charts do not?

a. Burnup charts show velocity

b. Burnup charts show the number of iterations

c. Burnup charts show total work

d. Burnup charts show project duration

Answer: c.

Explanation: Burnup charts show total work whereas burndown charts do not.

QUIZ 6	If the CPI of a project is 1.1 and the SPI is 0.8, what is the inference about the project?

a. It is over budget and behind schedule

b. It is under budget and ahead of schedule

c. It is under budget and behind schedule

d. It is over budget and ahead of schedule

QUIZ 6	If the CPI of a project is 1.1 and the SPI is 0.8, what is the inference about the project?

a. It is over budget and behind schedule

b. It is under budget and ahead of schedule

c. It is under budget and behind schedule

d. It is over budget and ahead of schedule

Answer: c.

Explanation: The project is under budget as the CPI is greater than one and behind schedule because the SPI is less than one.

QUIZ 7	A project team has completed three iterations and recorded a velocity of 25, 30, and 35 story points; the total Release backlog has 300 story points. How many iterations are required to complete the project?

a. 10

b. 7

c. 8.5

d. 12

QUIZ 7	A project team has completed three iterations and recorded a velocity of 25, 30, and 35 story points; the total Release backlog has 300 story points. How many iterations are required to complete the project?

a. 10

b. 7

c. 8.5

d. 12

Answer: b.

Explanation: On average the project is delivering 30 points an iteration (25+30+35)/3 = 30. Ten iterations would be required to complete the Total Story points (300/30)=10. Three iterations have been completed so the remaining points should be delivered in 7 iterations (10-3)= 7.

Summary

Here is a quick recap of what was covered in this lesson:

- Metrics are important for evaluation of a project. Business Metrics, Process Metrics, and Project Testing Metrics are the three major categories of commonly used metrics.
- Velocity is a measure of a team's rate of progress in an iteration. The unit of measure for velocity is determined by the unit of measure used by the team during estimation.
- Velocity is visualized in the form of the burn charts in Agile projects. Burndown charts, burnup charts, and combined burn charts are commonly used to track the project progress.
- Earned value management for Agile projects can be done on the basis of stories sized in relative terms using story point units.
- Escaped defects are the defects that were not found by the quality assurance team, but are found by end users after release version has been made available to them.

THANK YOU