

Estimating Activity Durations



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Module Overview



The **Estimate Activity Durations** process

- Analogous estimating
- Parametric estimating
- Three point estimating
- Contingency reserves
- Exploring the process's components

The Estimate Activity Durations Process



...the process of estimating the number of work periods needed to complete individual activities with estimated resources.



Estimating Activity Durations

Planning

Project Schedule
Management

Adds a time component to resource estimates

Works hand in hand with **Project Resource Management** process
Estimate Activity Resources

Each equally critical to developing the project schedule



Estimating Activity Durations

Planning

Project Schedule Management

Uniform units are more easily aggregated, reported and understood

Durations should be standardized in format and unit of measure when possible



Estimating Activity Durations

Planning

Project Schedule
Management

Duration estimates should be progressively elaborated

Consider adding more cushion when dealing with less experience or less information



Estimating Activity Durations

Planning

Project Schedule
Management

Accuracy of estimates should improve as...

Activities are completed

Dependencies are defined

Project work progresses



Project Resource Management

Estimate Activity Resources

Determine work effort required

Determine which resources *could* be used

Determine which resources *should* be utilized for each activity

Determine resources and work effort required

Use similar assumptions about resources and duration whenever possible

Project Schedule Management

Estimate Activity Durations

Determine how long completion options may take

Analogous Estimating

Analogous Estimating

Uses historical data from similar activities or projects to estimate duration or cost

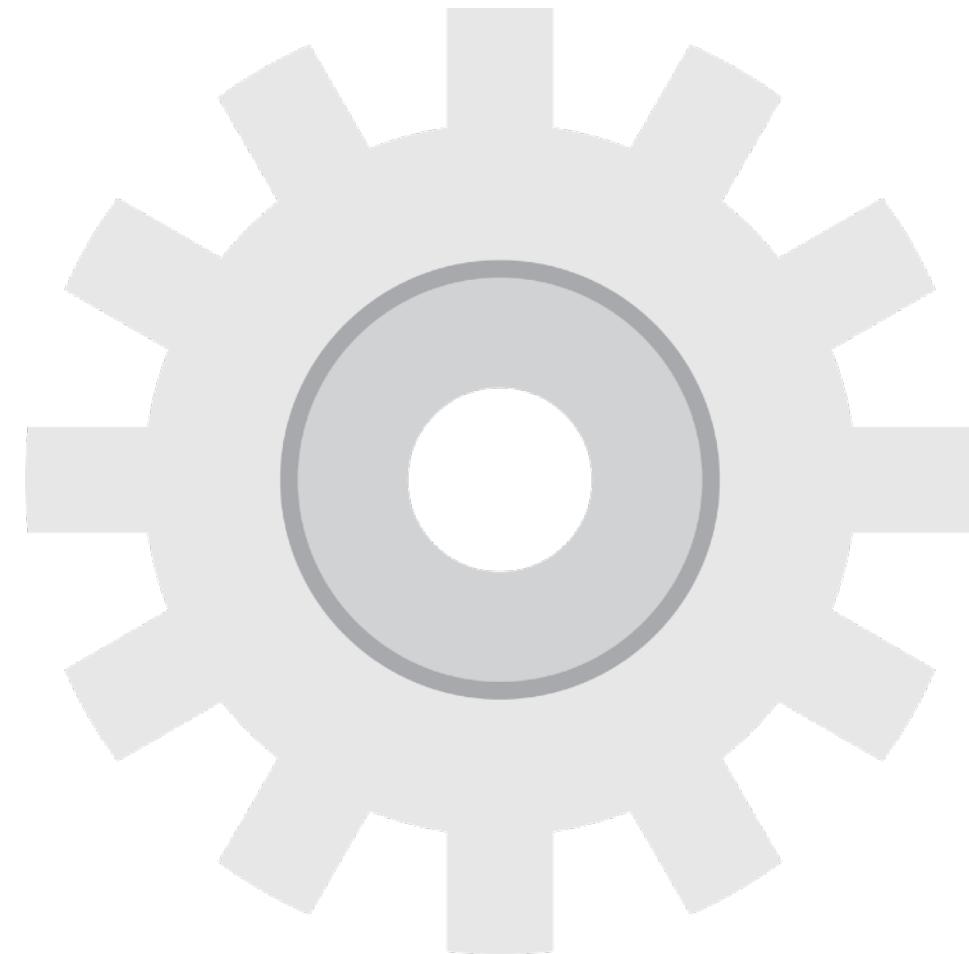
Relies on parameters like...

Duration
Budget
Size

Weight
Complexity

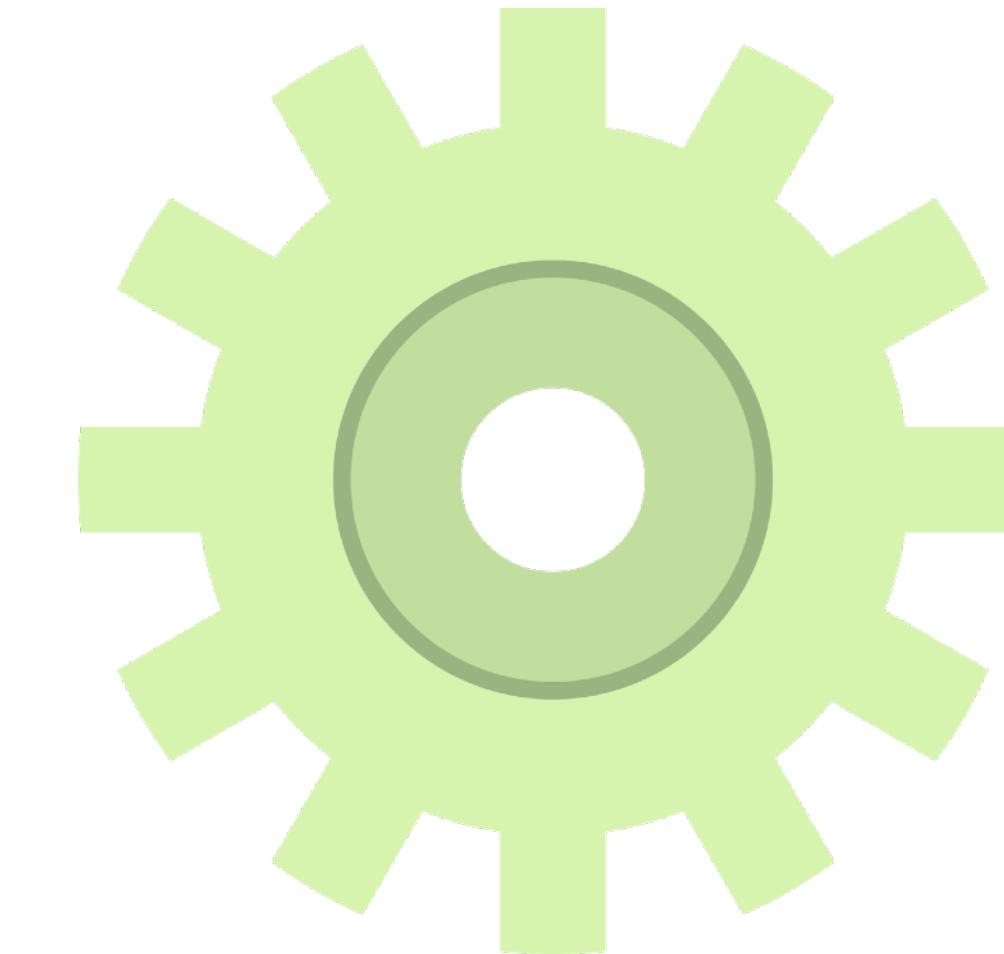


Widget 12,424



Project Cost: \$10,000
Project Duration: Three Months

Widget 12,425



Expected Cost: \$10,000
Expected Duration: Three Months

Analogous Estimating

Useful when project specifics aren't known well

Less costly and time consuming than other estimation methods

Less accurate than other estimation methods



Analogous Estimating

May be used to estimate whole projects or just a portion

Gross value approach, adjustable for factors like complexity

Most reliable when project is *actually* similar to others, not just similar on the surface



Parametric Estimating

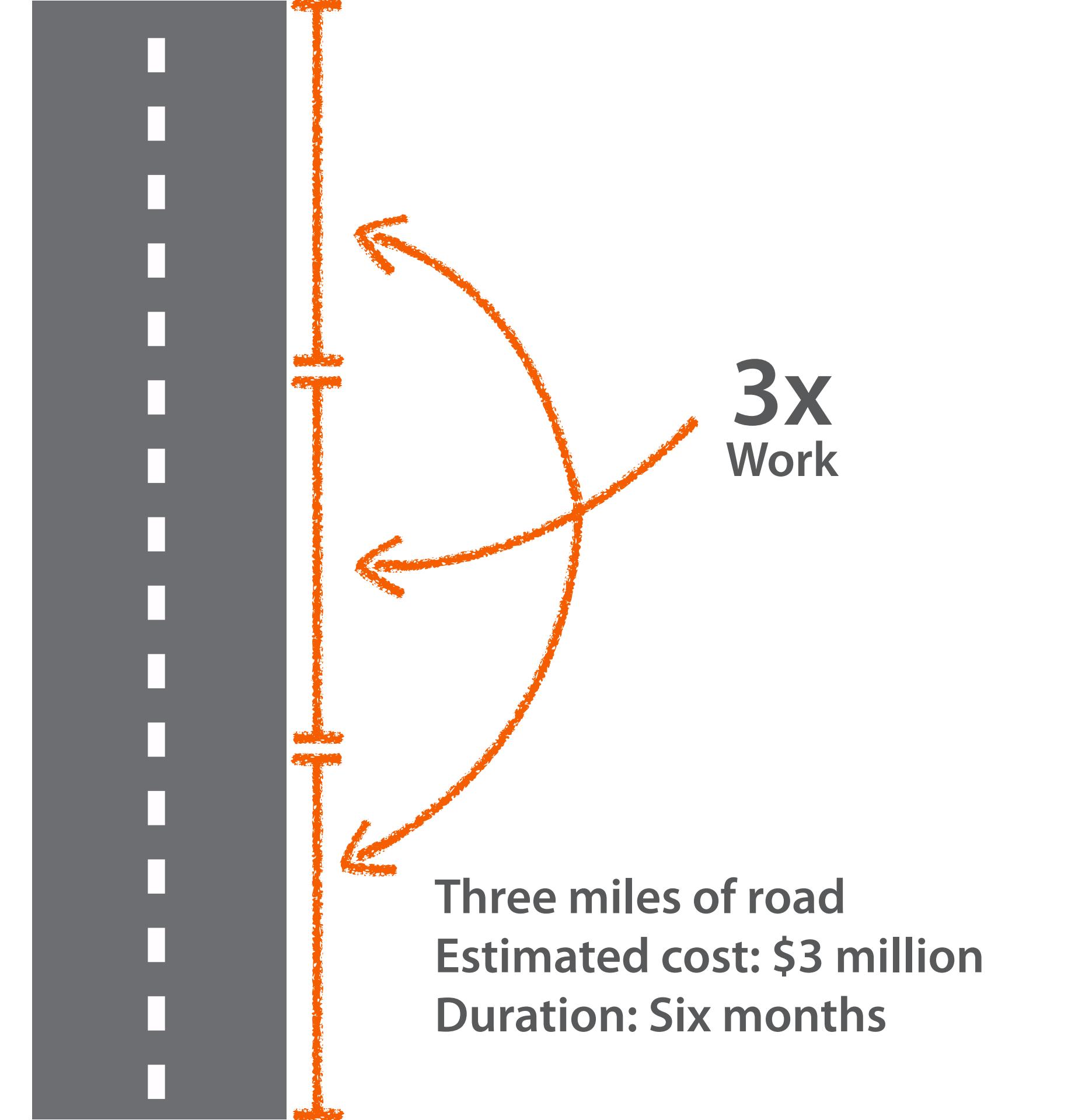
Parametric Estimating

Develop algorithm to calculate cost or duration

Use project parameters and historical data to generate estimates



One mile of road
Total cost: \$1 million
Duration: Two months



Three miles of road
Estimated cost: \$3 million
Duration: Six months

One mile of road
Total cost: \$1 million
Duration: Two months

Key Assumptions:

- Similar deadline
- Similar geography
- Similar road material
- Similar road specifications
- Similar labor effort and cost
- Similar strength and quality parameters

Parametric Estimating

Key Factors:

Quality of data

Sophistication of model



Parametric Estimating

Simple formula:

Project duration = 2x

x = distance in miles

Advanced formula:

Project duration = x*w*q*m

x = distance in miles

w = width factor

q = quality factor

m = manpower factor

Width	Factor	Life	Factor
2 Lanes	2	5 Years	0.5
3 Lanes	4	10 Years	1
4 Lanes	6	30 Years	3
5 Lanes	8		
6 Lanes	10		

Crew	Factor
Half	3
Full	1
Double	.65

Parametric Estimating

5 mile long four lane road with 10 year lifespan and double crew

$$5 * 6 * 1 * .65 = 19.5 \text{ months}$$

10 mile long two lane road with 5 year lifespan and full crew

$$10 * 2 * 0.5 * 1 = 10 \text{ months}$$

Advanced formula:

Project duration = $x * w * q * m$

$x = \text{distance in miles}$

$w = \text{width factor}$

$q = \text{quality factor}$

$m = \text{manpower factor}$

Width	Factor
2 Lanes	2
3 Lanes	4
4 Lanes	6
5 Lanes	8
6 Lanes	10

Life	Factor
5 Years	0.5
10 Years	1
30 Years	3

Crew	Factor
Half	3
Full	1
Double	.65

Parametric Estimating

Useful for estimating whole projects or portions of projects

May be used in conjunction with other methods



Three Point Estimating

Three Point Estimating

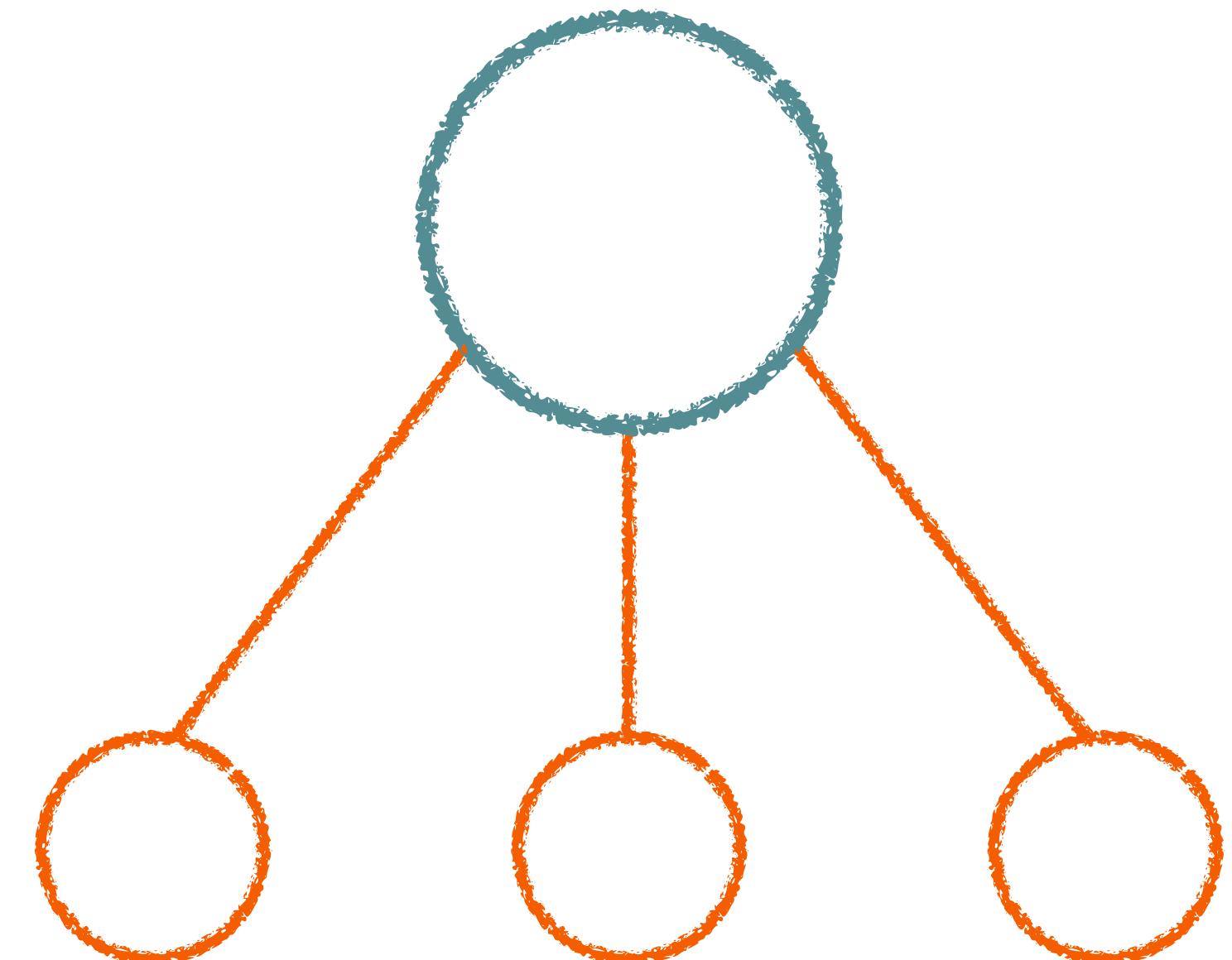
Often better to use several estimates based on different assumptions or outcomes

Three point estimating combines:

Optimistic outcome

Pessimistic outcome

Most likely outcome

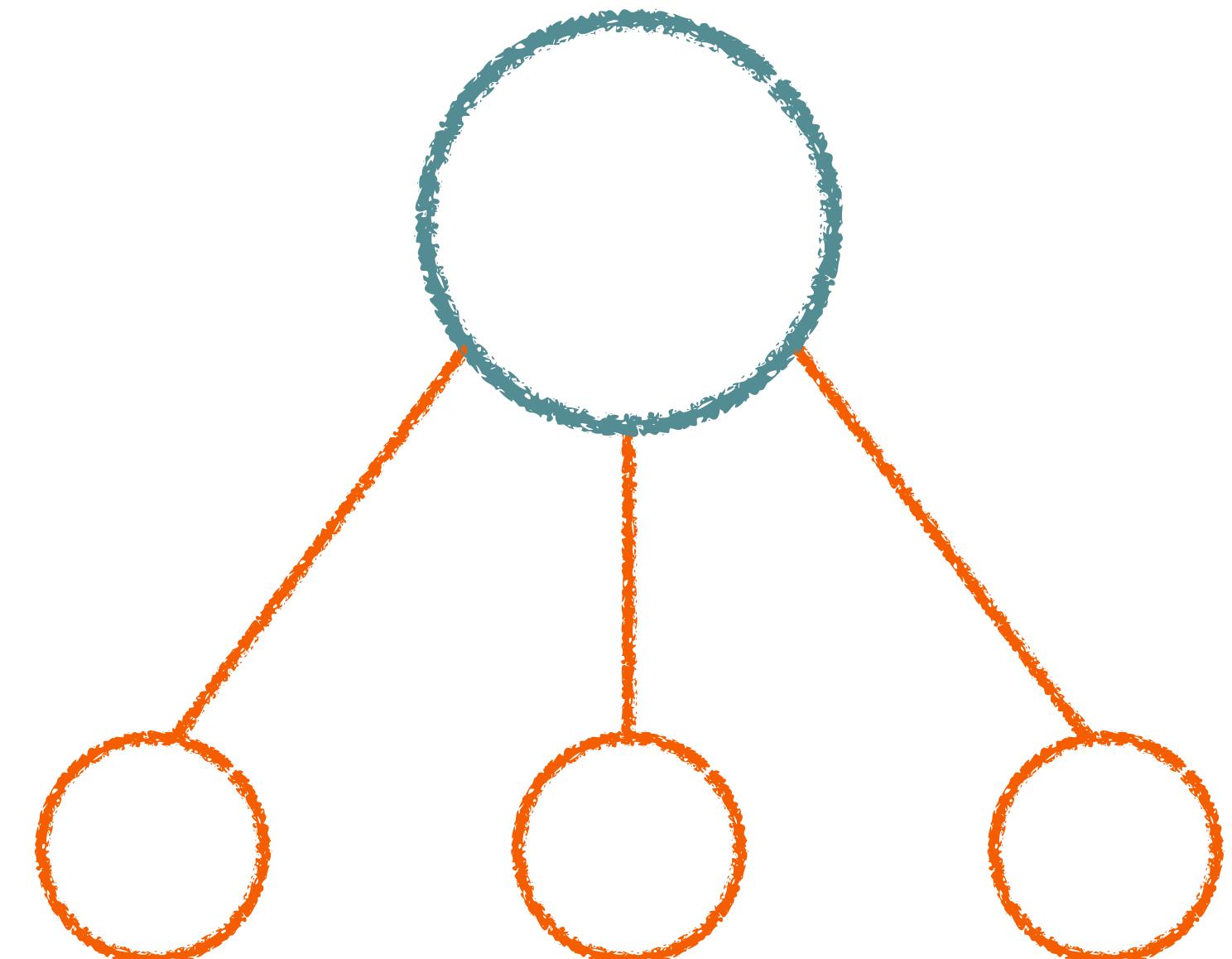


Three Point Estimating

Two common methods:

Triangular Distribution

PERT Method



Triangular Distribution Method

Weights optimistic, pessimistic and most likely scenarios equally

$$tE = \frac{(tO + tM + tP)}{3}$$

tE = Time expected

tO = Optimistic estimate

tM = Most likely estimate

tP = Pessimistic estimate

Example

"Optimistically, we think we can complete the project in 20 days. Worst case would be 75 days. I'd guess 35 days is most likely, though."

$$tE = \frac{(20 + 35 + 75)}{3}$$

$$tE = 43\frac{1}{3} \text{ days}$$

Program Evaluation & Review Technique (PERT) Method

Weights most likely scenario much more heavily than less likely ones

$$tE = \frac{(tO + 4tM + tP)}{6}$$

tE = Time expected

tO = Optimistic estimate

tM = Most likely estimate

tP = Pessimistic estimate

Example

"Optimistically, we think we can complete the project in 20 days. Worst case would be 75 days. I'd guess 35 days is most likely, though."

$$tE = \frac{(20 + (4*35) + 75)}{6}$$

$$tE = 39\frac{1}{6} \text{ days}$$

"If the permit comes through, we can be finished in three months, though four is more likely. If not, we could be delayed twelve months reapplying for the permit."

Triangular Method

$$tE = \frac{(3 + 4 + 16)}{3}$$

$$tE = 7 \frac{2}{3} \text{ months}$$

PERT Method

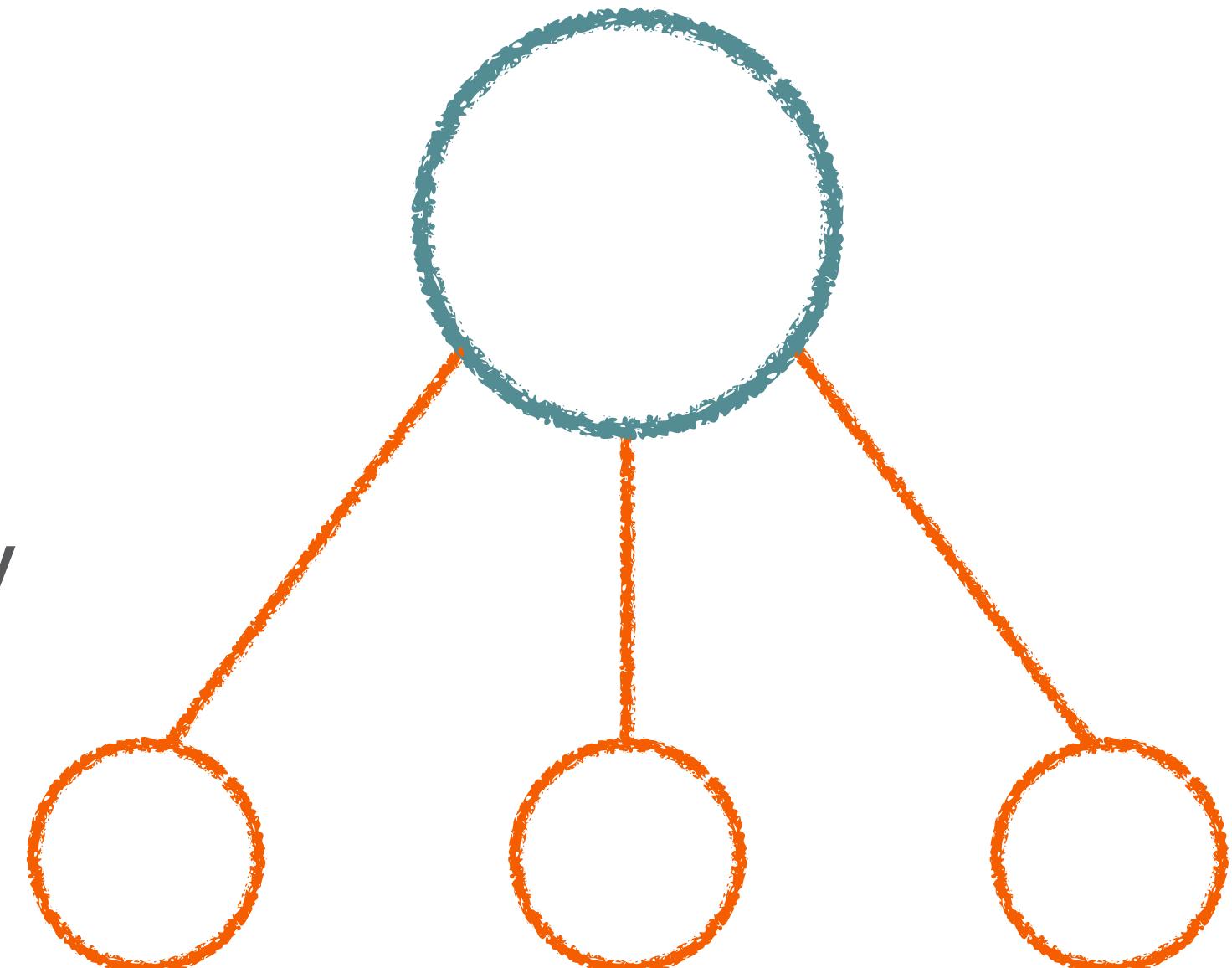
$$tE = \frac{(3 + (4*4) + 16)}{6}$$

$$tE = 5 \frac{5}{6} \text{ months}$$

Three Point Estimating

Important to document all three estimates, not just the aggregate

Indicates breadth of variance, may inform risk management



Contingency Reserves & Reserve Analysis

Contingency Reserves

Reserves are a buffer against uncertainty

Useful not just for cost budgets, but for time budgets, as well



Contingency Reserves

Focused on known unknowns

Offset potential impact of identified risks

Must understand risk, have mitigation strategy and idea of potential impact



Contingency Reserves

Reserve Calculation Methods:

Percentage of duration

Flat number of work periods

Determined via quantitative methods



Contingency Reserves

Monte Carlo Method:

Develops potential reserve amount
based on project simulations

Harnesses odds of various durations for
activities or work packages

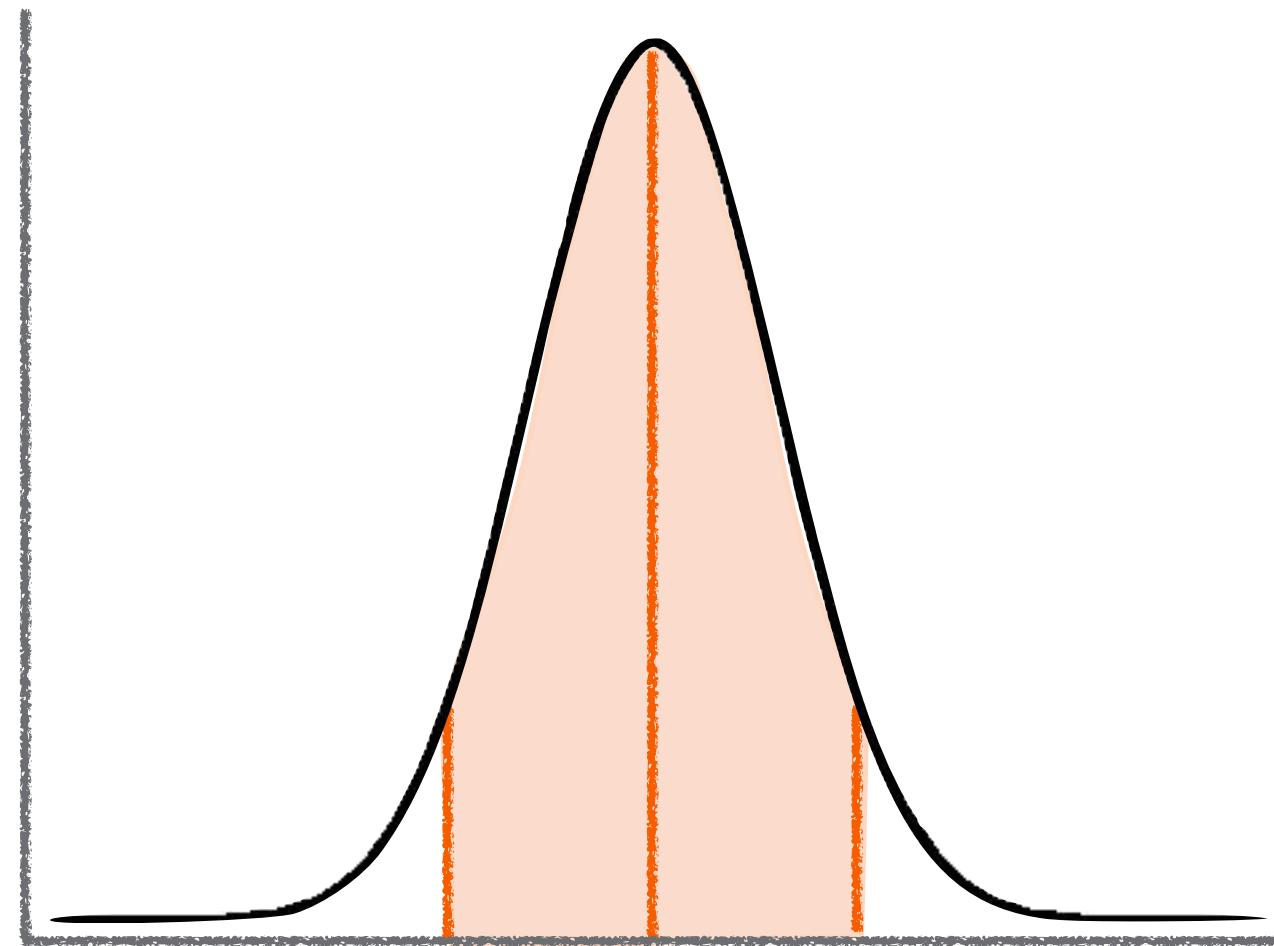


Contingency Reserves

Monte Carlo Method:

May determine reserves using statistical methods following results

Possible to apply to either duration or cost estimates



Contingency Reserves

May be planned at an activity level or grouped into a larger bucket of tasks

May expand, contract or be removed as project progresses

Should be clearly separated from actual estimates in duration documentation



**Known Unknowns
Contingency Reserves**

**Unknown Unknowns
Management Reserves**

Known Unknowns
Contingency Reserves

Unknown Unknowns
Management Reserves

Management Reserves

Time or money included in project plans under management control

Allows unforeseen work within project scope to be performed



Management Reserves

Not to be used on out-of-scope work

Not included in schedule baseline

Is included in project duration requirements

Use of management reserve may require baselines to be modified



Estimate Activity Durations

Process Inputs

Estimate Activity Durations

Planning

Project Schedule Management

Inputs	Tools & Techniques	Outputs
Project Management Plan	Expert Judgment	Duration Estimates
Project Documents	Analogous Estimating	Basis of Estimates
Enterprise Environmental Factors	Parametric Estimating	Project Documents Updates
Organizational Process Assets	Three Point Estimating	
	Bottom-Up Estimating	
	Data Analysis	
	Decision-Making Techniques	
	Meetings	

Estimate Activity Durations

Inputs

T&Ts

Outputs

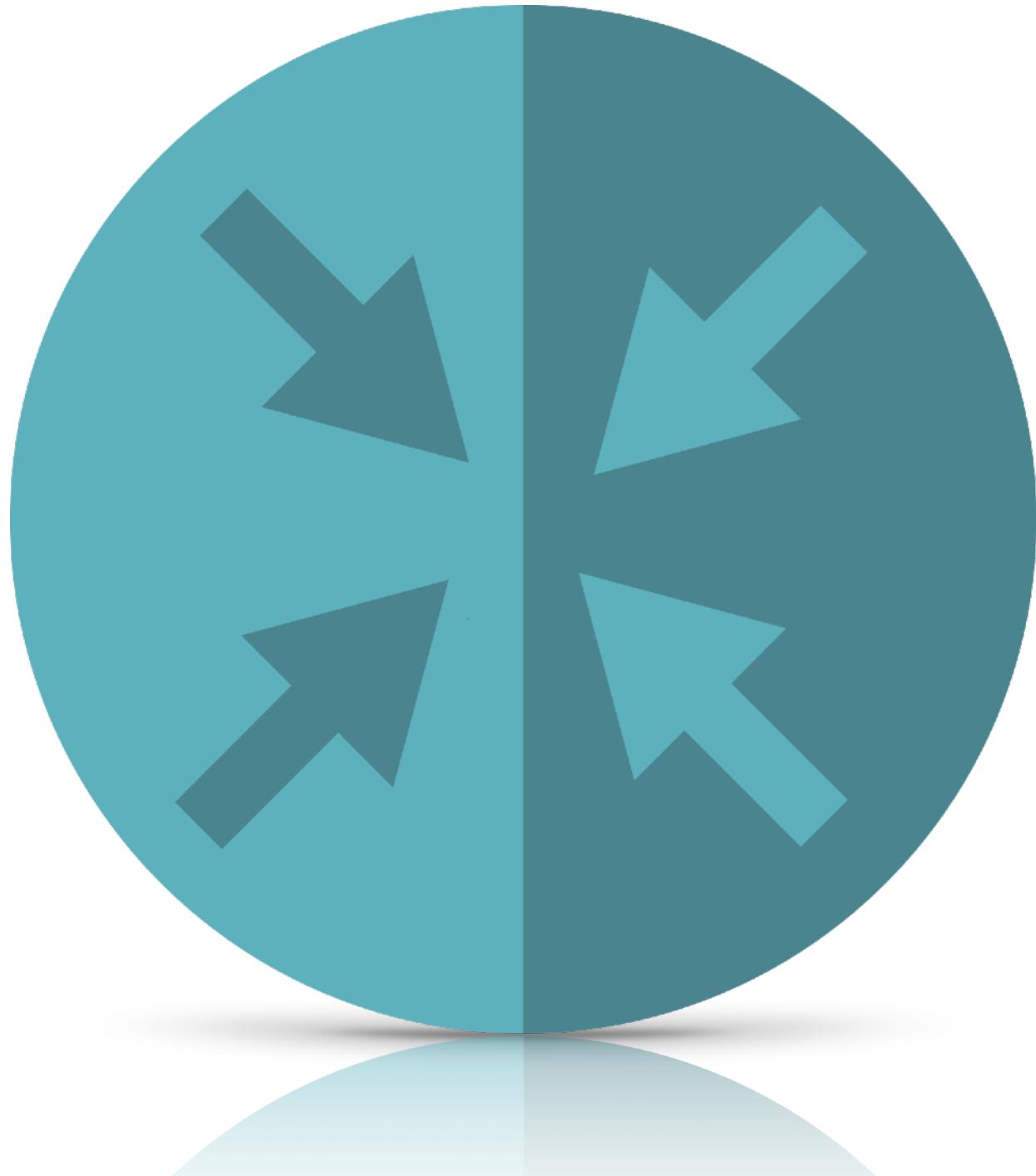
Project Management Plan

Schedule Management Plan

Describes level of accuracy required

Scheduling method may impact duration estimates

Outlines schedule priorities



Estimate Activity Durations

Inputs

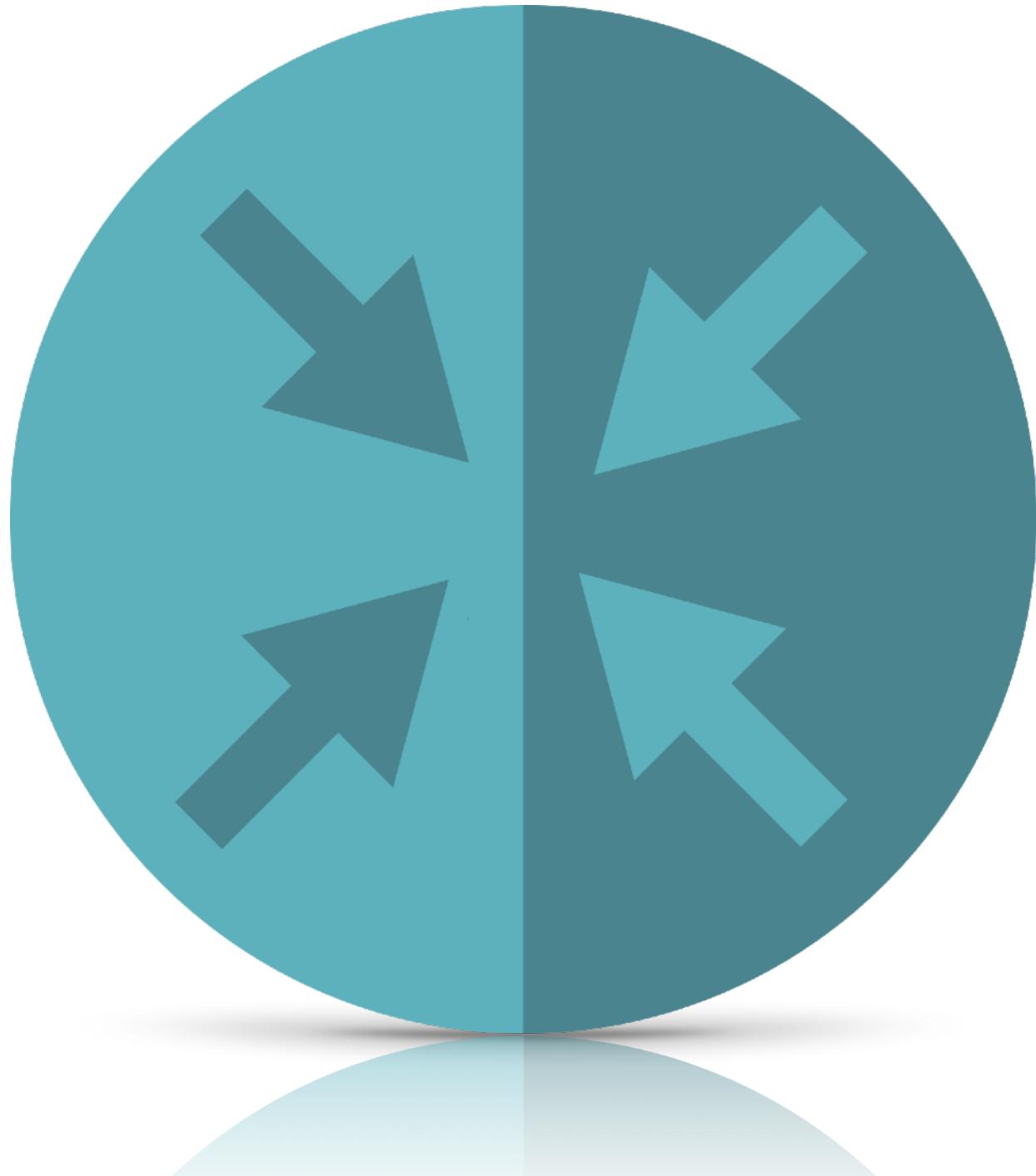
T&Ts

Outputs

Project Management Plan

Scope Baseline

WBS and WBS Dictionary include information that may impact estimates



Estimate Activity Durations

Inputs

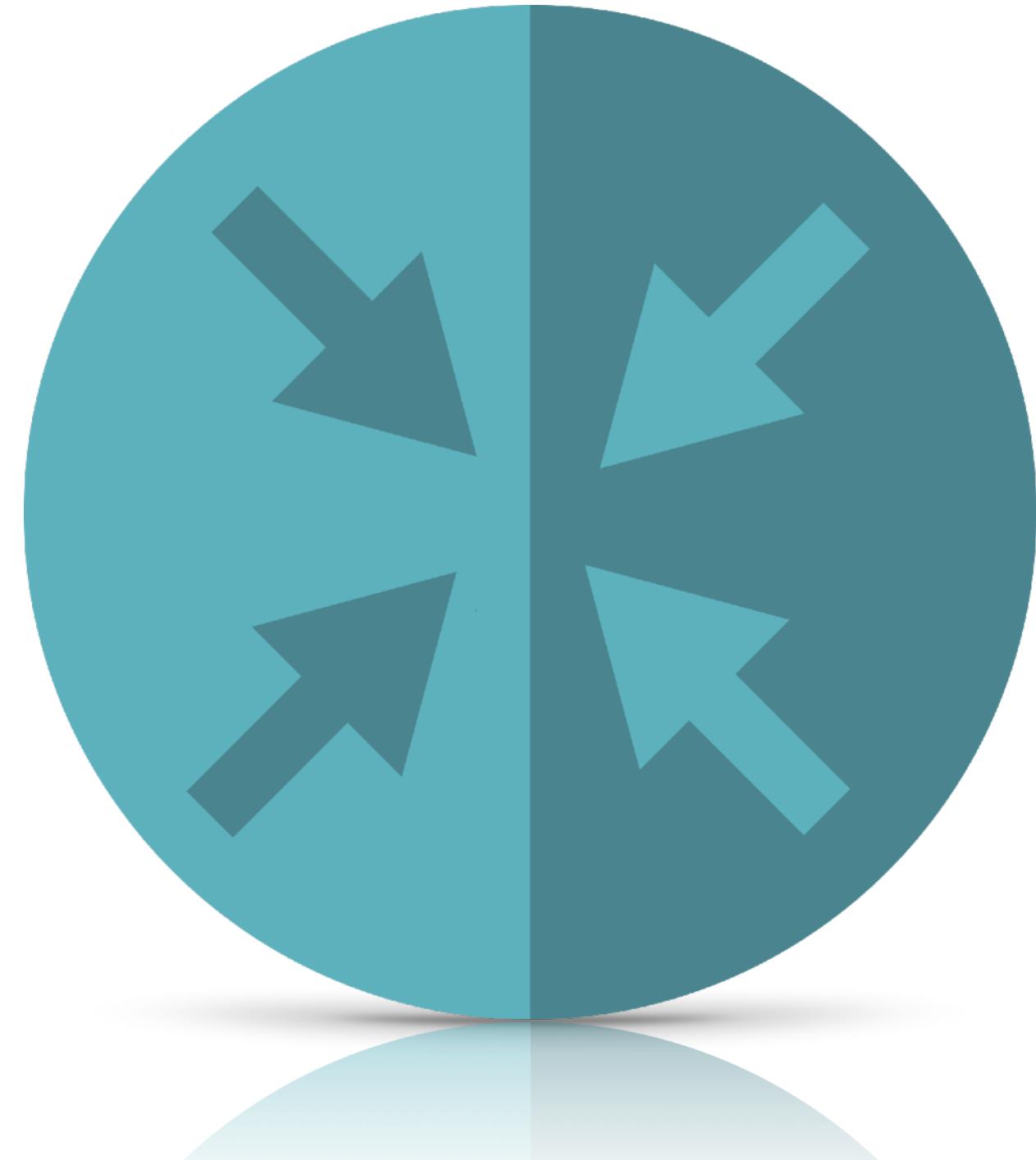
T&Ts

Outputs

Project Documents

Activity List

Includes all project activities that will require duration estimates



Estimate Activity Durations

Inputs

T&Ts

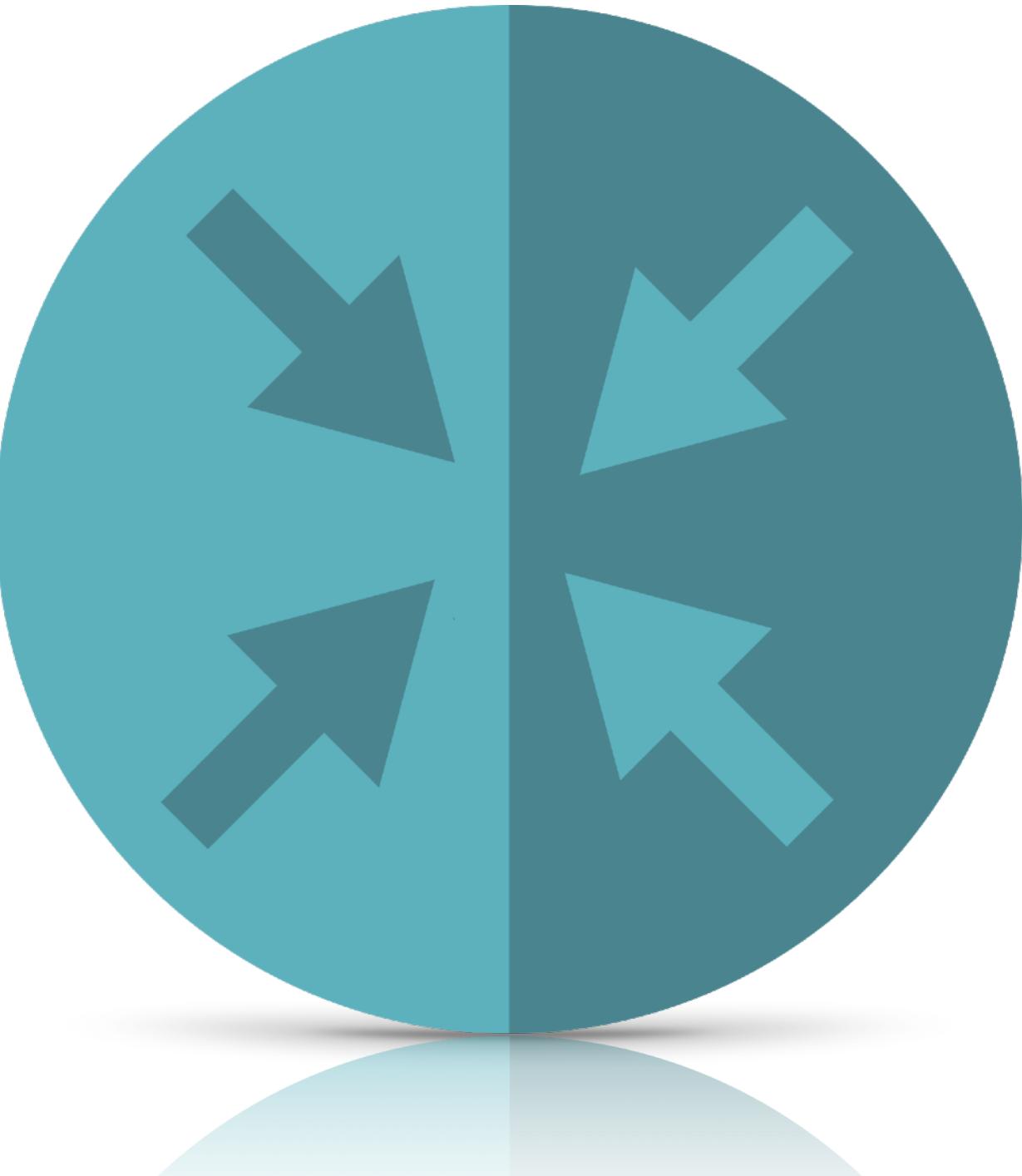
Outputs

Project Documents

Activity Attributes

Key information about each activity and its requirements

Primary input for duration estimates



Estimate Activity Durations

Inputs

T&Ts

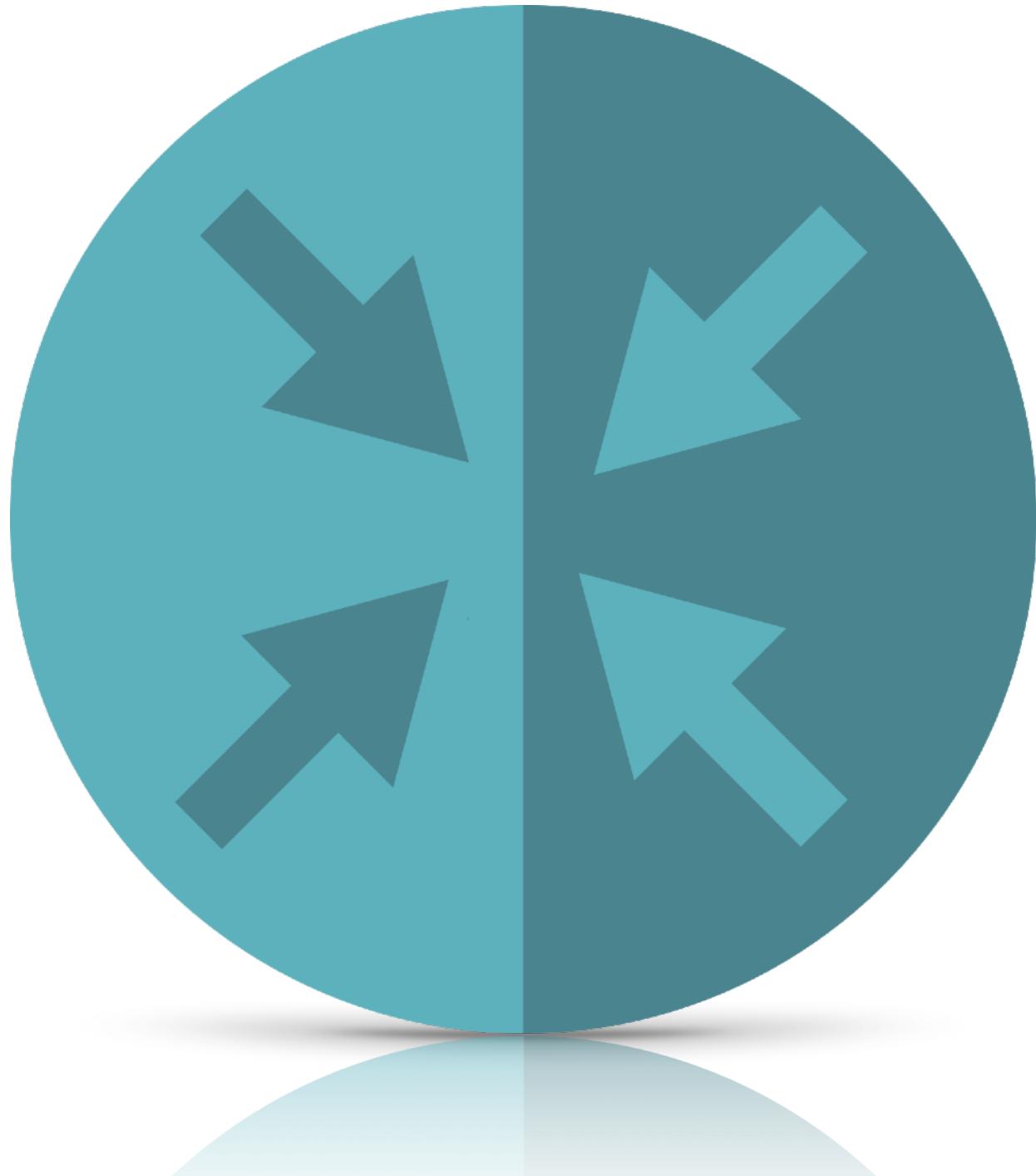
Outputs

Project Documents

Activity Resource Requirements

Resource requirements directly determine possible durations

Quality of resources impacts duration



Estimate Activity Durations

Inputs

T&Ts

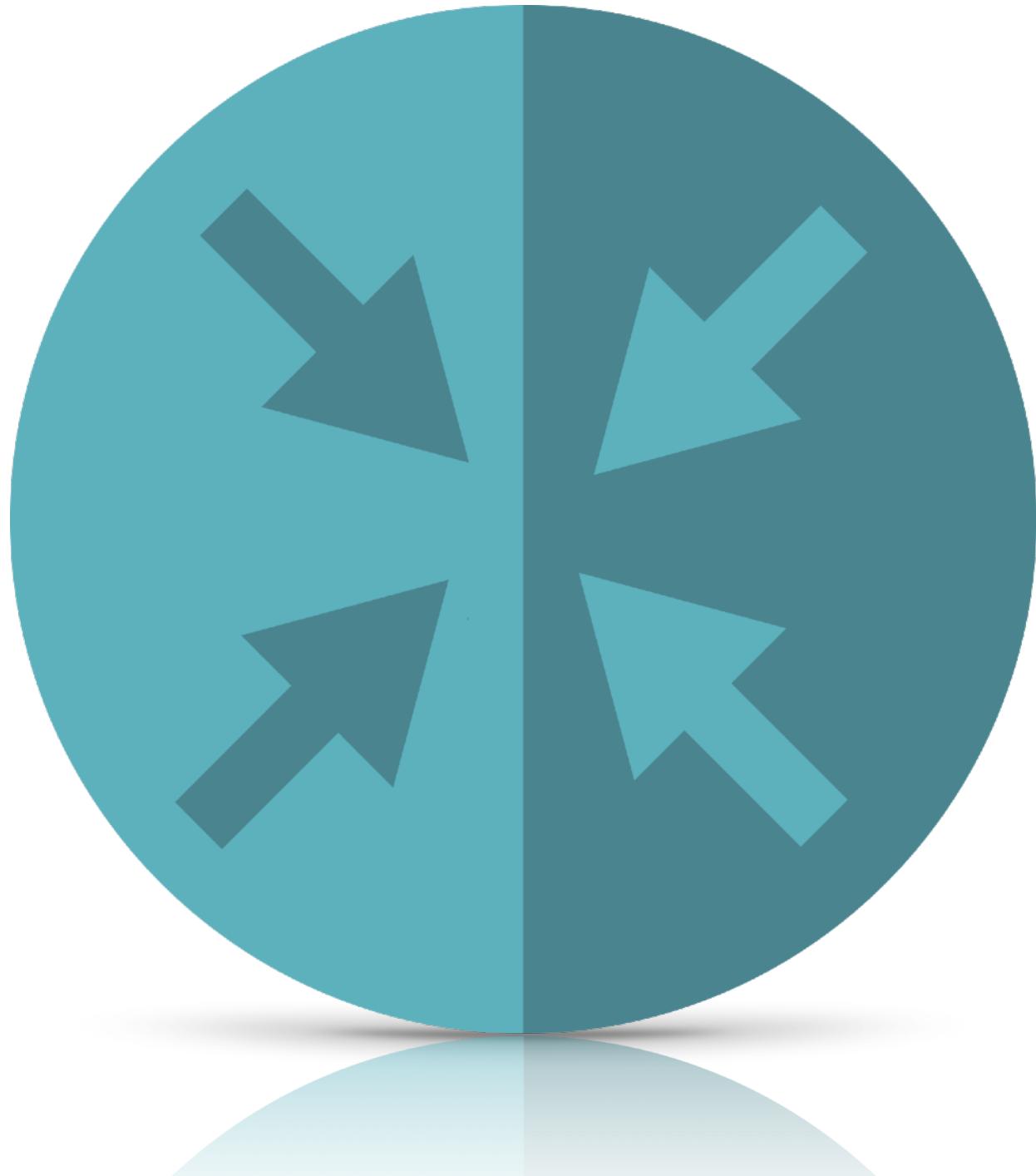
Outputs

Project Documents

Resource Calendars

Availability may impact selection of resources or when resources conduct activities

General availability of resources will impact duration (part vs. full-time)



Estimate Activity Durations

Inputs

T&Ts

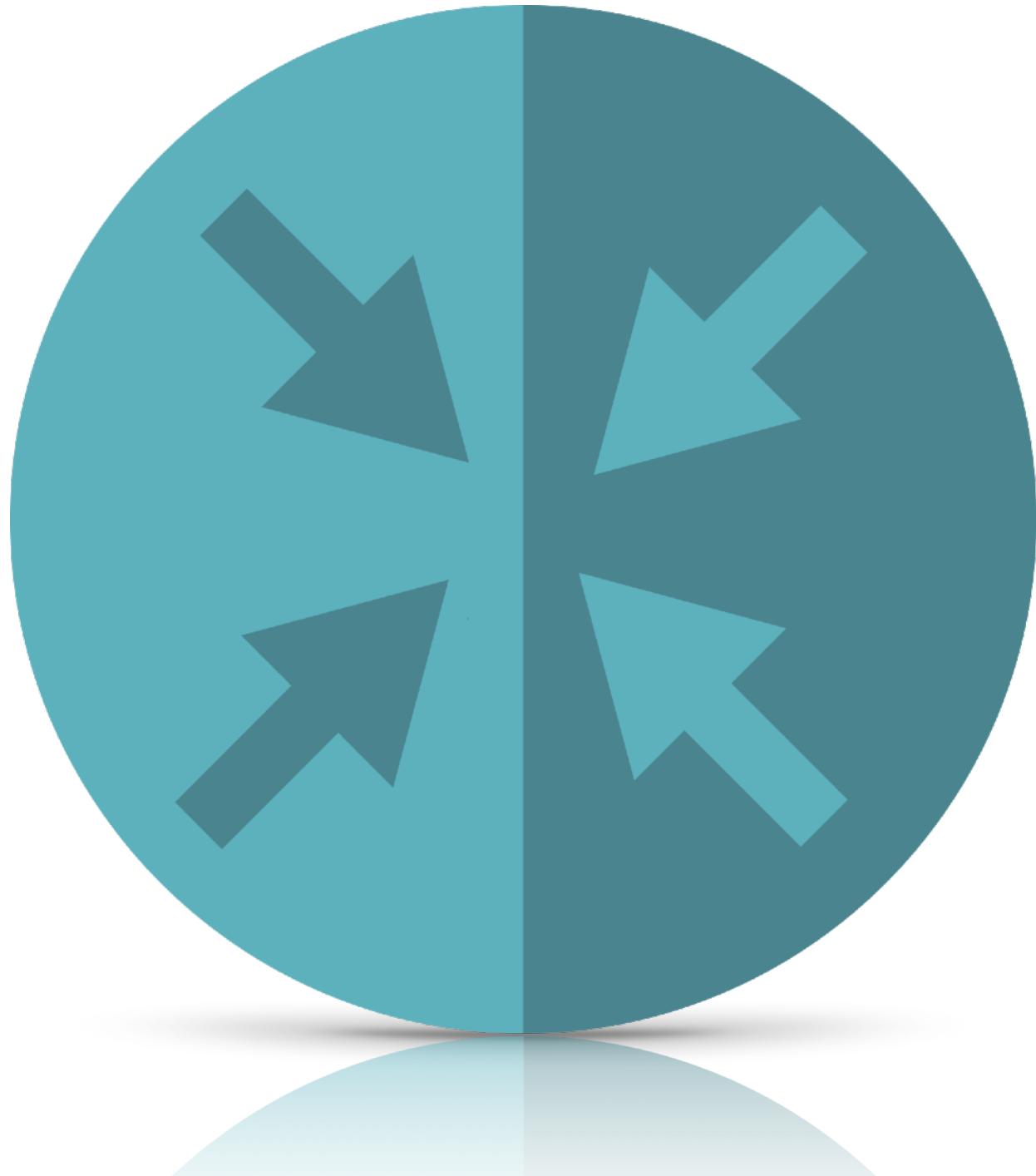
Outputs

Project Documents

Risk Register

Impacts resource selection,
prioritization of work, sequence of
activities

Impacts size of contingency and
management budgets



Estimate Activity Durations

Inputs

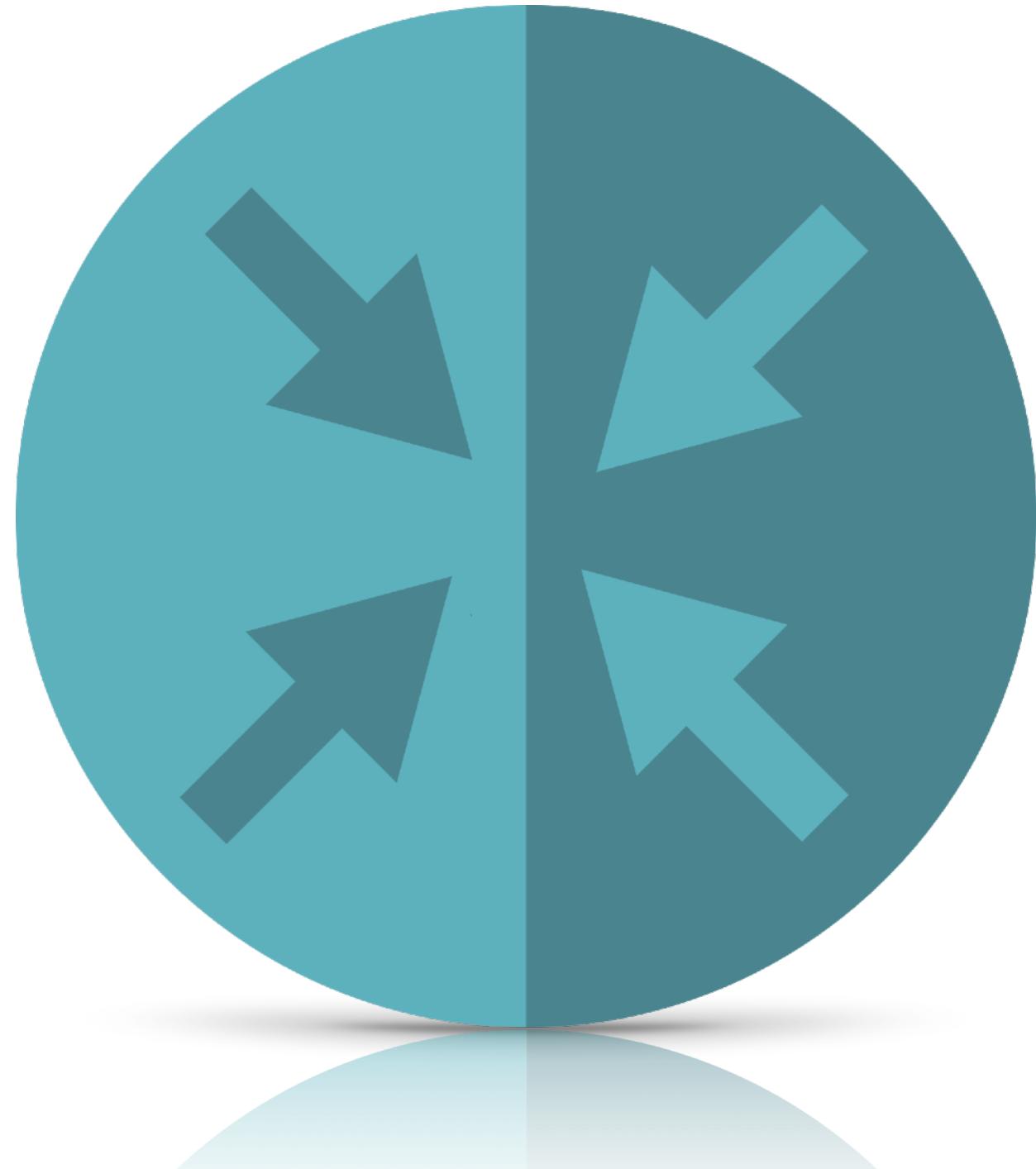
T&Ts

Outputs

Project Documents

Resource Breakdown Structure

Visual representation of resources and their attributes, useful in estimation and planning



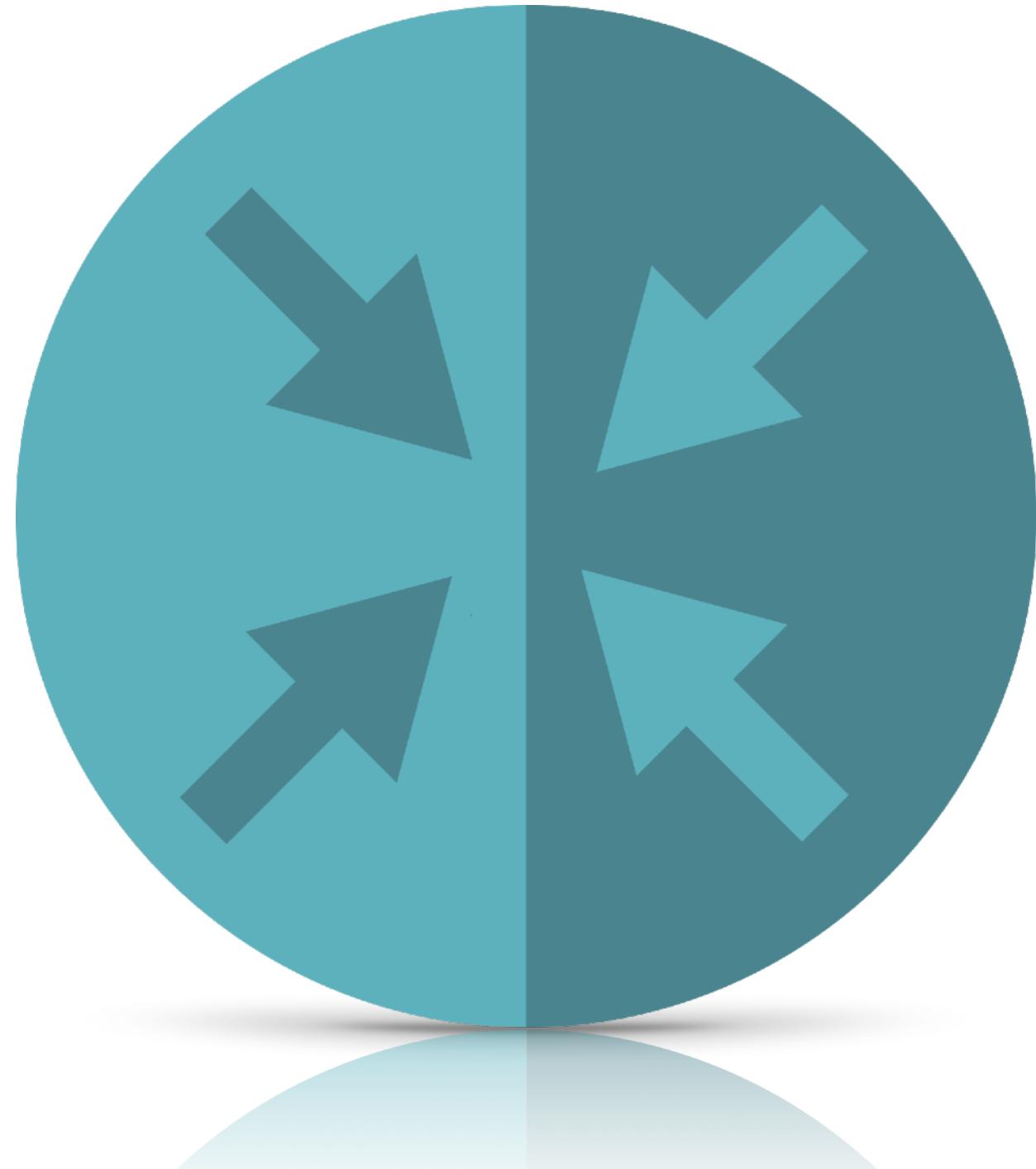
Estimate Activity Durations

Inputs

T&Ts

Outputs

Project Documents
Project Team Assignments
Staff alignment to requirements may
impact duration estimates



Estimate Activity Durations

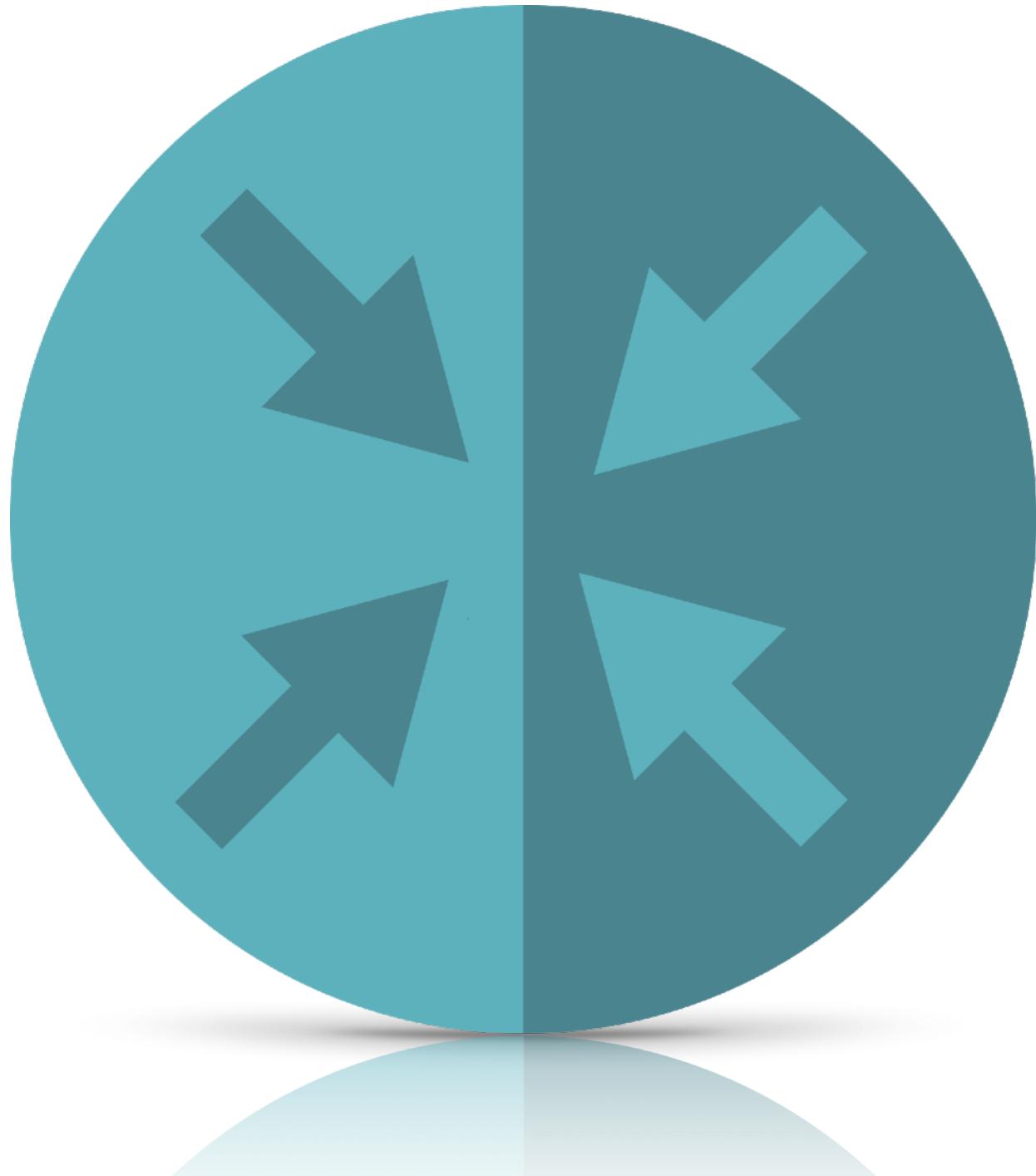
Inputs

T&Ts

Outputs

Project Documents Milestone List

Duration estimates may be shaped by
milestones in timeline



Estimate Activity Durations

Inputs

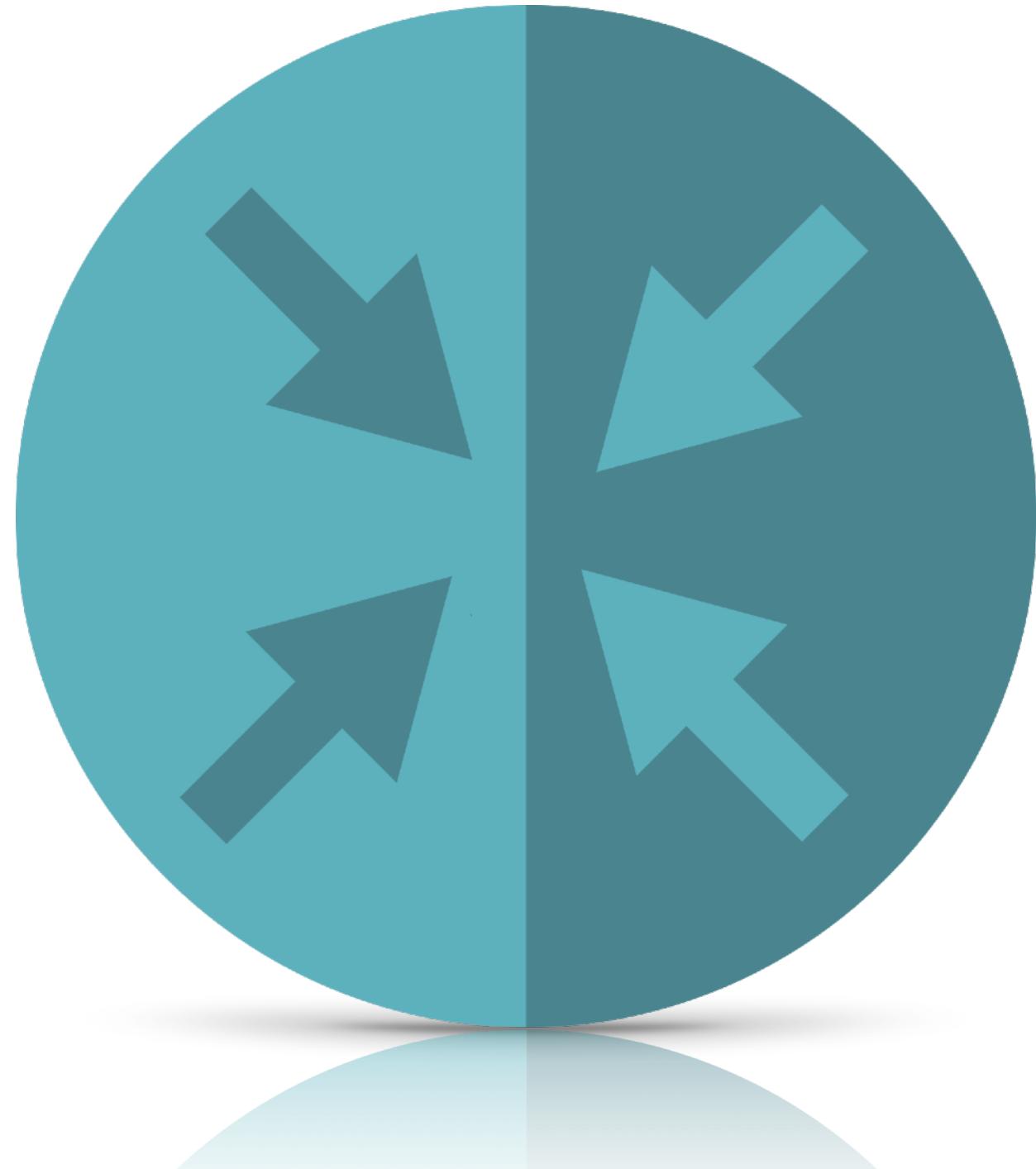
T&Ts

Outputs

Project Documents

Assumptions Log

Helpful in identifying risks that may impact estimates and estimate accuracy



Estimate Activity Durations

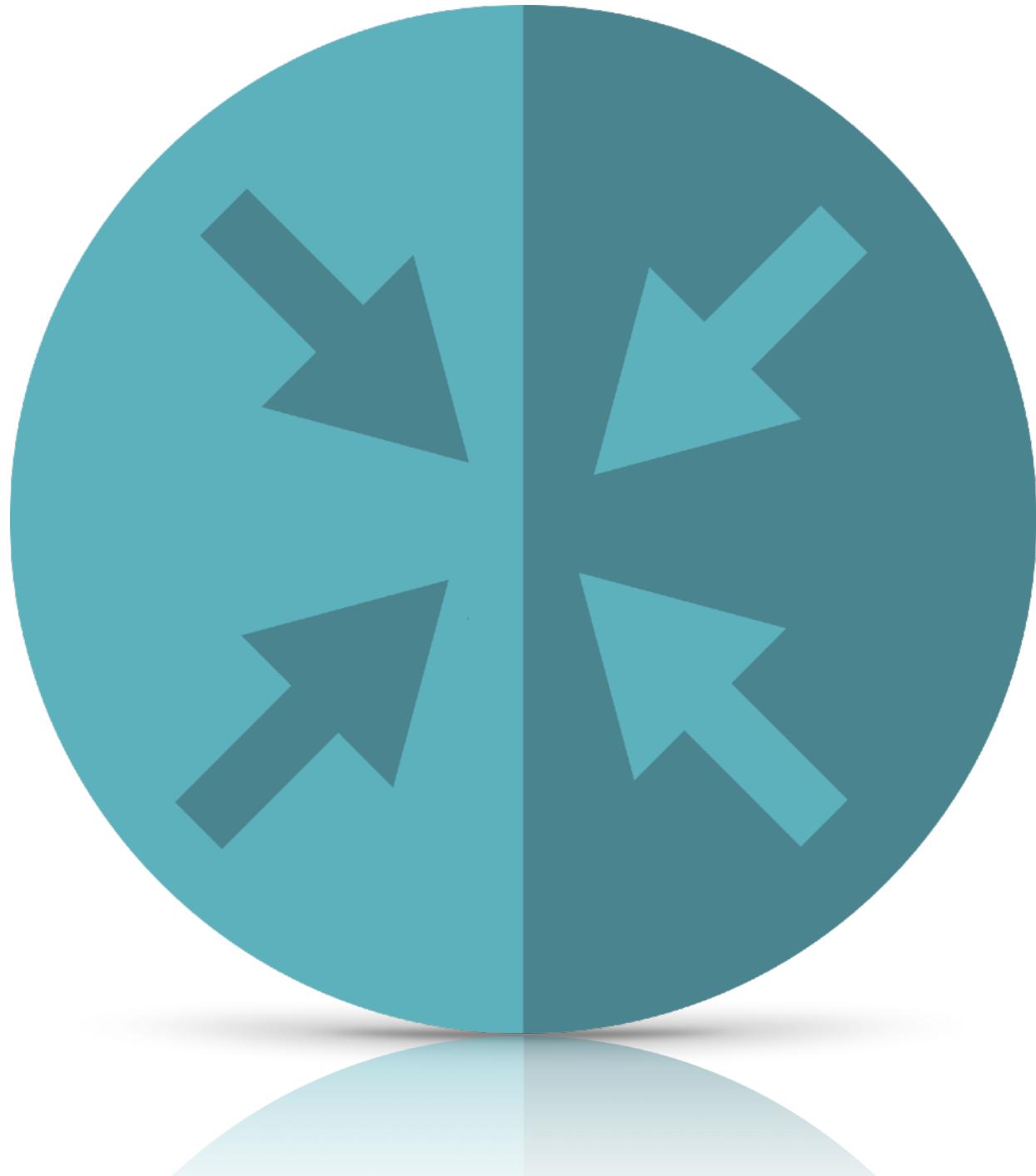
Inputs

T&Ts

Outputs

Project Documents
Lessons Learned Register

Prior estimates may help in shaping
and improving new estimates



Estimate Activity Durations

Inputs

T&Ts

Outputs

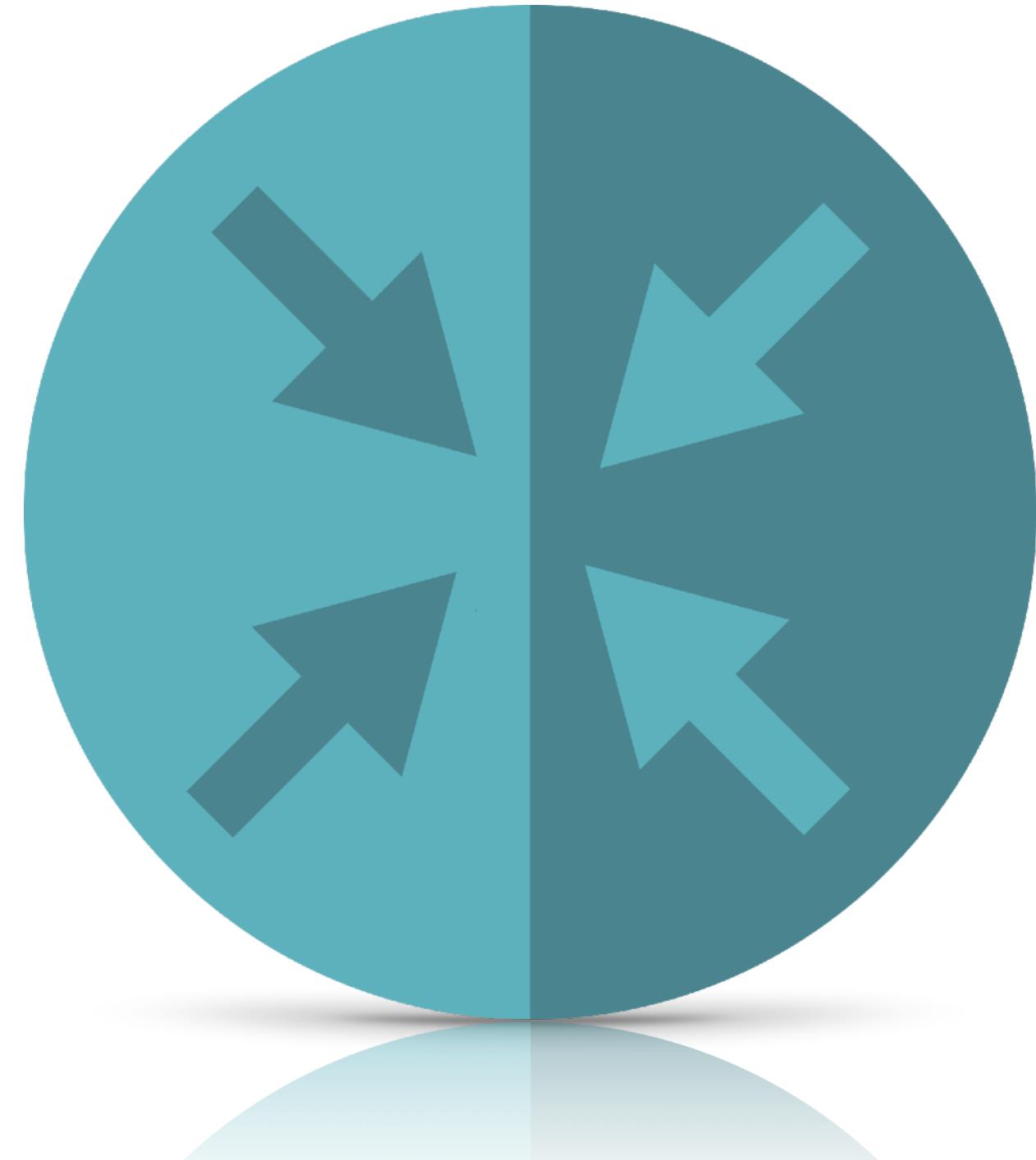
Enterprise Environmental Factors

Duration estimating databases

Productivity metrics

Published commercial information

Location of team members



Estimate Activity Durations

Inputs

T&Ts

Outputs

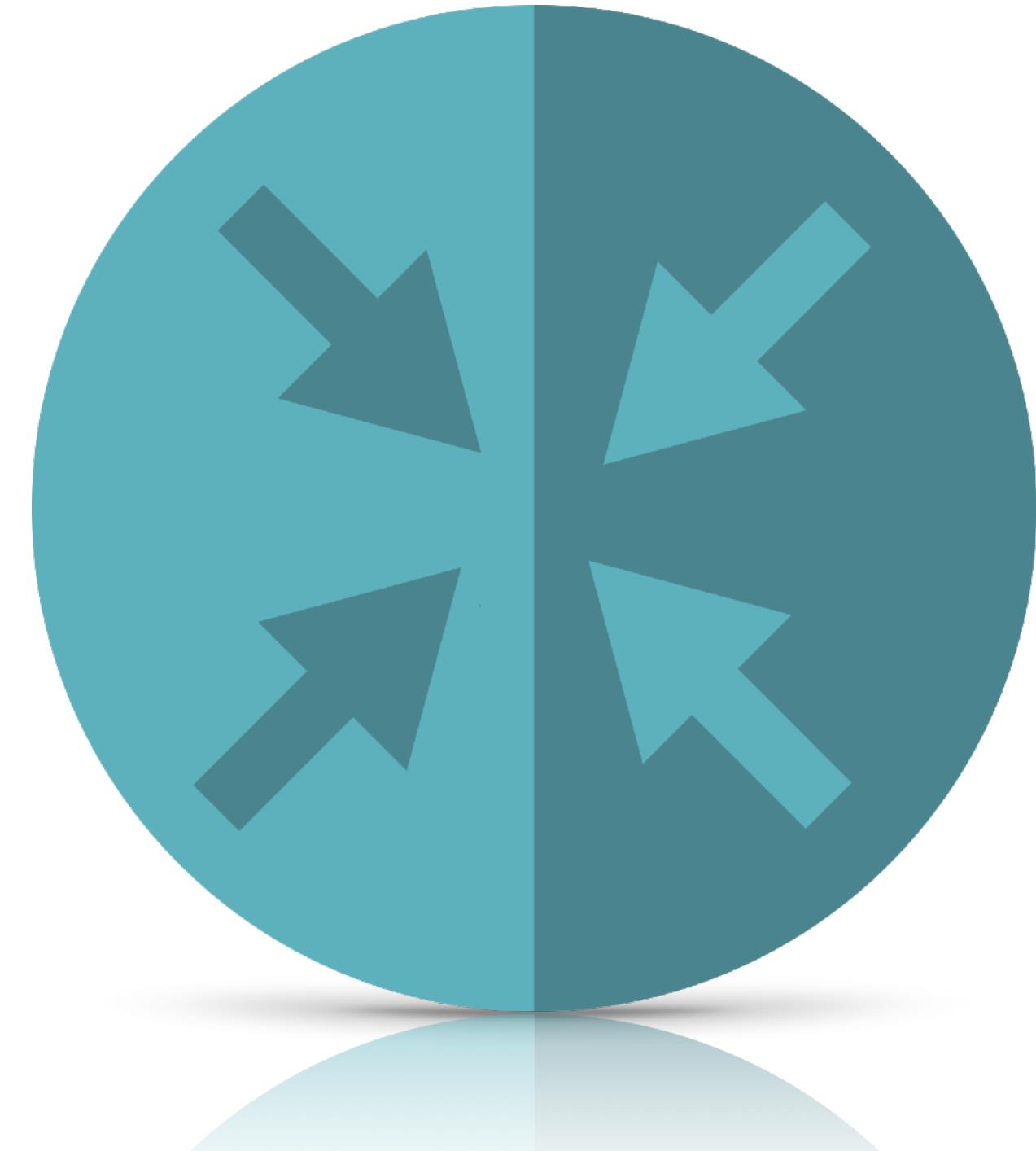
Organizational Process Assets

Historical duration information

Project calendars

Scheduling methodology

Lessons learned



Estimate Activity Durations

Process Tools, Techniques and Outputs

Estimate Activity Durations

Inputs

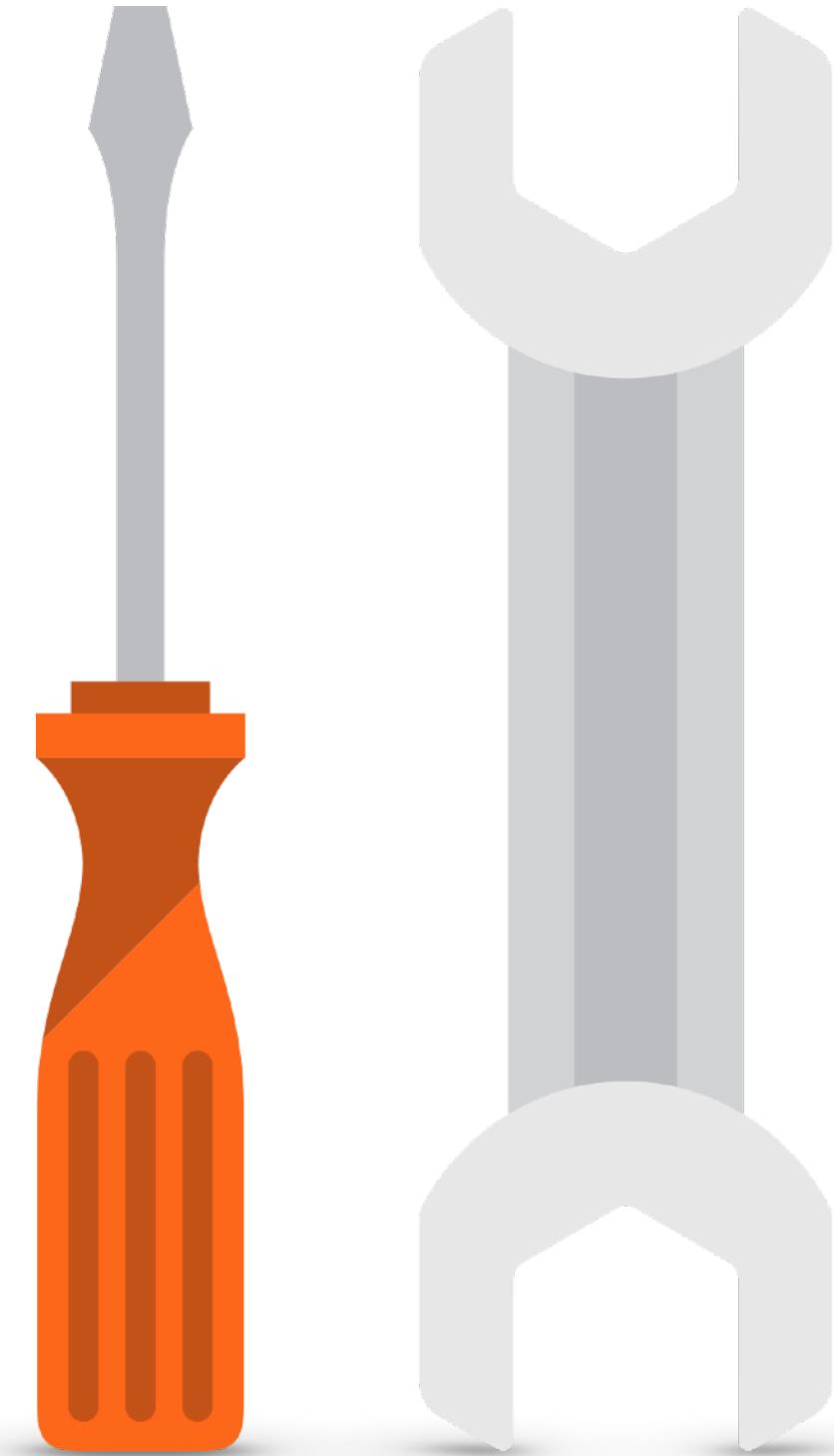
T&Ts

Outputs

Expert Judgment

Recommends durations based on prior experience

Useful in determining which estimation methods are most suitable



Estimate Activity Durations

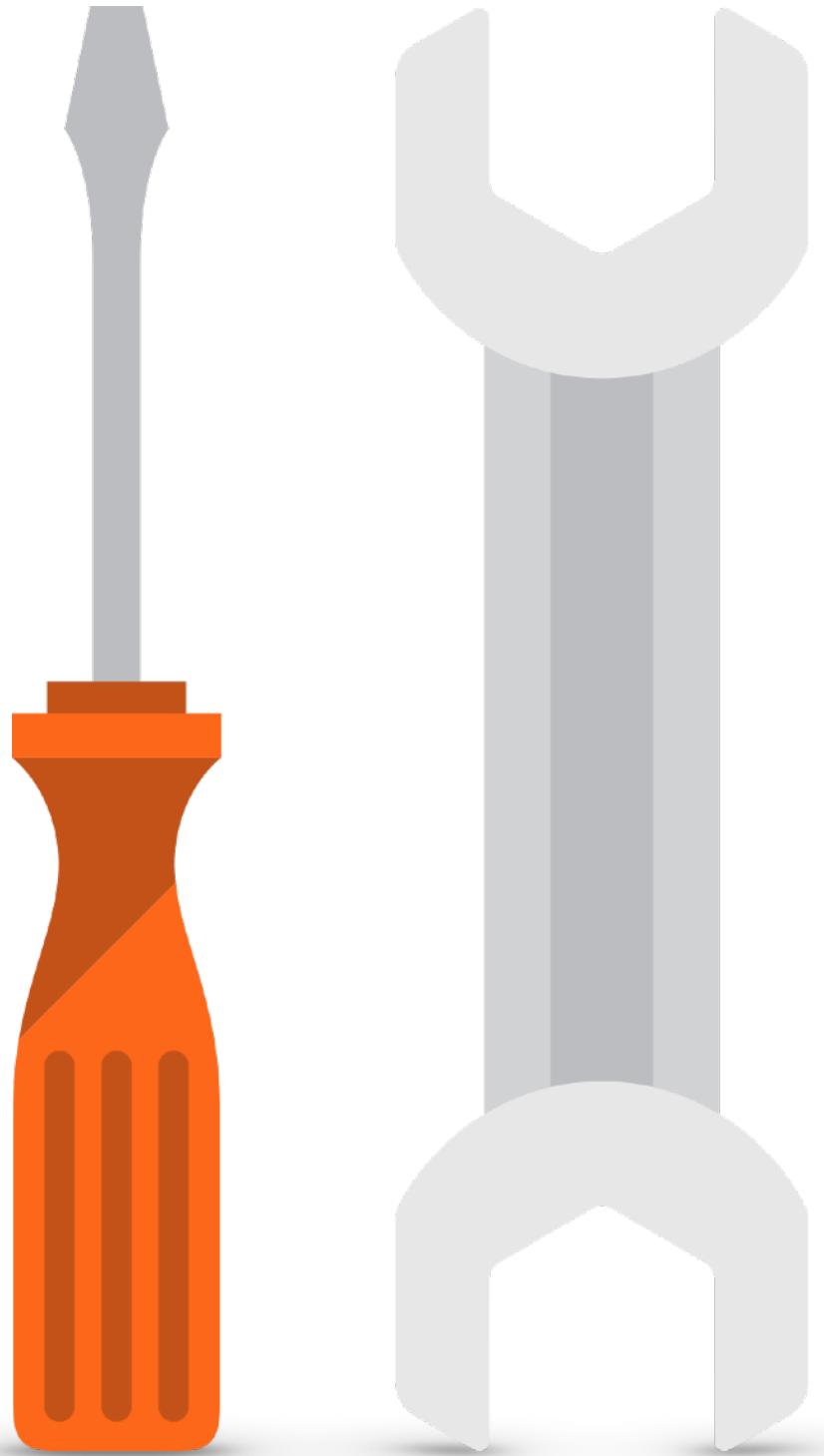
Inputs

T&Ts

Outputs

Analogous Estimating

Estimates duration based on historical data from similar activities or projects



Estimate Activity Durations

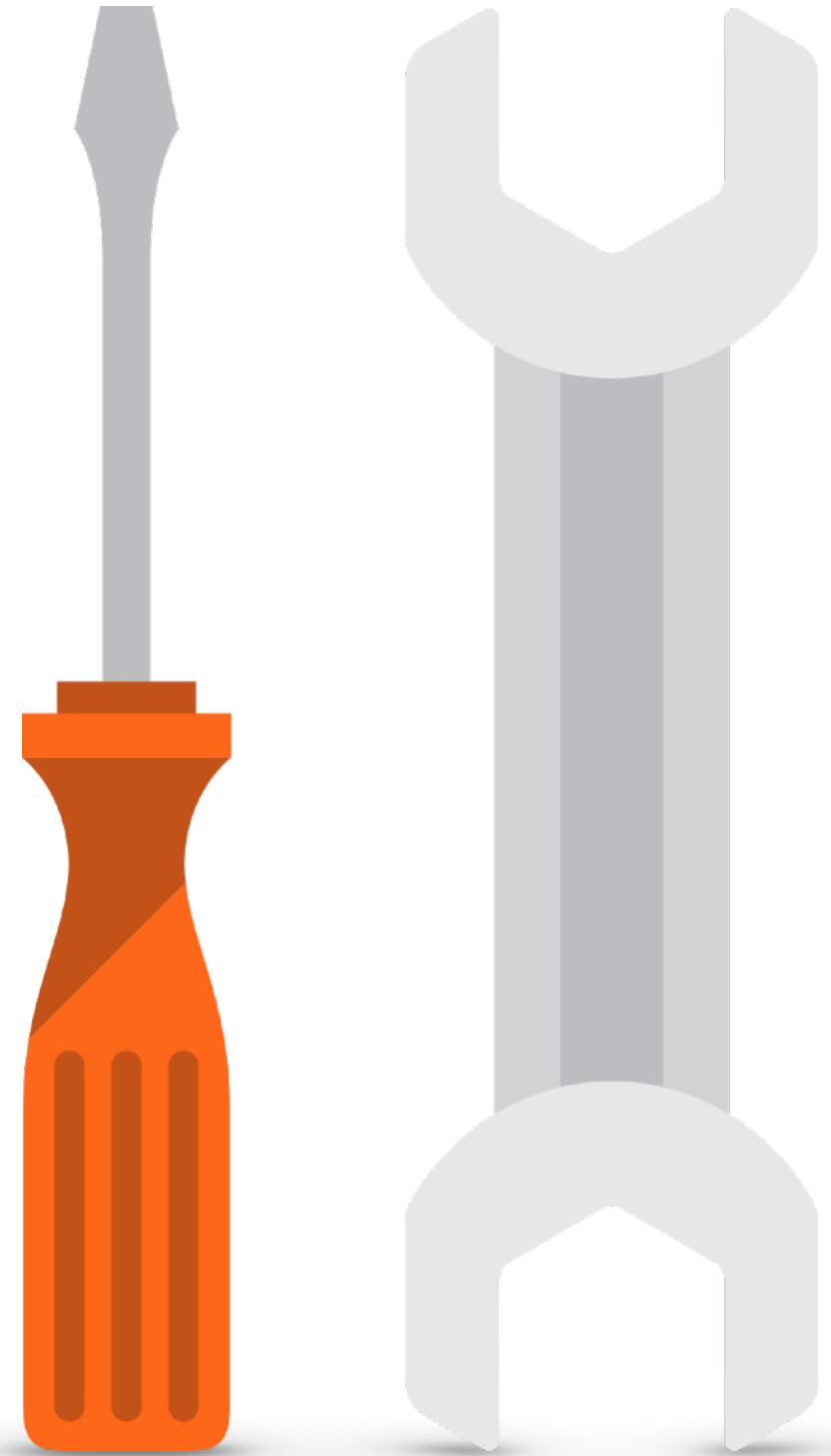
Inputs

T&Ts

Outputs

Parametric Estimating

Uses formulas to estimate duration, using historical data



Estimate Activity Durations

Inputs

T&Ts

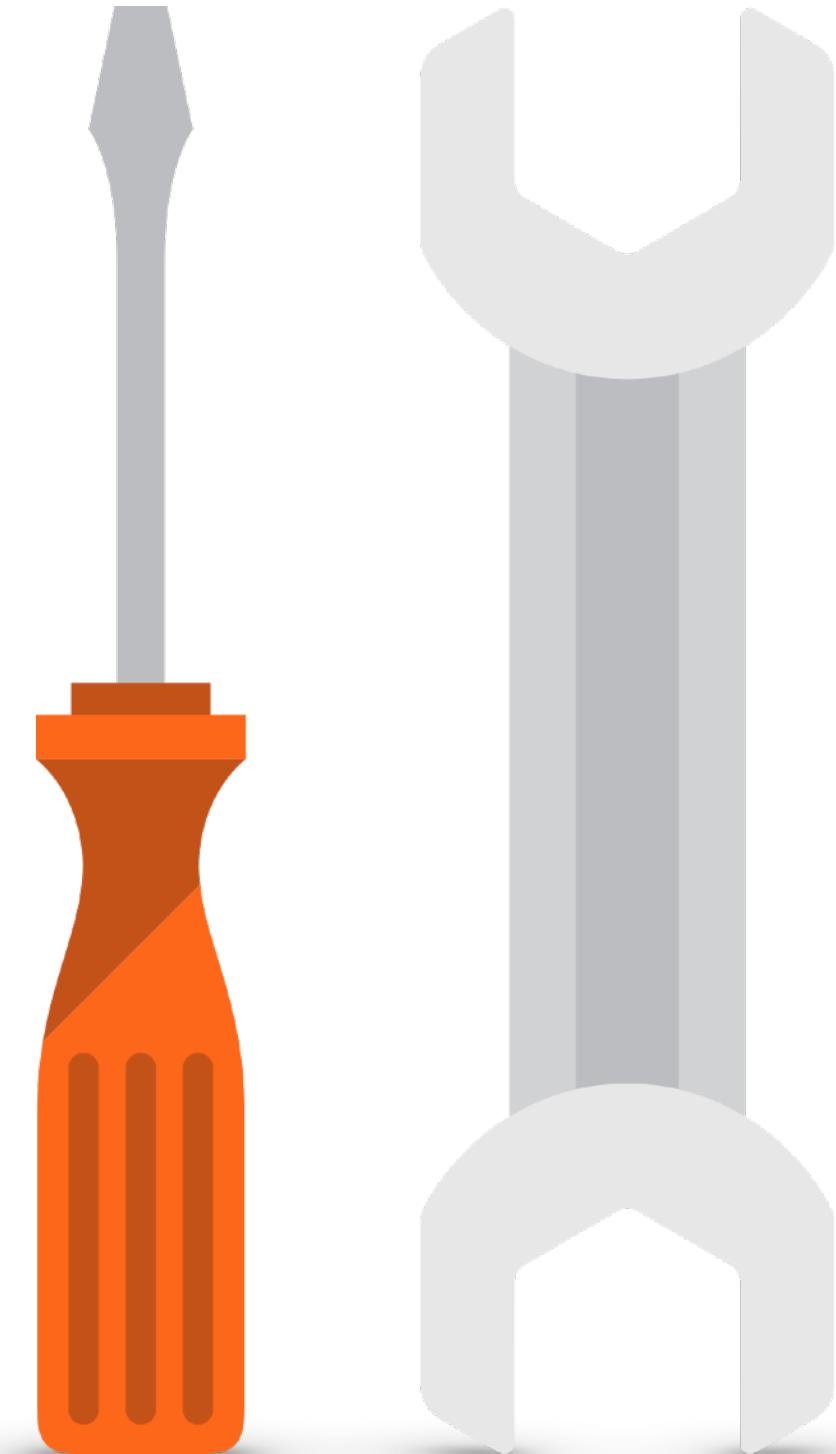
Outputs

Three Point Estimating

Generates estimates based on optimistic, pessimistic and most-likely projections

Triangular – Weights projections equally

PERT – Weights most-likely outcome more than others: $tE = \frac{(tO + 4tM + tP)}{6}$



Estimate Activity Durations

Inputs

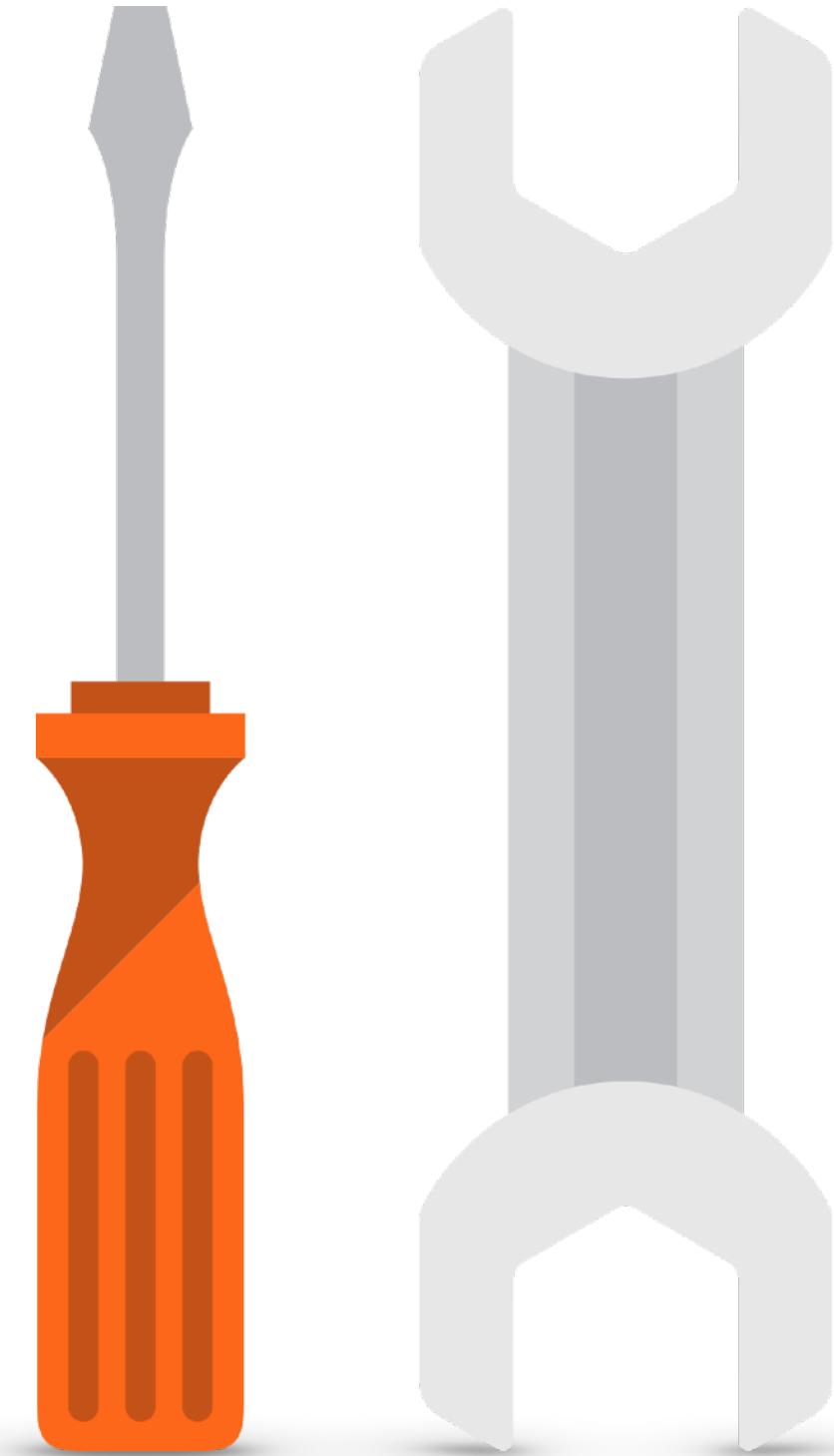
T&Ts

Outputs

Bottom-Up Estimating

Aggregates activity or work package estimates into a broader estimate

Understanding activity sequencing and dependencies is critical to this approach



Estimate Activity Durations

Inputs

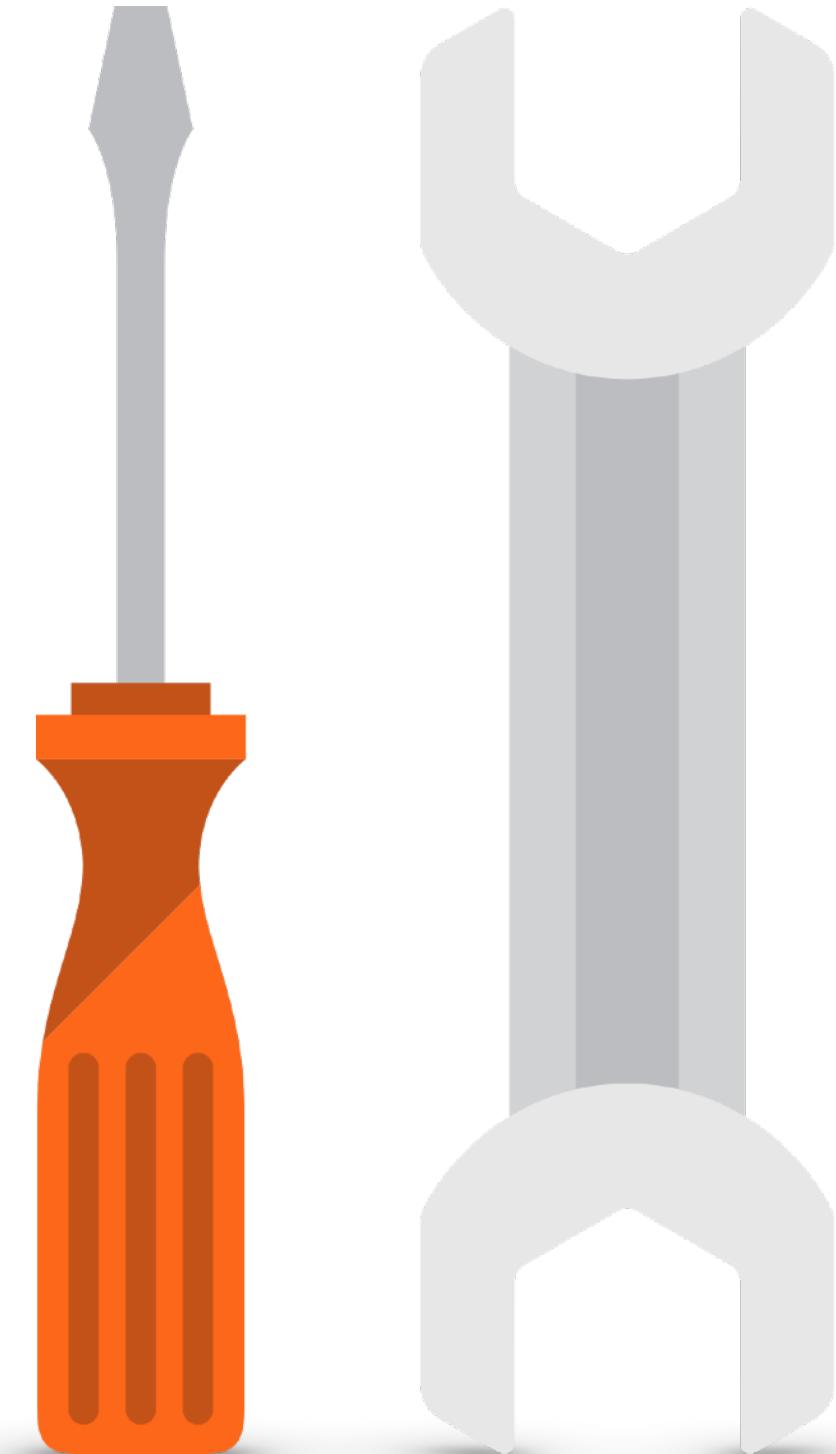
T&Ts

Outputs

Data Analysis

Alternatives Analysis

Comparison of resources,
scheduling techniques, make vs.
buy and other decisions are
inherent to duration estimates



Estimate Activity Durations

Inputs

T&Ts

Outputs

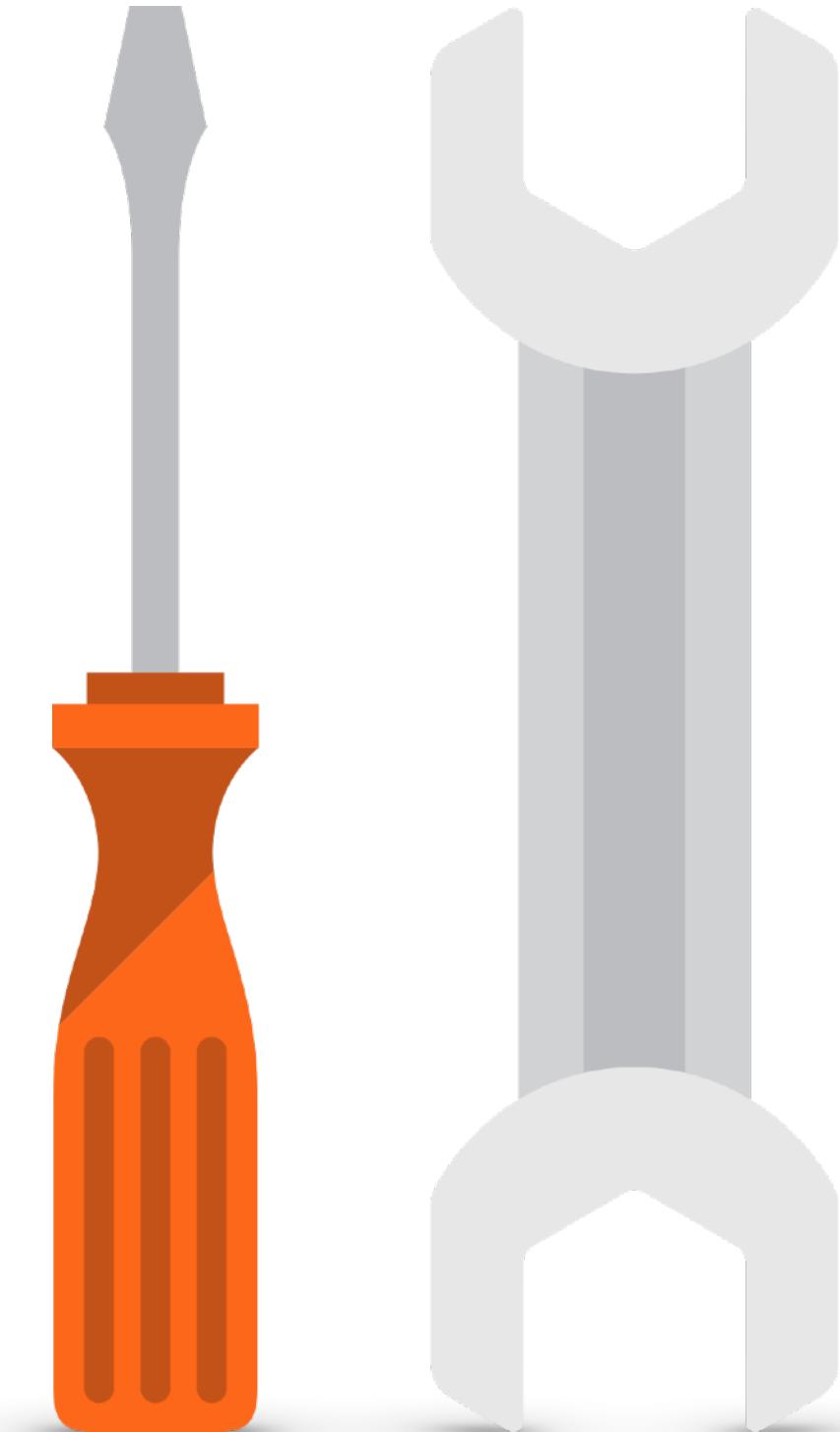
Data Analysis

Reserve Analysis

Technique of developing time reserves

Contingency Reserves: Based on known risks, clearly separated from estimates

Management Reserves: Targeted toward unknown risks, baked into requirements but not project baselines



Estimate Activity Durations

Inputs

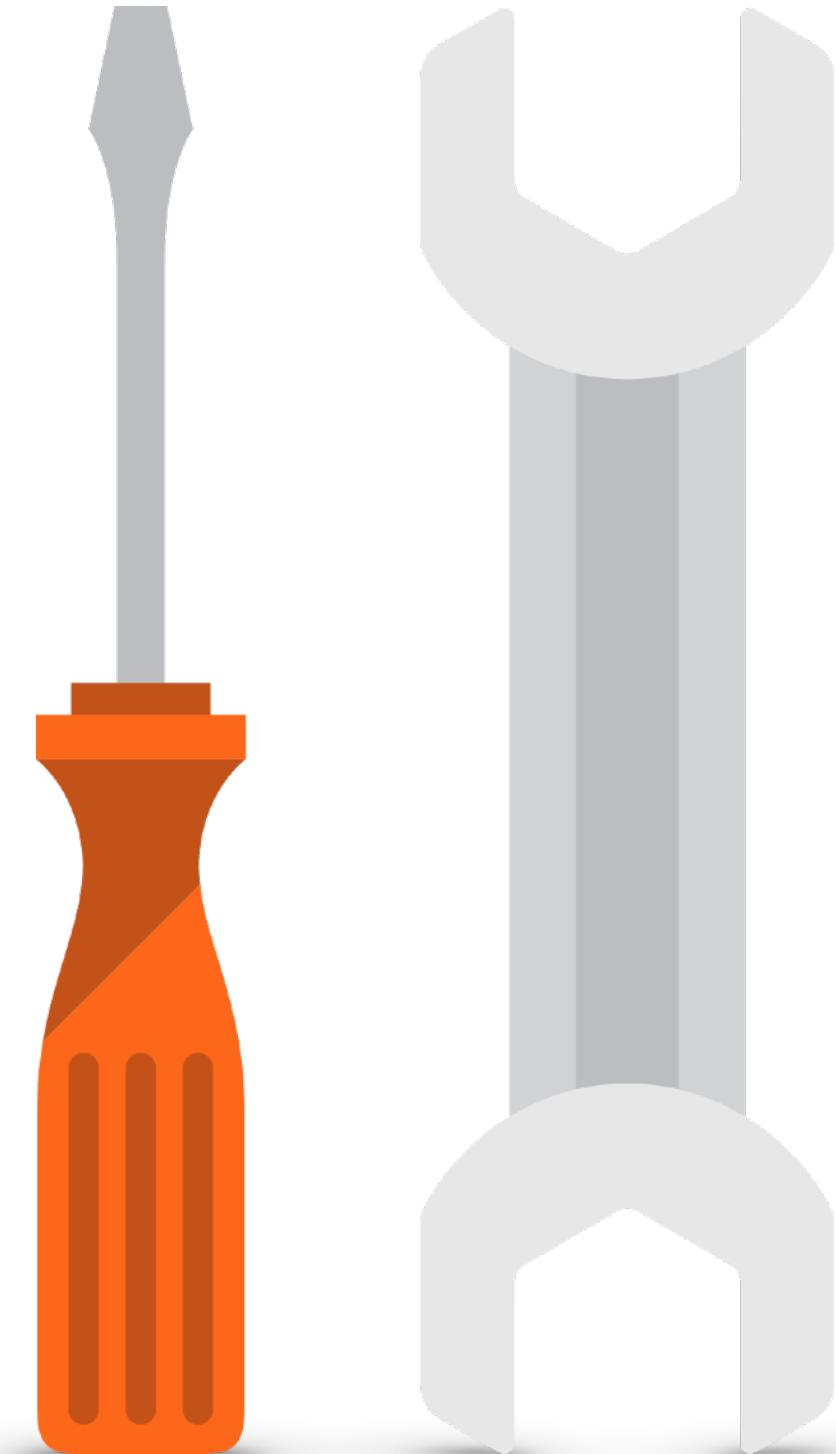
T&Ts

Outputs

Decision-Making Techniques

Involving SMEs and key stakeholders leads to better estimates based on greater input

Increases stakeholder commitment to estimates and project success



Estimate Activity Durations

Inputs

T&Ts

Outputs

Duration Estimates

Indicate how long activities are expected to take from beginning to completion, given particular resources

Do not include lead or lag times

Generally indicate projected likelihood or range of outcomes



Estimate Activity Durations

Inputs

T&Ts

Outputs

Basis of Estimates

Context of estimates

Assumptions and constraints

Range of possibilities/variance

Confidence level

Risks related to estimates



Estimate Activity Durations

Inputs

T&Ts

Outputs

Project Documents Updates

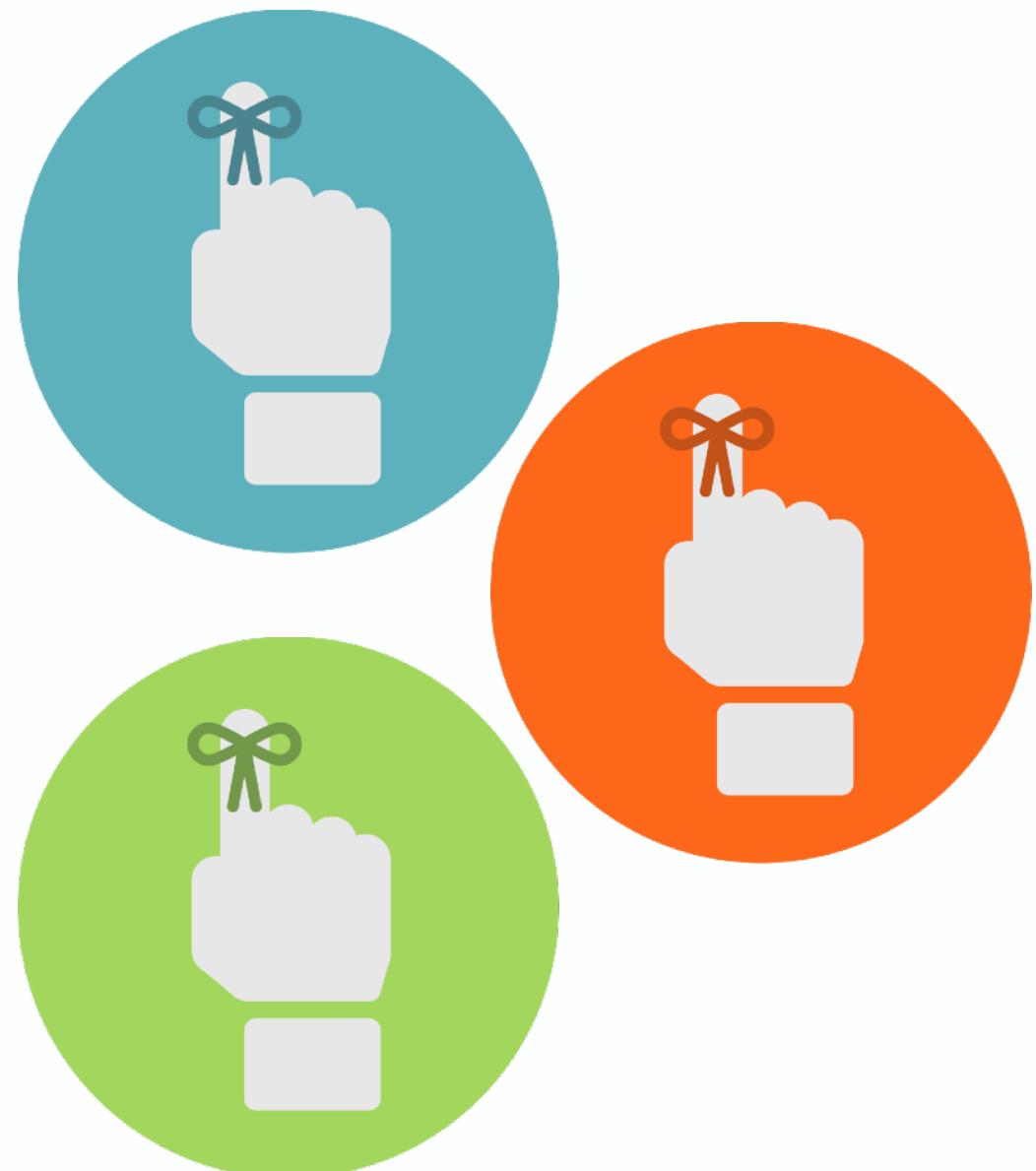
Activity attributes

Duration assumptions

Lessons learned register



Module Review:



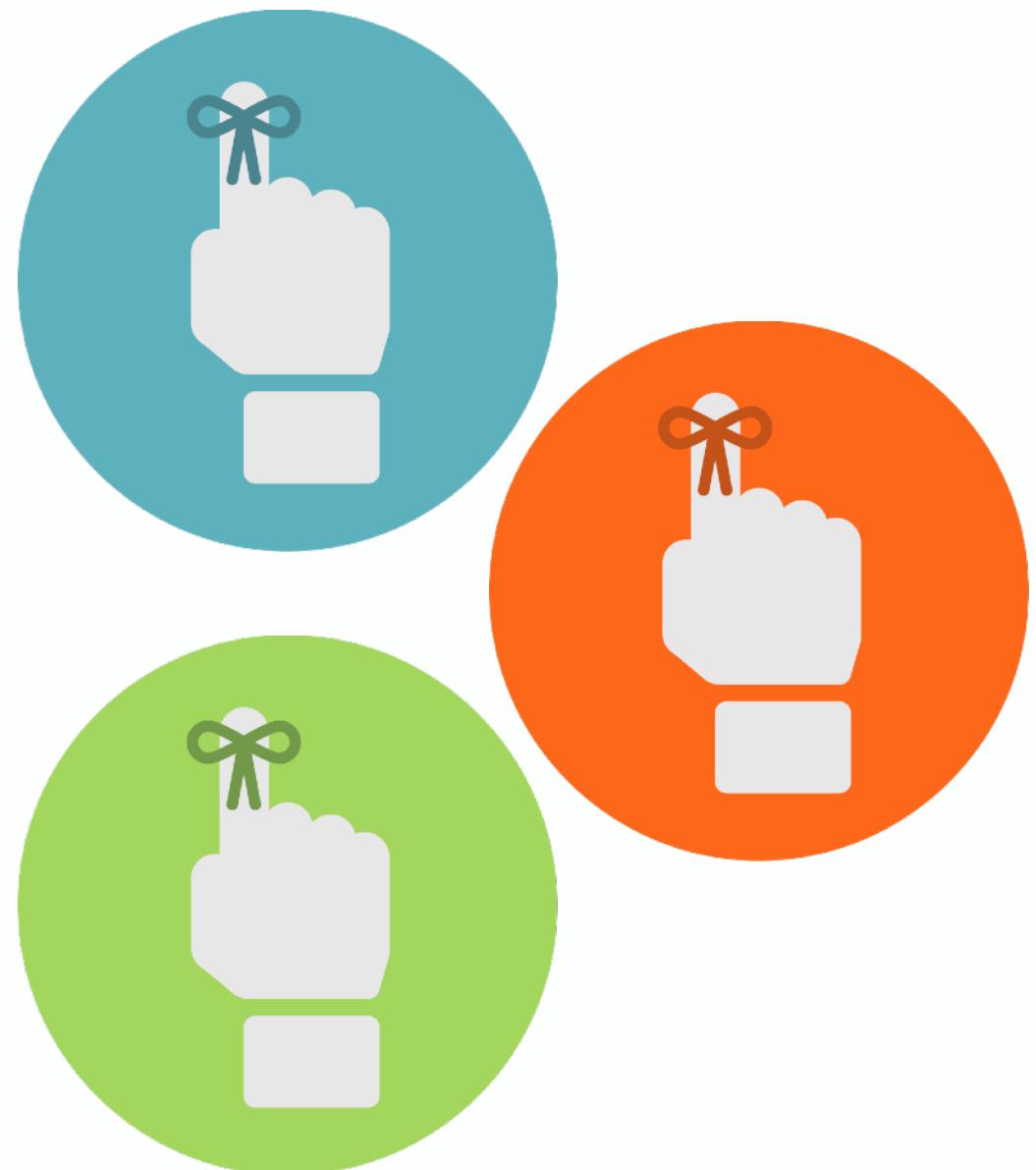
Estimating Activity Durations

Determines reasoned activity timelines

Closely tied to other processes, especially

**Estimate Activity Resources, Estimate Costs and
Develop Schedule**

Module Review:

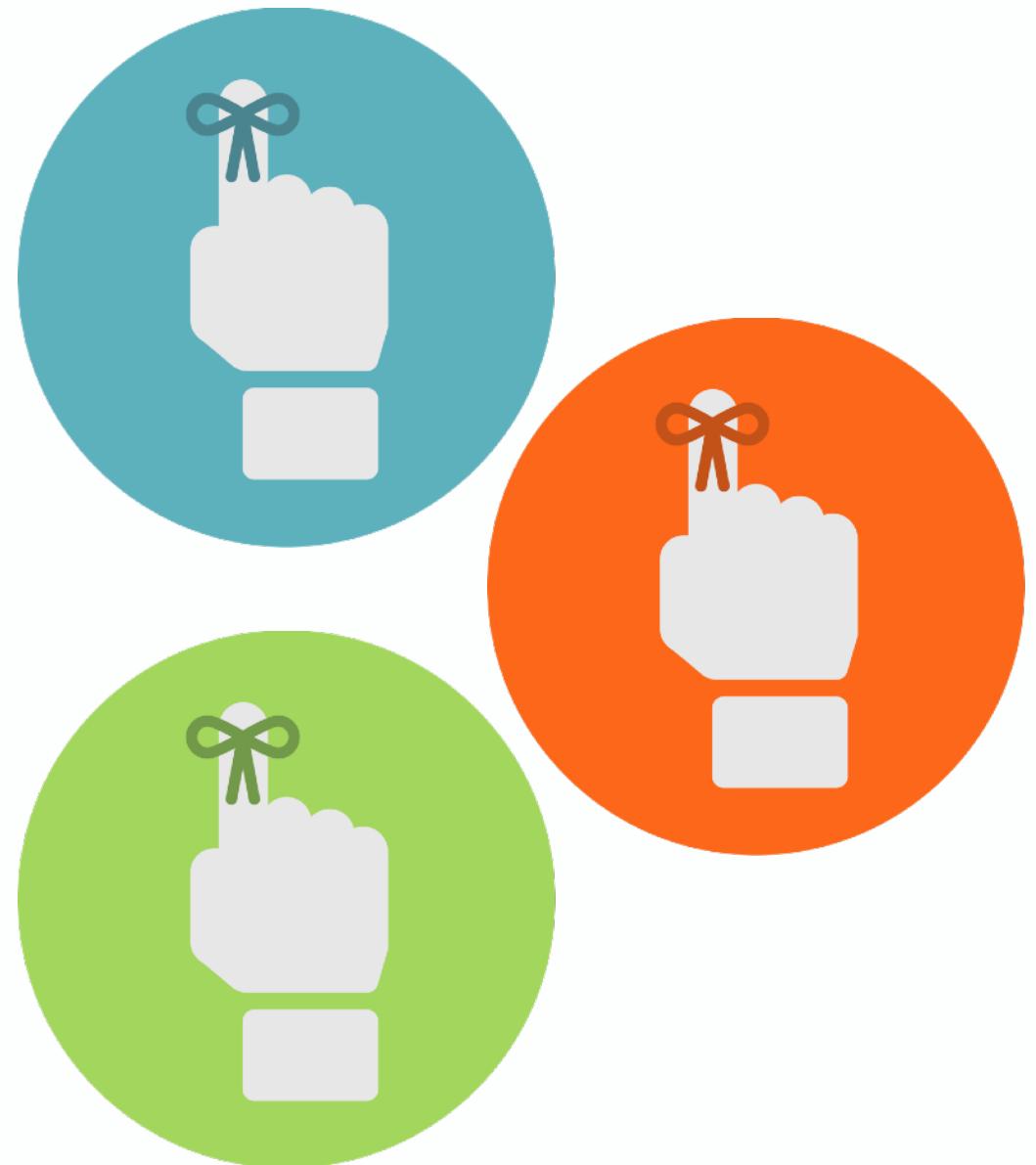


Estimating Activity Durations

Estimations should be made using
standardized units when possible

Estimates progressively elaborated as project
work progresses

Module Review:



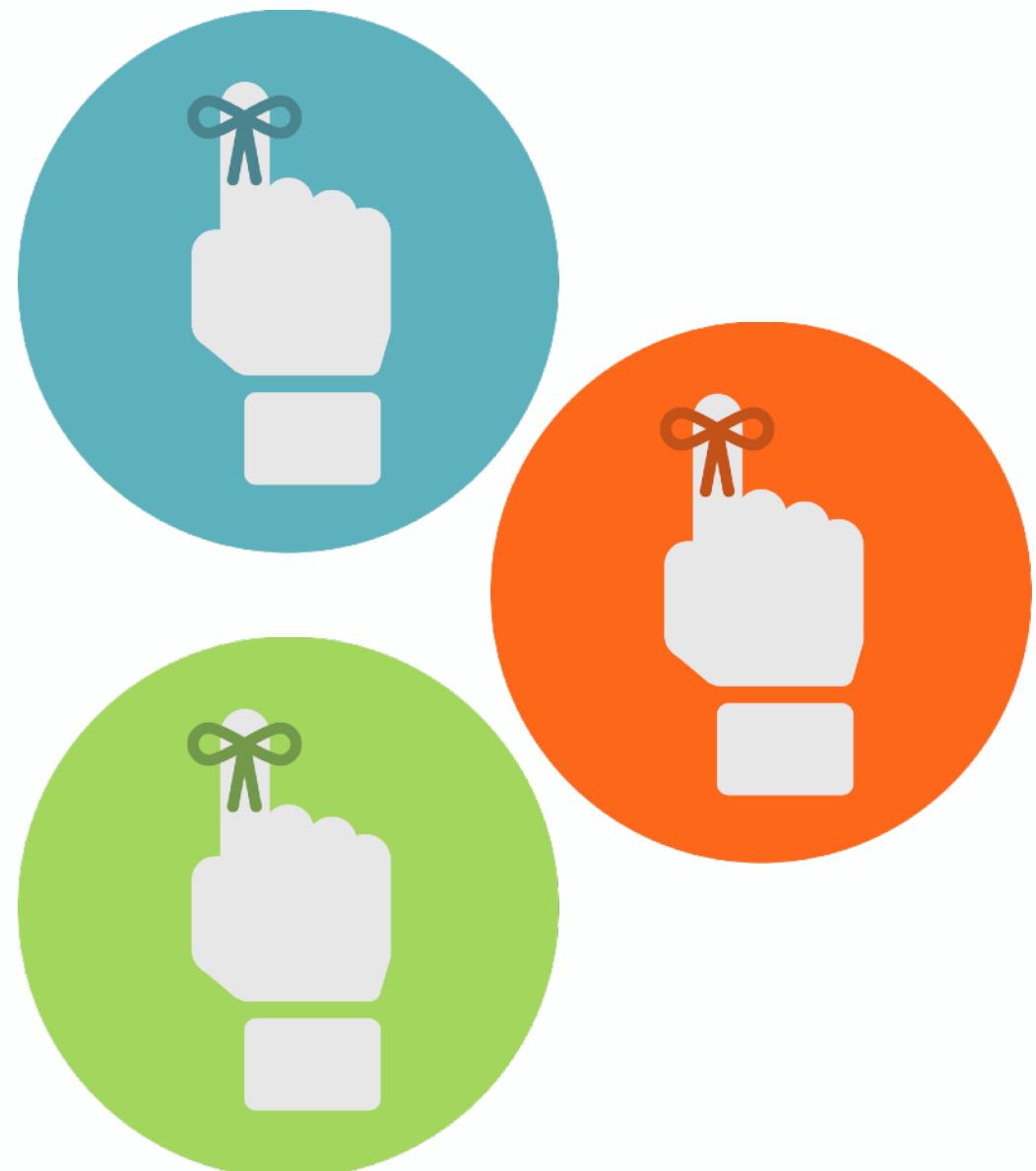
Estimating Activity Durations

Analogous Estimating creates projections based on similar work in the past

Parametric Estimating creates projections by using formulas that harness historical data

Three Point Estimating creates optimistic, pessimistic and most-likely projections and suggests a reasonable middle-ground

Module Review:

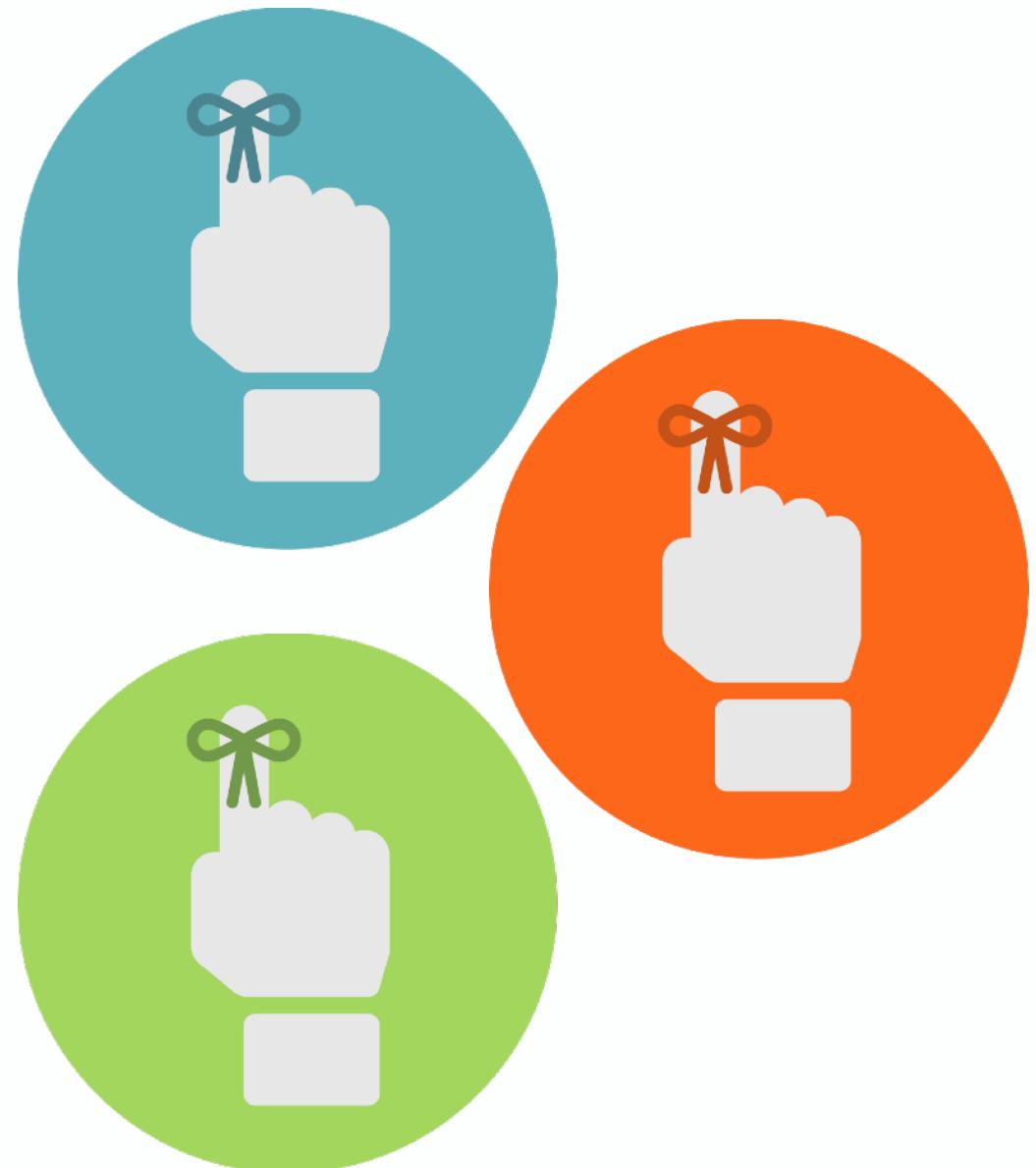


Estimating Activity Durations

Contingency Reserves tackle known risks that may arise during a project

Management Reserves tackle unknown risks that may arise during a project

Module Review:



Estimating Activity Durations

Inputs: Project management plan, project documents, EEFs, & OPAs

Tools & Techniques: Expert judgment, analogous estimating, parametric estimating, three point estimating, bottom-up estimating, data analysis, decision-making techniques and meetings

Outputs: Duration estimates, basis of estimates, and project documents updates



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Preparing for the PMP® Exam





Congratulations!