Gesellschaft für Informatik

Tagung der GI-Fachgruppe "Software-Messung und -Bewertung"

Fraunhofer IESE, Kaiserslautern, Germany

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Continuously Monitoring Project Deadlines in Software Development

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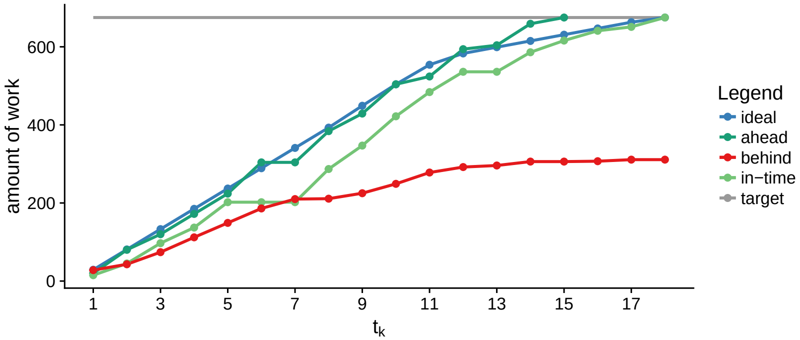
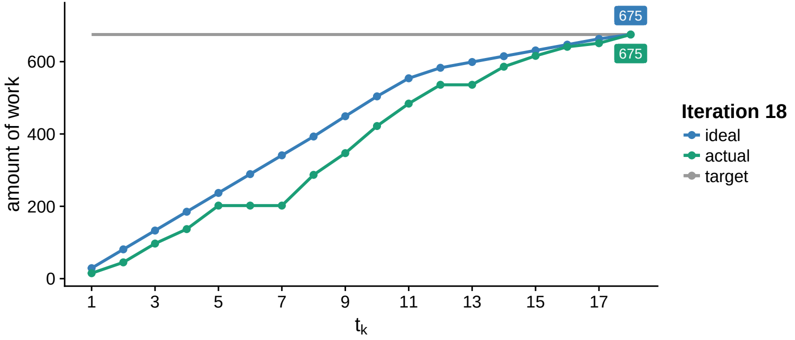
Burn-up Chart at Deadline



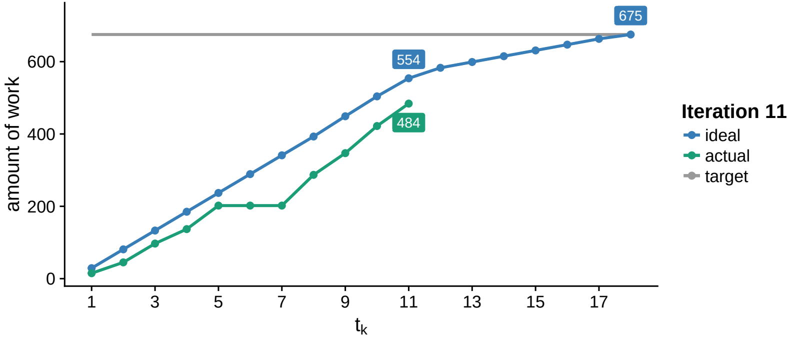
amount of work	user story points, use case points, CFP, FP, # use cases, # test cases/steps, effort, etc.
t_k	point in time of measurement $(1 \leq k \leq n)$

Calculation Rule



$$w_x(t_k) = \begin{cases} x(t_1), & \text{for } k = 1, \\ w_x(t_{k-1}) + x(t_k), & \text{otherwise.} \end{cases} \qquad (x \in \{p, c\})$$

Typical Question



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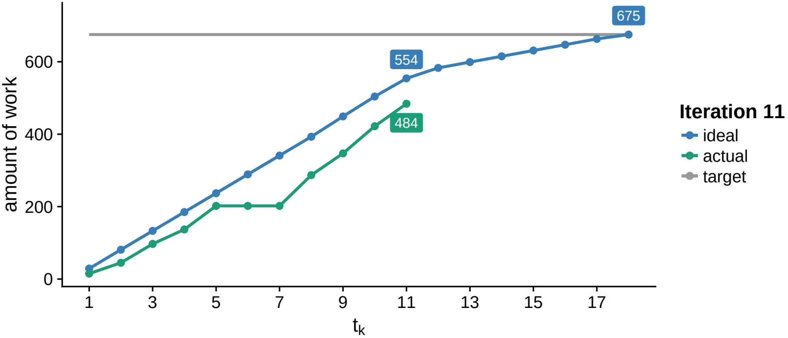

"Can we expect that all planned work will be completed at project deadline?"

Rule of Thumb Procedure

1. At actual iteration k, consider the work completed during the last k_0 iterations (incl. the actual iteration),
2. calculate the mean and standard deviation accordingly,
3. update the burn-up chart.

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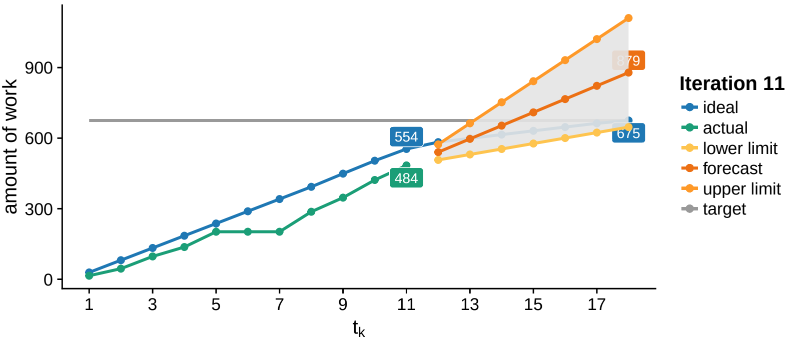

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Applying `forecast` Package

$$\texttt{fc} \leftarrow \texttt{forecast(data=c[1:t}_{\texttt{k}}\texttt{]), h=t}_{\texttt{n}}\texttt{-t}_{\texttt{k}}\texttt{, level=c(95))}$$

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$$\Rightarrow \quad \texttt{avg} \approx \texttt{44}, \quad \texttt{Lo95} \approx \texttt{-11}, \quad \texttt{Hi95} \approx \texttt{99}$$

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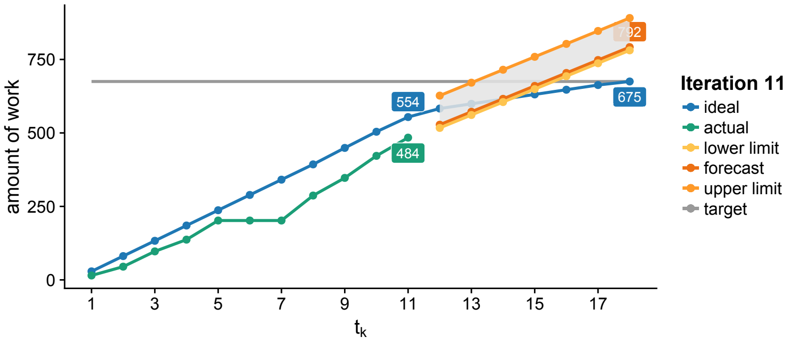

$$\texttt{fc} \leftarrow \texttt{forecast(data=c[1:}t_k\texttt{]), h=}t_n - t_k\texttt{, level=c(95))}$$

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Fundamental Property

Calculation Rule

$$w_x(t_k) = \begin{cases} x(t_1), & \text{for } k = 1, \\ w_x(t_{k-1}) + x(t_k), & \text{otherwise.} \end{cases}$$

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Mathematical Point of View

Burn-up charts depict order statistics!

Characteristics

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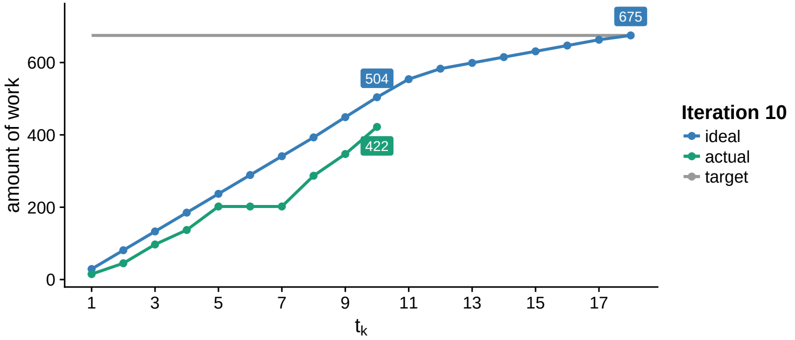
- utilizes order statistics and their properties,
- factors in the gap between planned and completed work,
- provides deadline estimates based on serial number analysis.

Updating Rules at t_k



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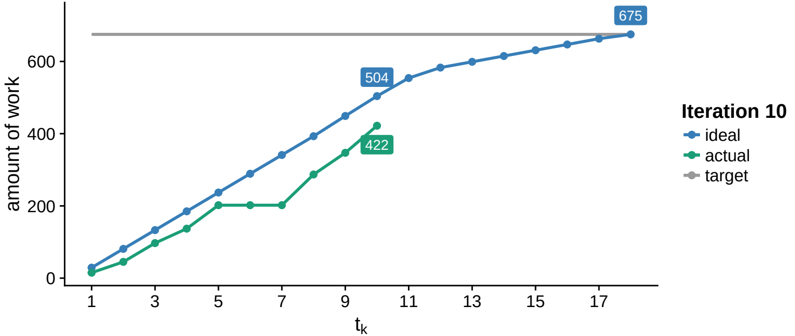

$$w_c(t_k) \leftarrow w_c(t_{k-1}) + c(t_k), \quad (1)$$

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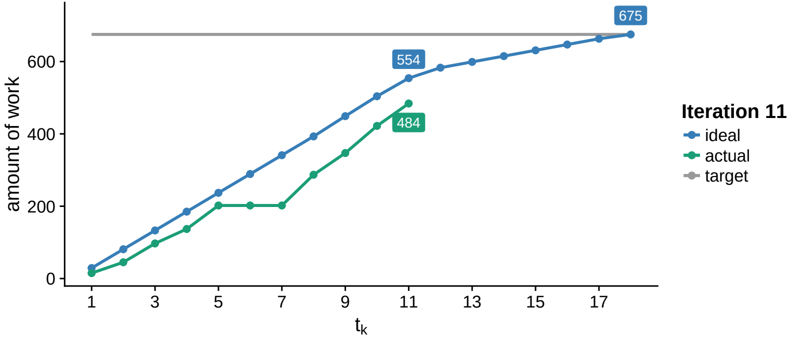

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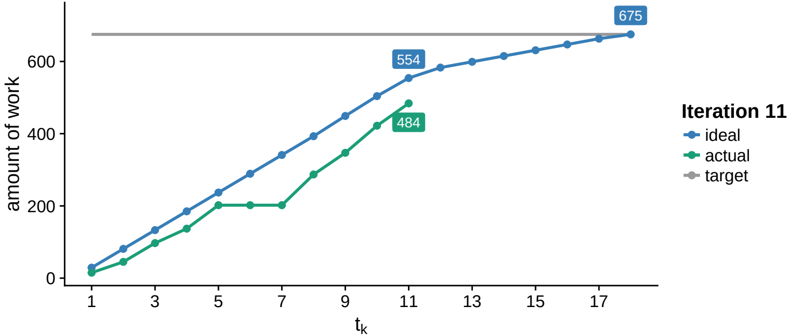

$$w_c(t_k) \leftarrow w_c(t_{k-1}) + c(t_k), \tag{1}$$

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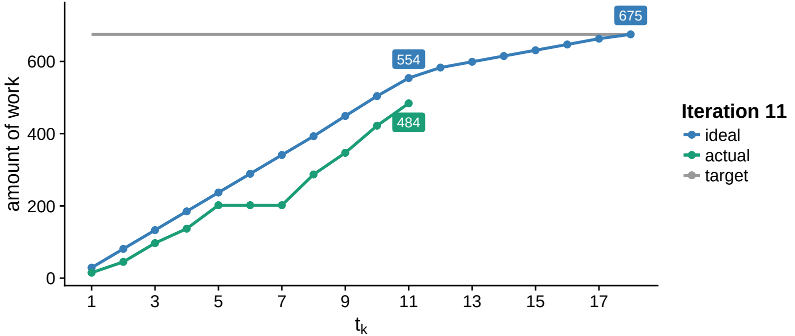

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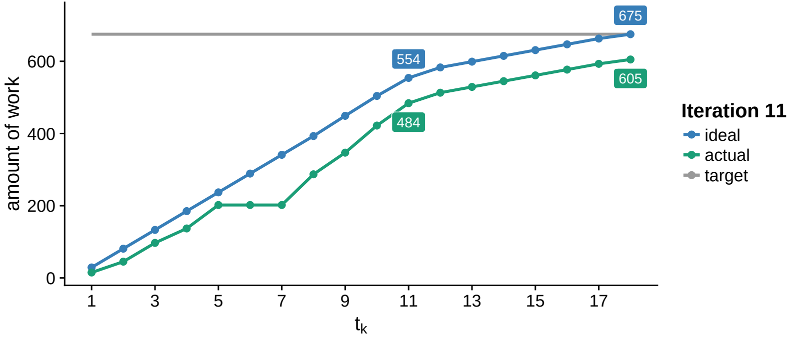

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Examples

- German tank problem,
- Number of taxis in a city, of marathon runners in a race, etc.

Bayes' Estimates

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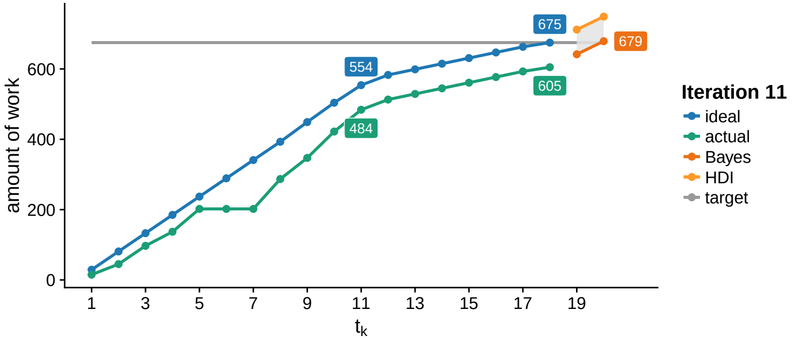

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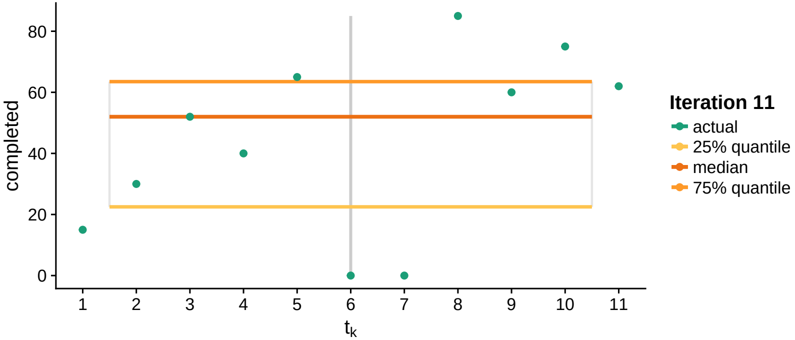
Five-Number Summary



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min	25%	median	75%	max
0.0	22.5	52.0	63.5	85.0

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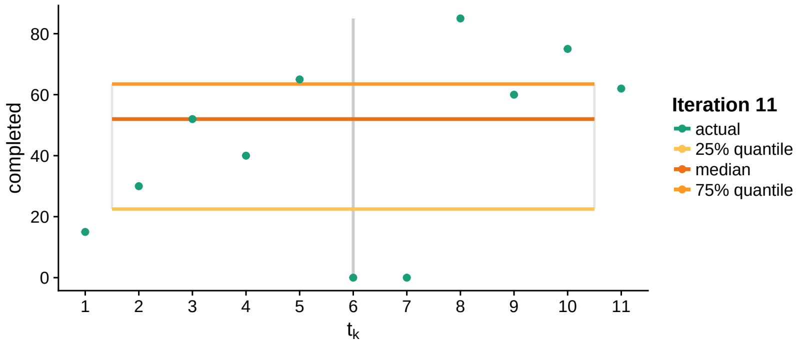

Five-Number Summary

i		1	2	3	
q_i	min	25%	median	75%	max
$c_{[q_i]}$	0.0	22.5	52.0	63.5	85.0

Quantile Graphs & Estimates

Quantile functions: $w_{c_{[q_i]}}(t_j) = w_c(t_k) + (t_j - t_k)c_{[q_i]},$

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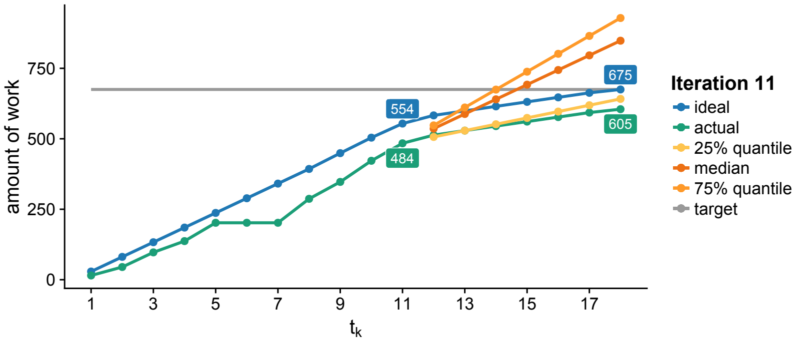

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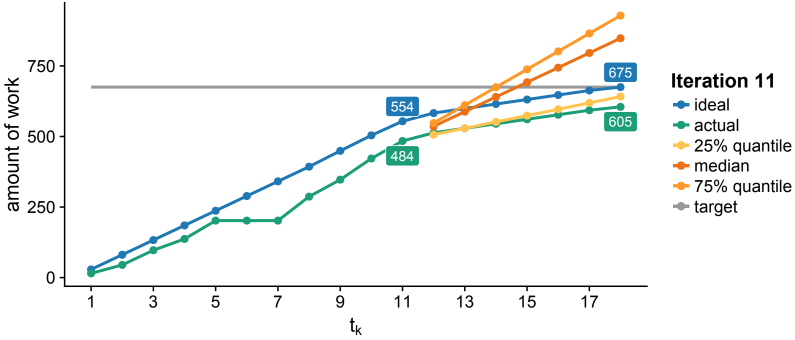
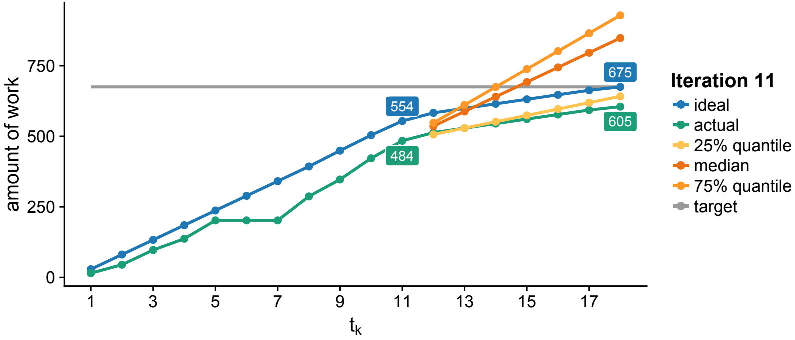


Quantile functions: $w_{c_{[q_i]}}(t_j) = w_c(t_k) + (t_j - t_k)c_{[q_i]},$

Deadline estimates: $\hat{t}_{c_{[q_i]}} = t_k + \frac{1}{c_{[q_i]}}\big(w_p(t_n) - w_c(t_k)\big).$

Stakeholder's Questions



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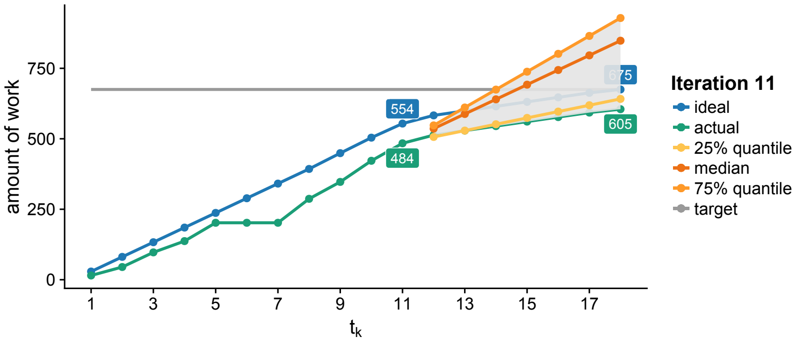

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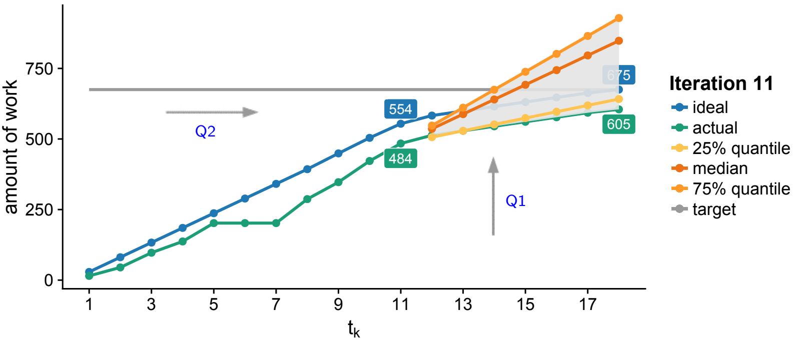

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Scope Creep Updating Rules

t_k	11	12	13	14	15	16	17	18
p		29	16	16	16	16	16	12
w_p	554	583	599	615	631	647	663	675
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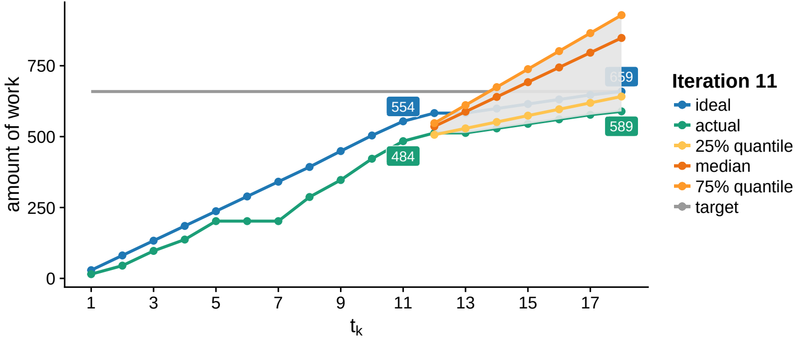

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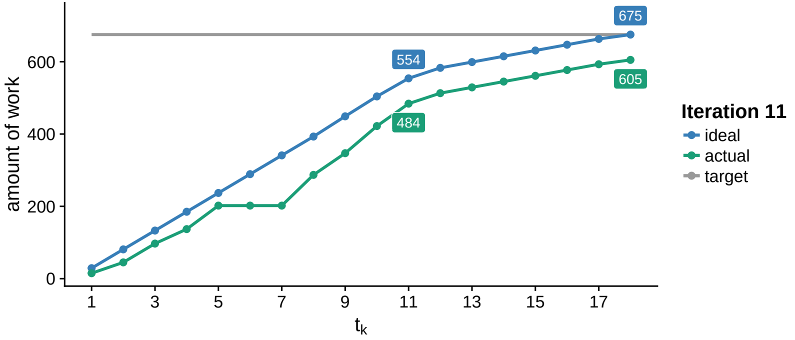
Capable Progress Indicator



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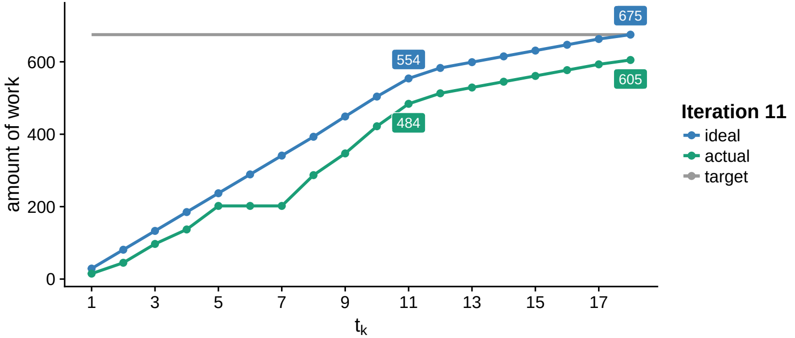

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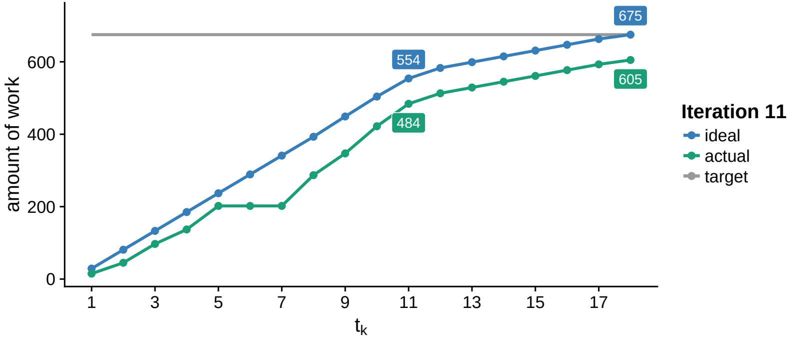
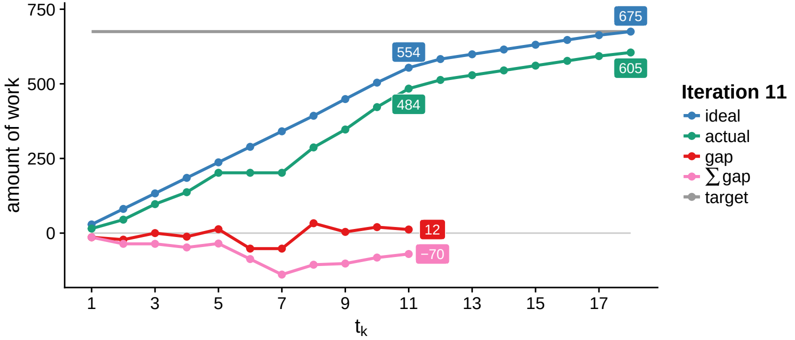


$$w_c(t_{k+j}) \leftarrow w_p(t_{k+j}) + \sum_{i=1}^{k} \Delta_{t_i} \qquad (3')$$

$\Rightarrow \sum \Delta_{t_i}$ is a capable indicator for project progress

Monitoring Δ_{t_k} and $\sum \Delta_{t_i}$



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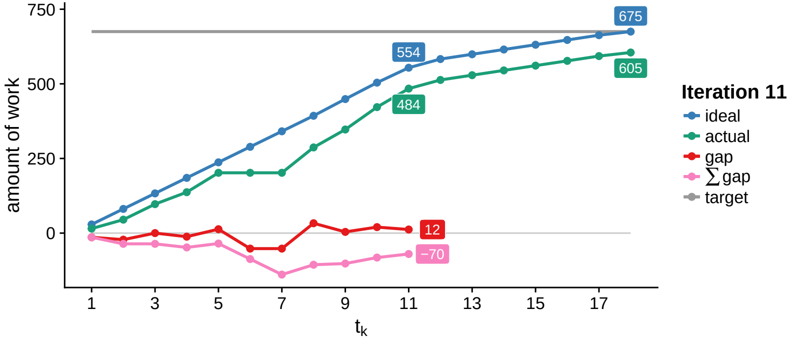
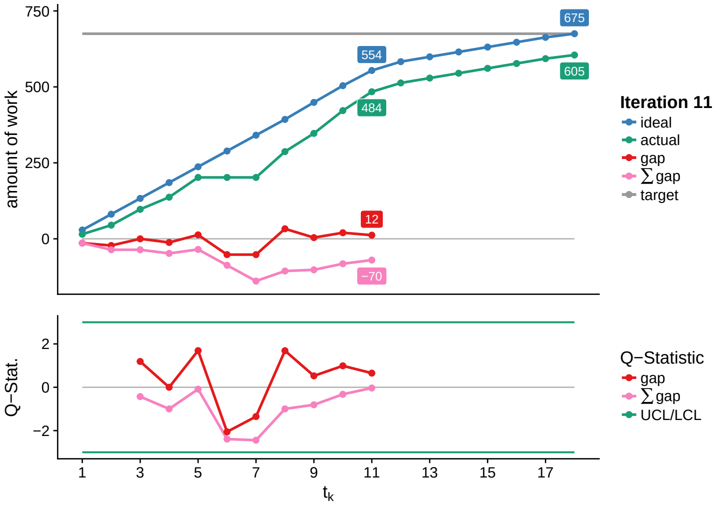


Δ_{t_k} and $\sum \Delta_{t_i}$ have disjoint control limits!

Q Control Chart



Summary

The new approach

- utilizes order statistics and their properties,
- factors in the gap between planned and completed work,
- provides deadline estimates (Bayes and/or quantiles)
- enables to realize the direct consequences of scope creep,
- makes more information available by SPC Q control charts,
- is easy to implement.

Future Work

Next Steps

- Conducting extensive practical experiments,
- extending the approach by Bayesian data analysis,
- refining the SPC add-on to detect out-of-control conditions,
- etc.