
Homework #6 Answer Key

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System & Project Management, ESD.185J
System Dynamics Capstone Question

Part 1 (20 Points)

1. (5 points)

Changes:

- Switch for Uncertain Customer Requirements = 0
- Normal Quality = 0.8
- Willingness to Hire = 0

2. (5 Points)

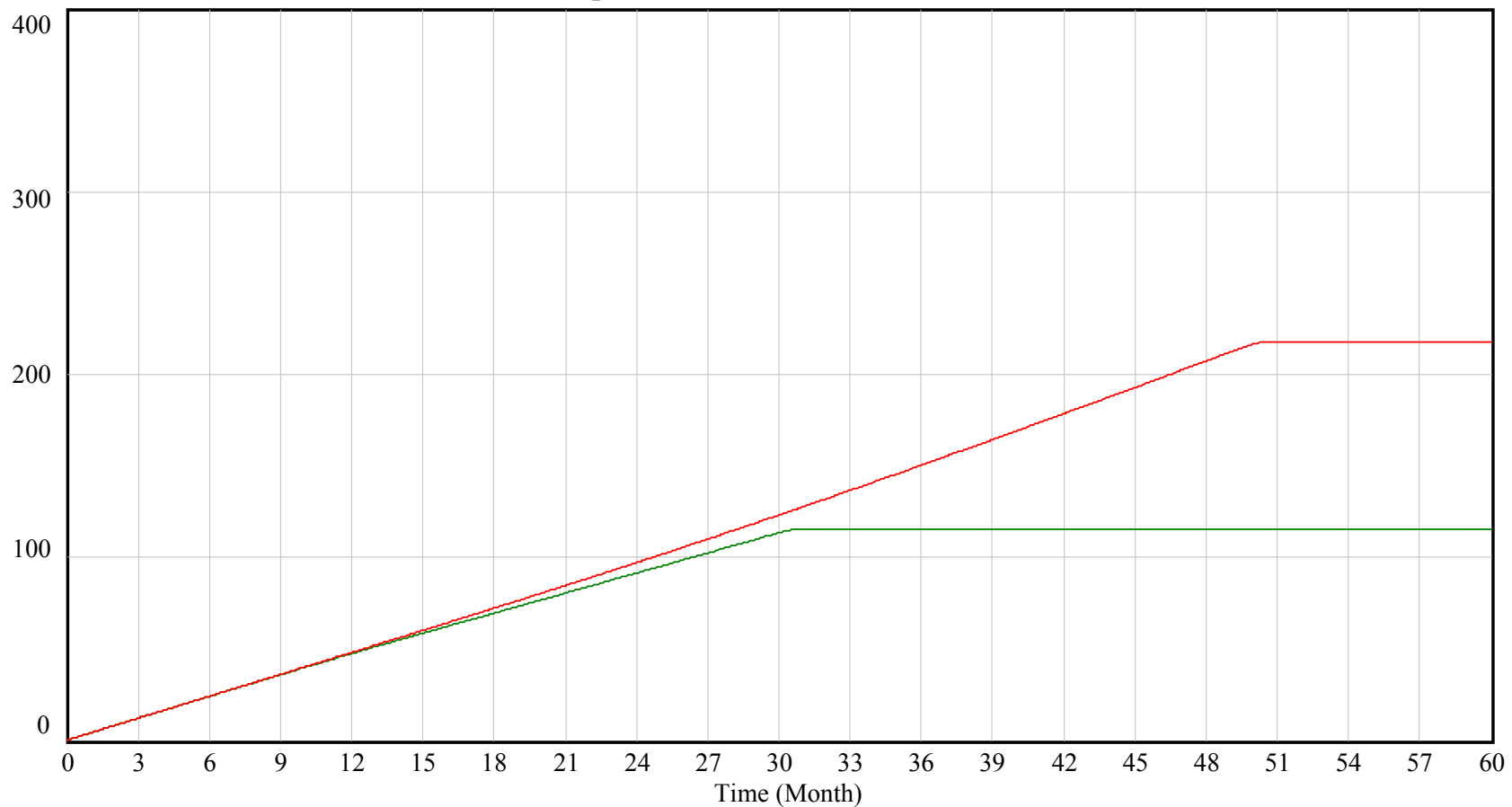
Best estimate has project finishing at month 50
and costing 201 person-months.

3. (10 Points) A 15 percentage point increase in errors ...

- Feedback effects amplify the 0.95 to 0.80 reduction in normal quality to create the four-fold increase in additional work (see following charts).
- And because of the additional work without additional staff, the project takes longer.

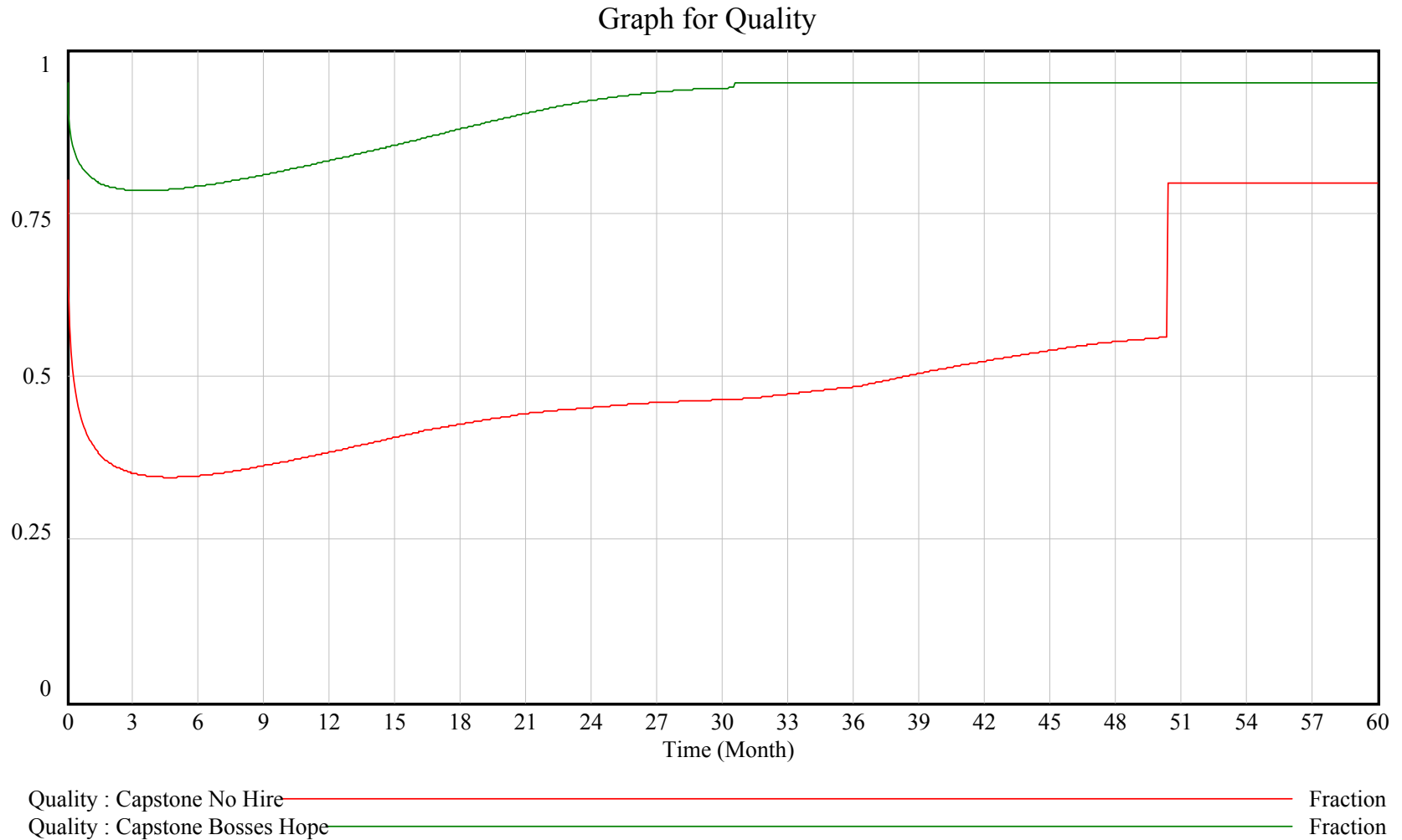
Lower quality increases the total amount of work done by ~ 100%

Graph for Cumulative Work Done



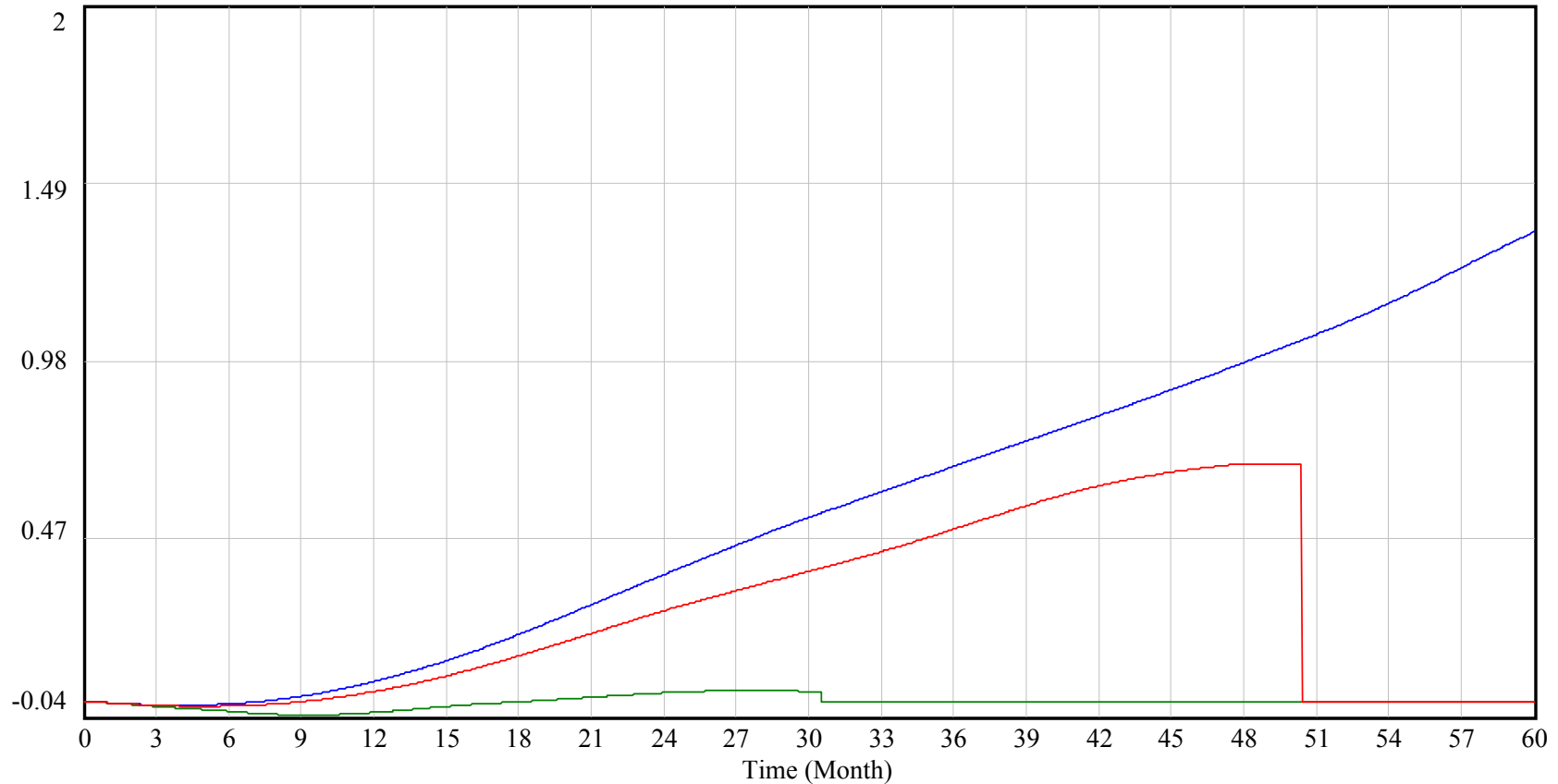
Cumulative Work Done : Capstone No Hire — Tasks
Cumulative Work Done : Capstone Bosses Hope — Tasks

While normal quality is 0.8 (vs. 0.95 in bosses hope), actual quality is far lower because of feedback effects ...



Trying to meet an unrealistic plan creates significant schedule pressure ...

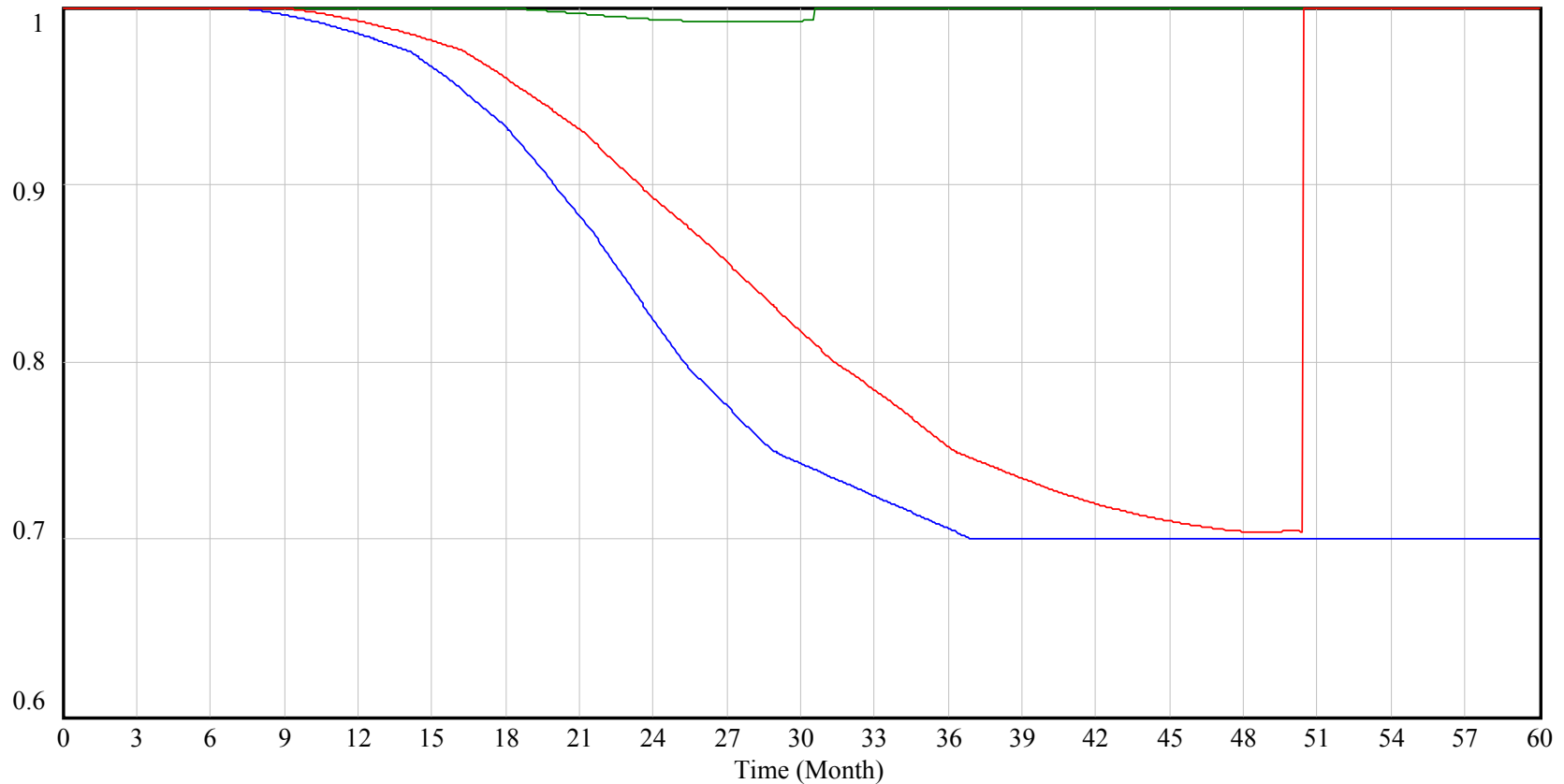
Graph for Anticipated Schedule Overrun



Anticipated Schedule Overrun : Capstone No Hire — Dimensionless
Anticipated Schedule Overrun : Capstone Bosses Hope — Dimensionless
Anticipated Schedule Overrun : Capstone Worst Case — Dimensionless

... which causes quality to fall ...

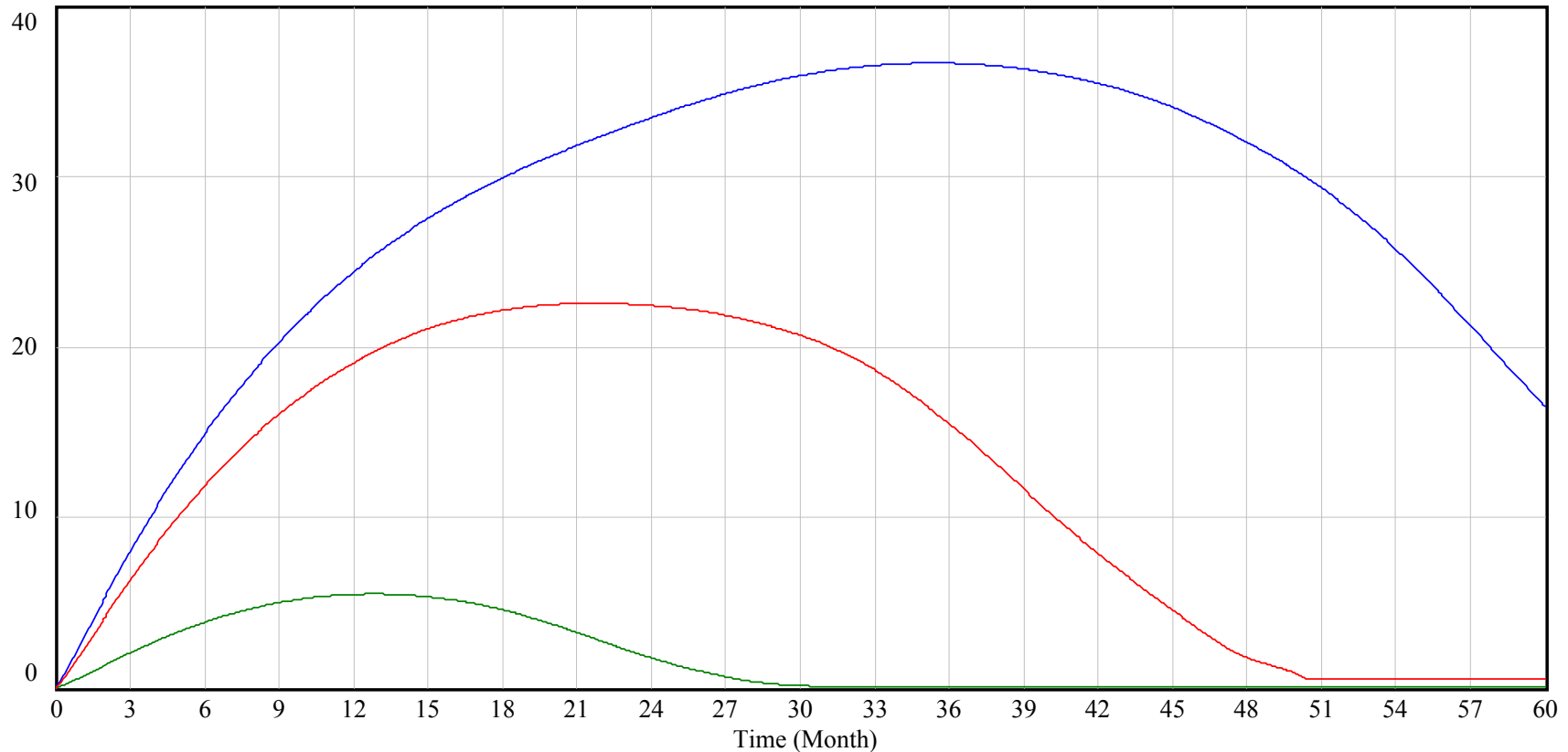
Graph for Effect of Schedule Pressure on Quality



Effect of Schedule Pressure on Quality : Capstone No Hire — Dimensionless
Effect of Schedule Pressure on Quality : Capstone Bosses Hope — Dimensionless
Effect of Schedule Pressure on Quality : Capstone Worst Case — Dimensionless

... increasing rework and making the project perform worse

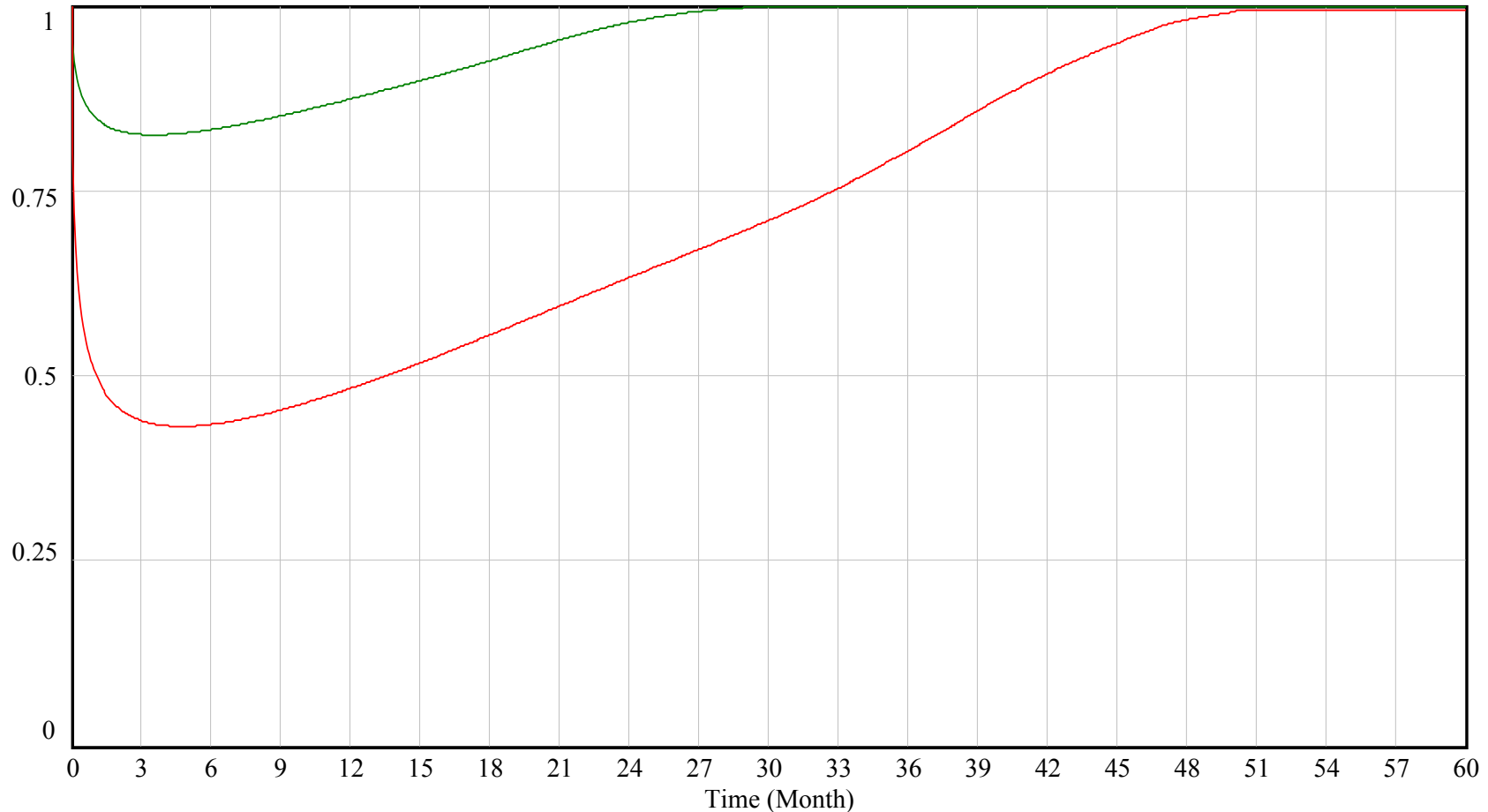
Graph for Undiscovered Rework



Undiscovered Rework : Capstone No Hire ——— Task
Undiscovered Rework : Capstone Bosses Hope ——— Task
Undiscovered Rework : Capstone Worst Case ——— Task

“Quality on quality” is the key driver -- undiscovered errors causes errors in downstream work

Graph for Effect of Prior Work Quality on Quality



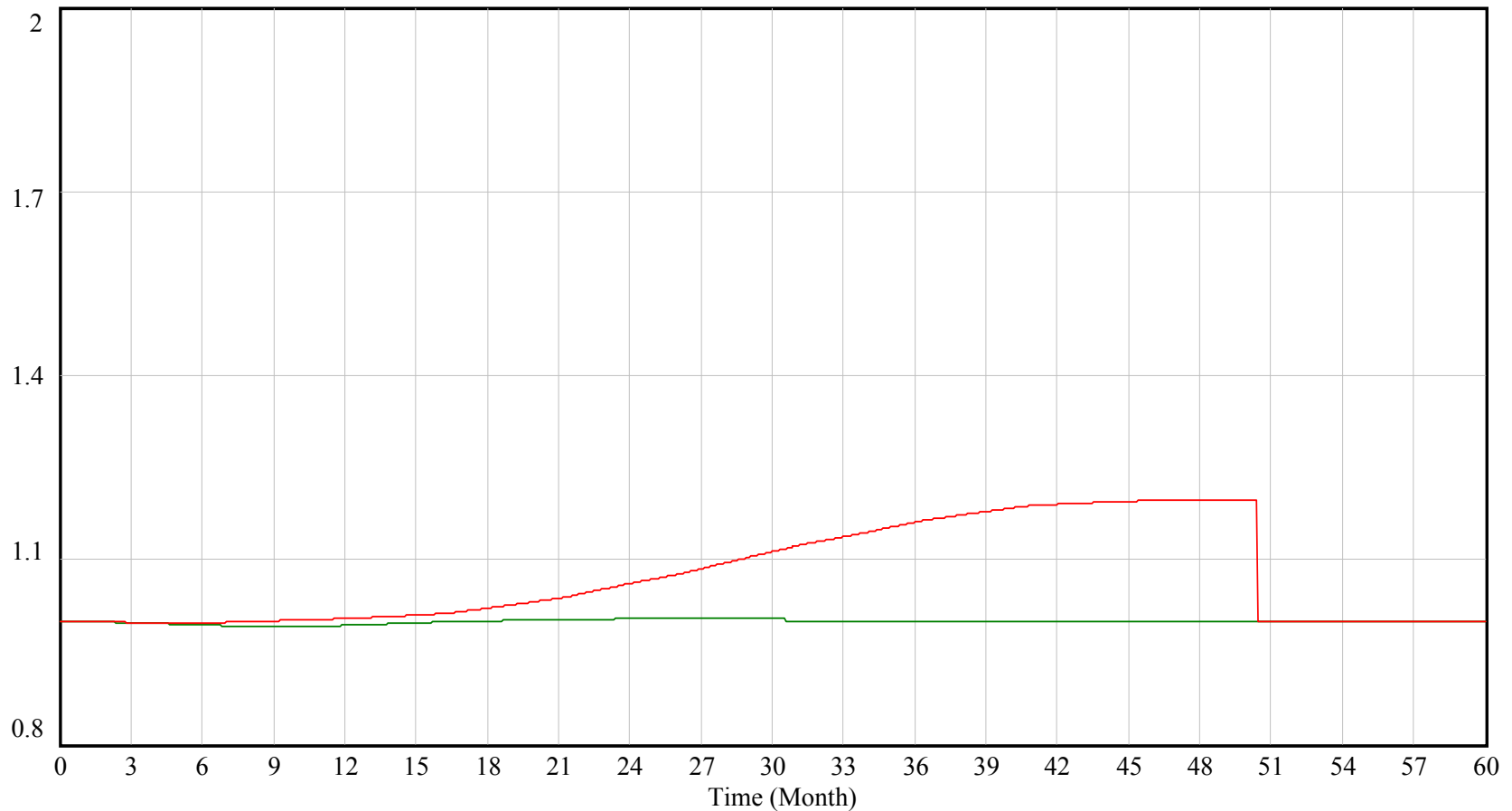
Effect of Prior Work Quality on Quality : Capstone No Hire — Dimensionless
Effect of Prior Work Quality on Quality : Capstone Bosses Hope — Dimensionless

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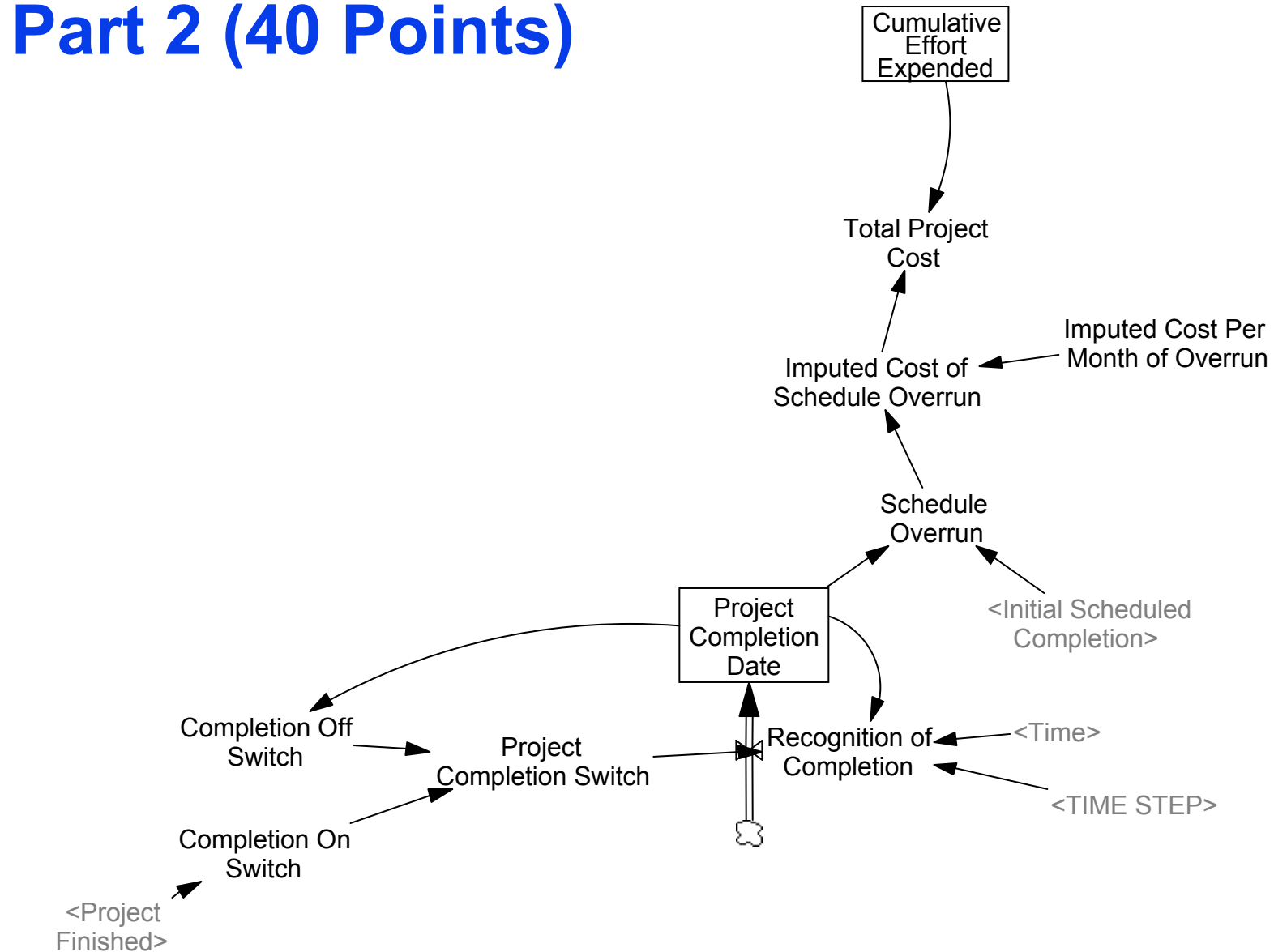
While schedule pressure also increase productivity, the net effect is more total work as shown in first graph.

Graph for Productivity



Productivity : Capstone No Hire — Task/(Month*Person)
Productivity : Capstone Bosses Hope — Task/(Month*Person)

Part 2 (40 Points)

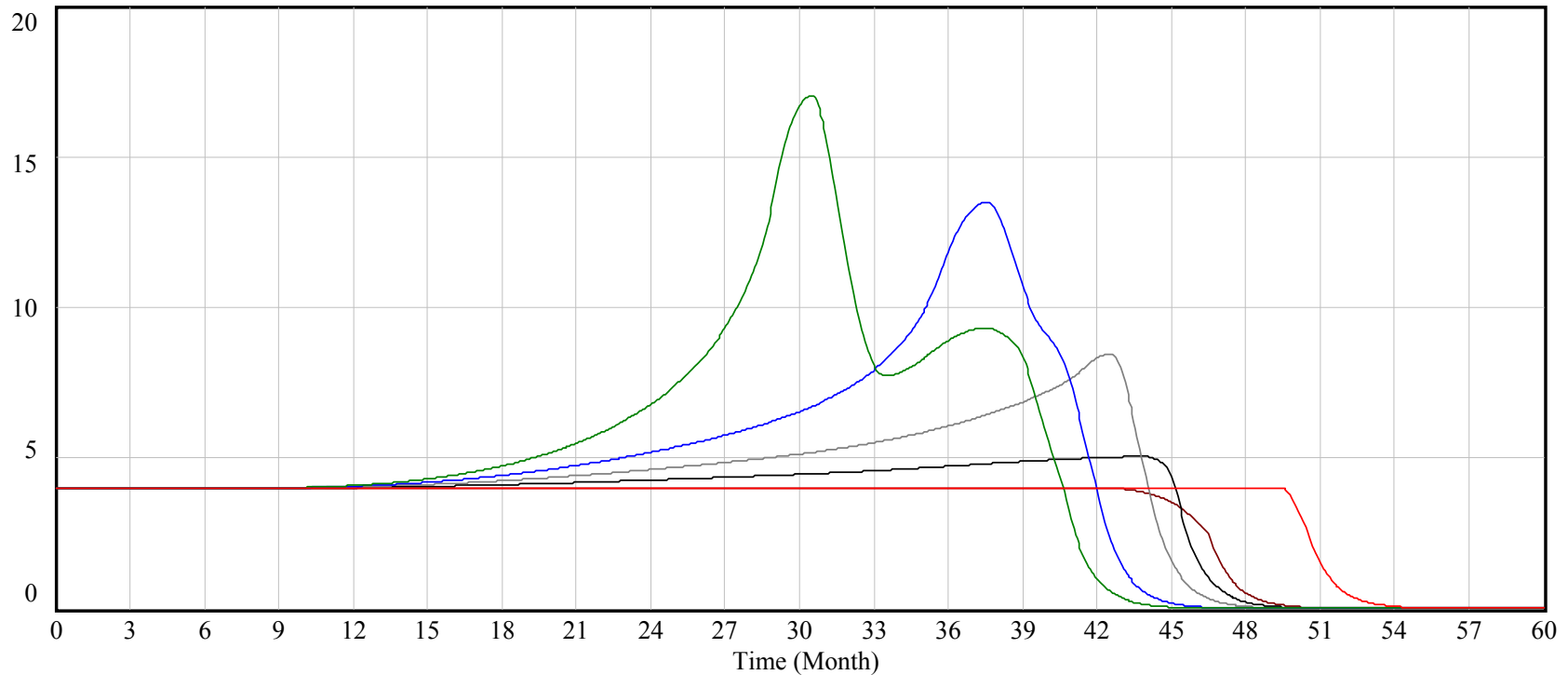


1. (15 Points) Hiring/Schedule Slip Analyses

<u>Test</u>	<u>Finish</u>	<u>Dir. Cost</u>	<u>Total Cost</u>
No Hire	50.43	201.2	405.6
S0H100	40.68	271	377.9
S25H75	41.93	248	367.4
S50H50	44.0	218	358
S75H25	45.25	196.4	348.9
S100H0	46.5	184.2	349.2

2. (5 Points)

Graph for Staff Level

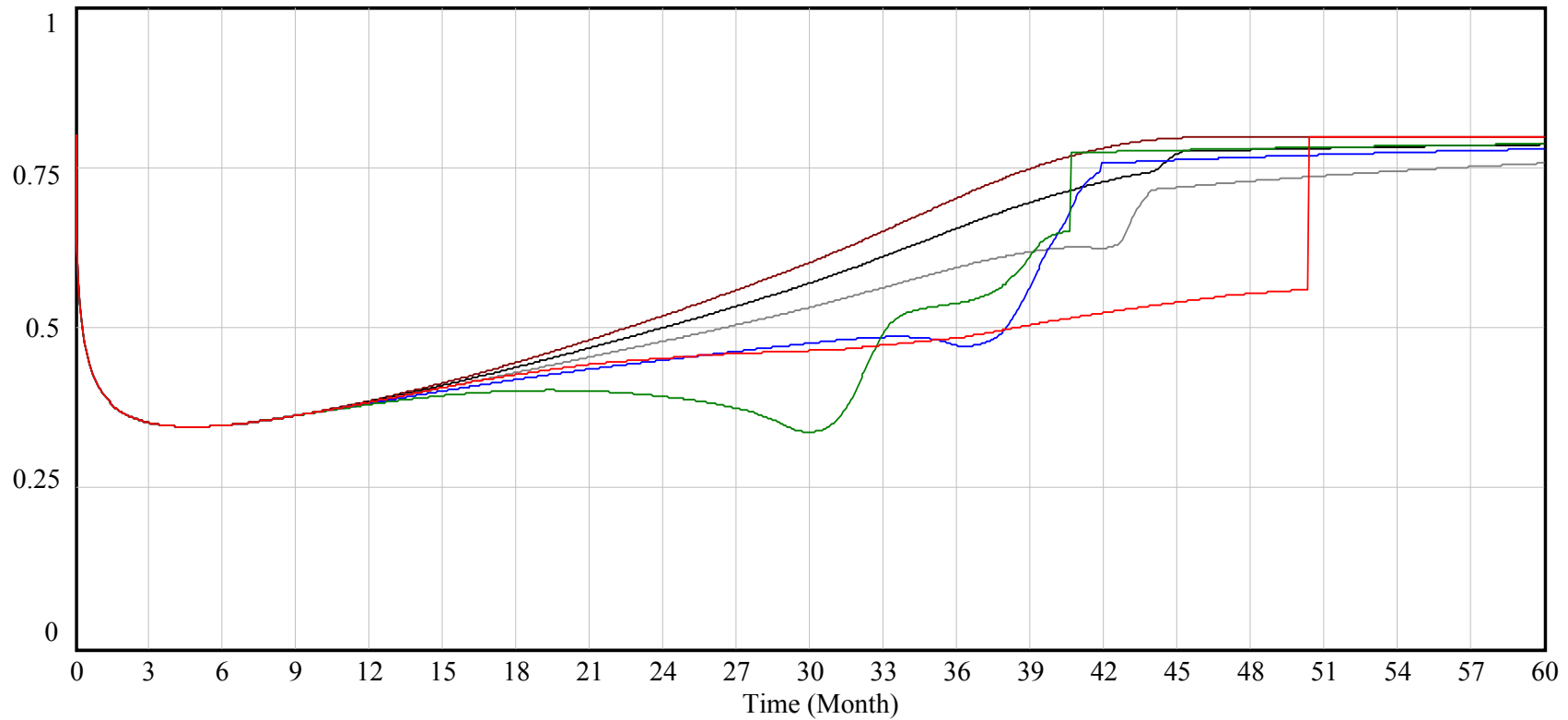


Staff Level : Capstone No Hire — People
Staff Level : Capstone S0H100 — People
Staff Level : Capstone S25H75 — People
Staff Level : Capstone S50H50 — People
Staff Level : Capstone S75H25 — People
Staff Level : Capstone S100H0 — People

3. (15 Points) Tradeoffs

- Direct cost falls as hiring is constrained and the schedule slipped, because (see graphs below) experience dilution is reduced and schedule pressure effects on quality reduced.
- Imputed cost increases with delay on the project. Given the numbers, schedule slip improves performance.

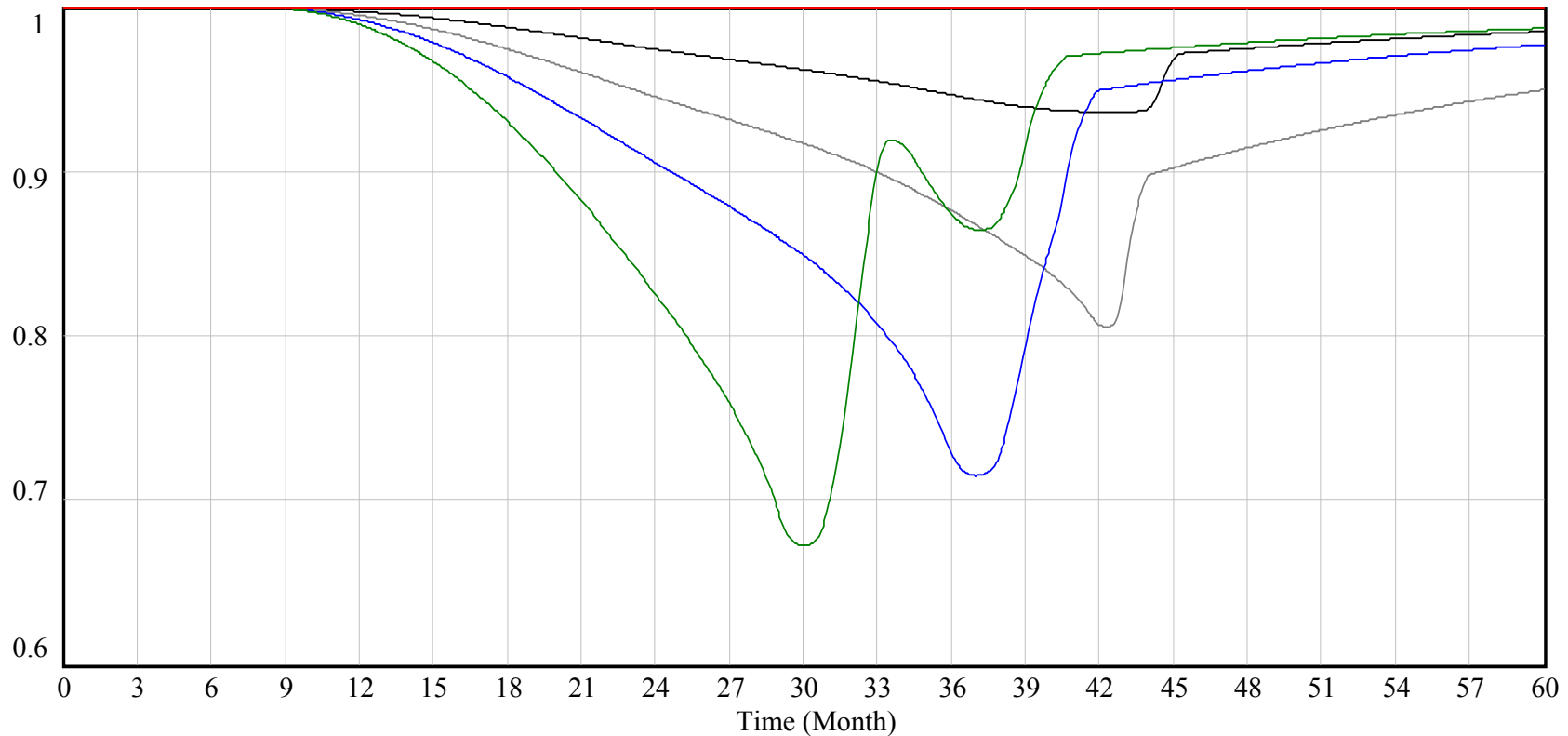
Quality improves Graph for Quality



- Quality : Capstone No Hire — Fraction
- Quality : Capstone S0H100 — Fraction
- Quality : Capstone S25H75 — Fraction
- Quality : Capstone S50H50 — Fraction
- Quality : Capstone S75H25 — Fraction
- Quality : Capstone S100H0 — Fraction

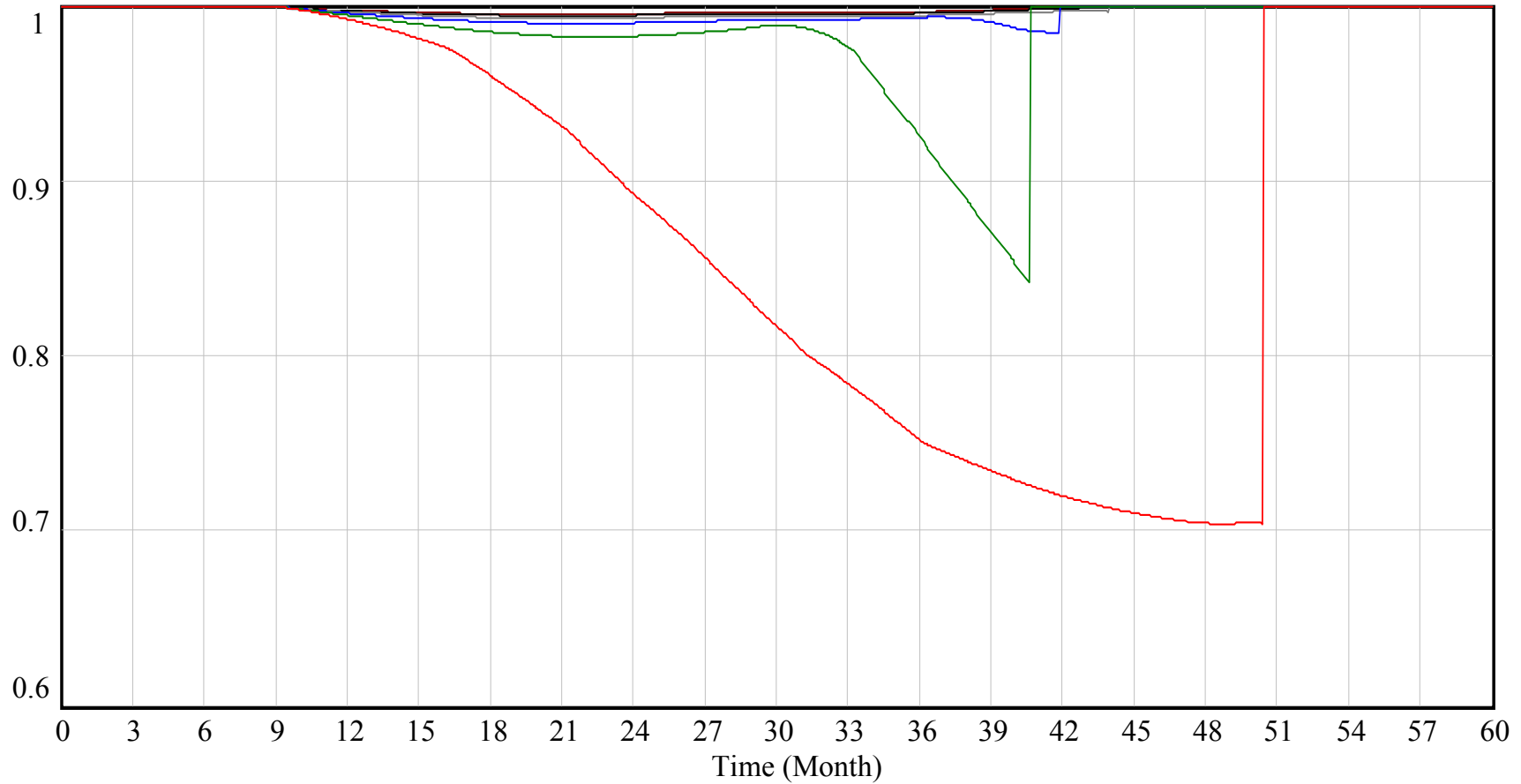
... because experience dilution is reduced

Graph for Effect of Experience on Quality



- Effect of Experience on Quality : Capstone No Hire — Dimensionless
- Effect of Experience on Quality : Capstone S0H100 — Dimensionless
- Effect of Experience on Quality : Capstone S25H75 — Dimensionless
- Effect of Experience on Quality : Capstone S50H50 — Dimensionless
- Effect of Experience on Quality : Capstone S75H25 — Dimensionless
- Effect of Experience on Quality : Capstone S100H0 — Dimensionless

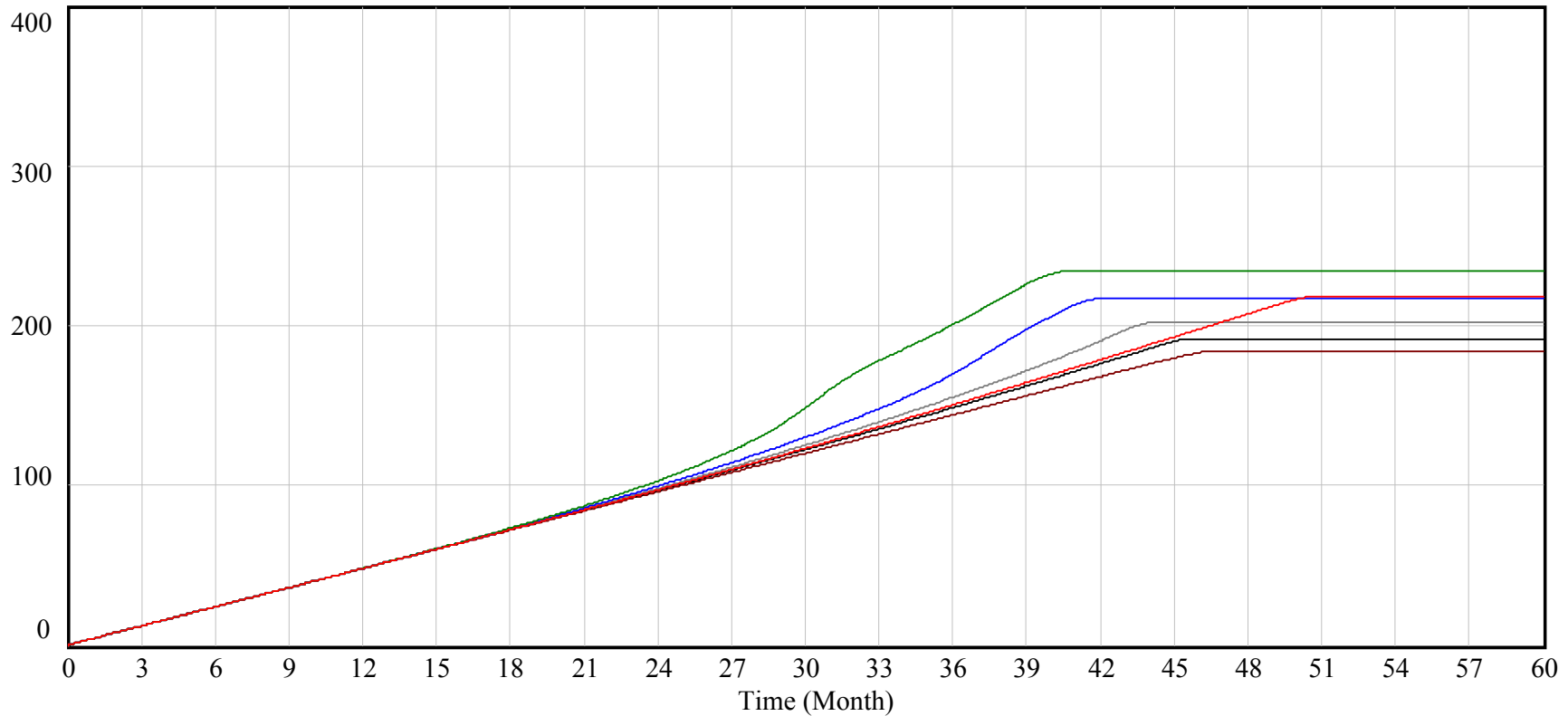
Graph for Effect of Schedule Pressure on Quality



- Effect of Schedule Pressure on Quality : Capstone No Hire — Dimensionles:
- Effect of Schedule Pressure on Quality : Capstone S0H100 — Dimensionles:
- Effect of Schedule Pressure on Quality : Capstone S25H75 — Dimensionles:
- Effect of Schedule Pressure on Quality : Capstone S50H50 — Dimensionles:
- Effect of Schedule Pressure on Quality : Capstone S75H25 — Dimensionles:
- Effect of Schedule Pressure on Quality : Capstone S100H0 — Dimensionles:

So total work done is reduced ...

Graph for Cumulative Work Done



- Cumulative Work Done : Capstone No Hire — Tasks
- Cumulative Work Done : Capstone S0H100 — Tasks
- Cumulative Work Done : Capstone S25H75 — Tasks
- Cumulative Work Done : Capstone S50H50 — Tasks
- Cumulative Work Done : Capstone S75H25 — Tasks
- Cumulative Work Done : Capstone S100H0 — Tasks

4. (5 Points)

- Best is $WTS=.75$, $WTH =.25$, as it provides the lowest total cost.
- To be thorough, they might want to test this with a quality of $.7$ and also $.95$. This was not specifically requested, so perhaps we should give extra credit if they did some sensitivity tests.

Part 3 (40 points)

1. (5 Points) For Changes and some explanation --

Normal pdy = .9

Max rwdd = 6 mos

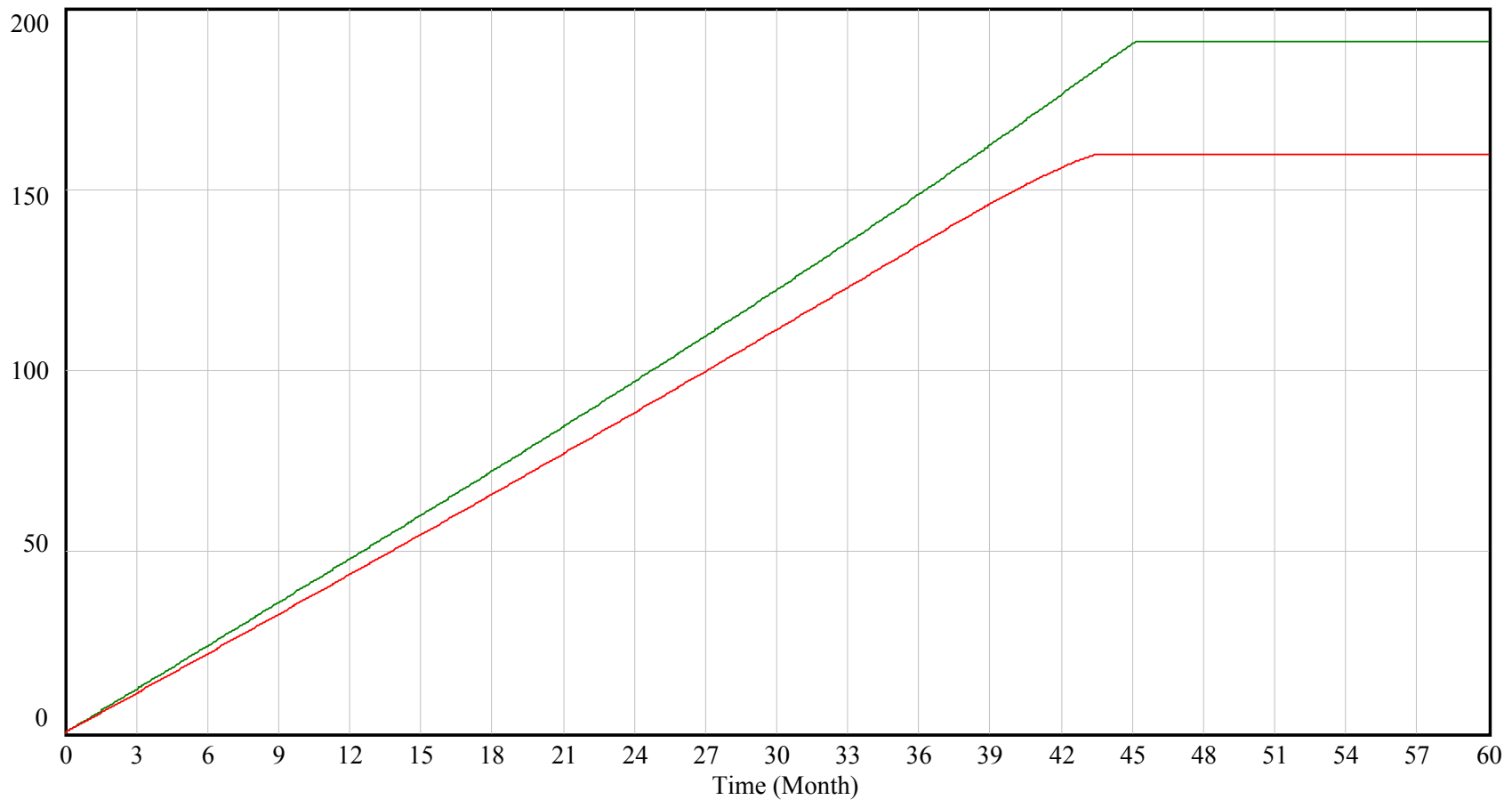
2. (10 Points) for what happened & why)

The performance of the project improves --

- completion date is 43.5 (vs. 45.25)
- direct expenditures fall to 180.11 (vs. 196.4)
- total cost improves to 313.11 (vs. 348.9)

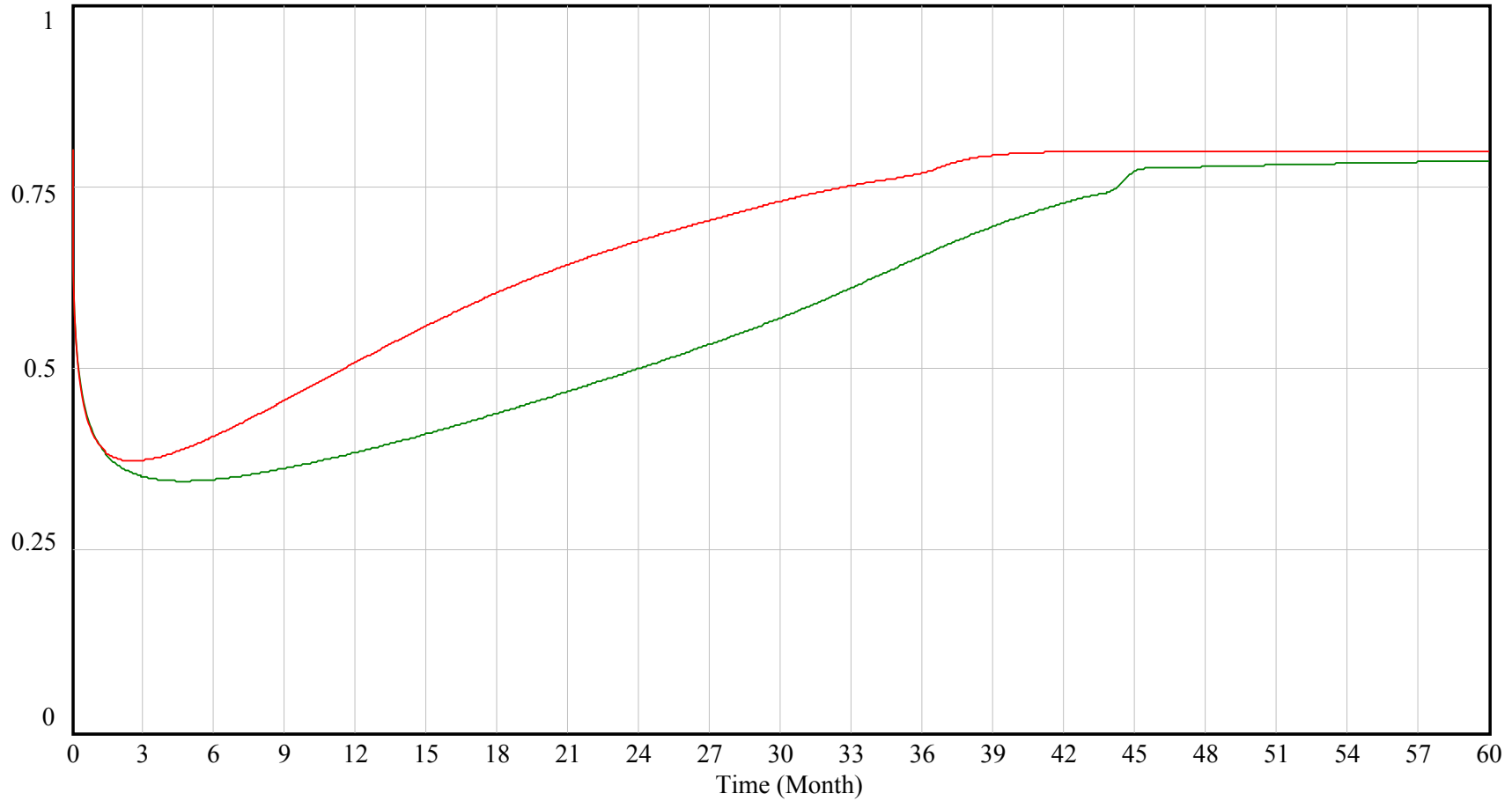
Why -- as shown in graphs following, a shorter rework discovery time reduces the amount of undiscovered rework and thereby decreases the quality on quality effect; quality improves, and less total work is done. Doing less work offsets the productivity hit.

Graph for Cumulative Work Done



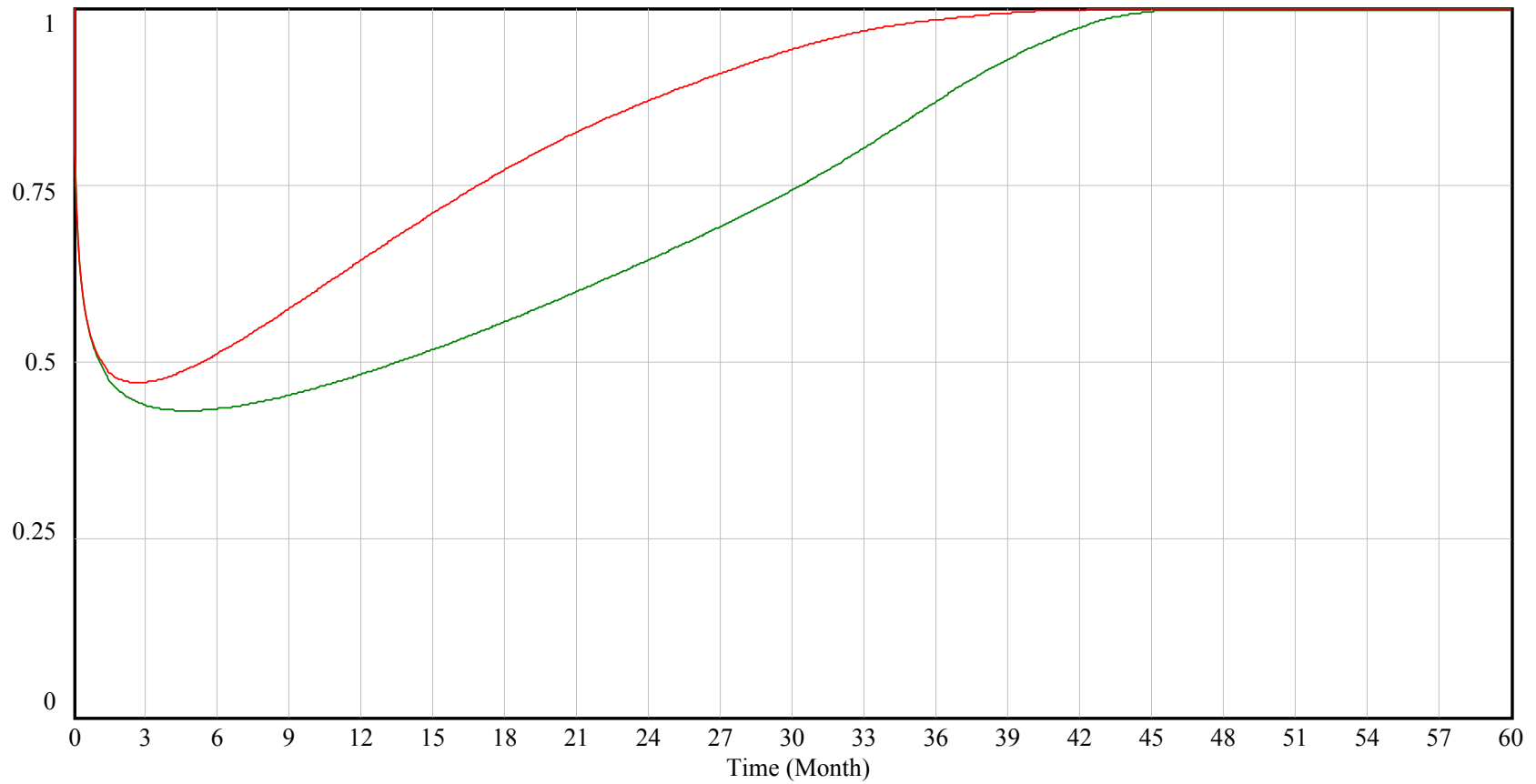
Cumulative Work Done : Capstone S75H25 Review Tasks
Cumulative Work Done : Capstone S75H25 Tasks

Graph for Quality



Quality : Capstone S75H25 Review — Fraction
Quality : Capstone S75H25 — Fraction

Graph for Effect of Prior Work Quality on Quality



Effect of Prior Work Quality on Quality : Capstone S75H25 Review — Dimensionless
Effect of Prior Work Quality on Quality : Capstone S75H25 — Dimensionless

3. Sensitivity (15 Points)

The benefit of the proposed review process decreases as the rework discovery reduction decreases. If the rework discovery time is only cut to 8 months from 12 months (rather than to 6 months), the review process produces no net benefit -- the quality improvement and work reduction is offset by the lower productivity.

The “breakeven” point for rework discovery delay increases to 9-10 months if normal quality (technical risk) falls to 0.7.

Sensitivity

The advisability of adopting the review process would depend on your confidence in getting at least a reduction to 8 months, or less if technical uncertainty might be higher.

Sensitivity Analyses

<u>Test</u>	<u>Finish</u>	<u>Dir. Cost</u>	<u>Total Cost</u>
No Hire	50.43	201.2	405.6
S75H25	45.25	196.4	348.9
RWDD = 6	43.5	180.1	315.1
RWDD = 7	44.6	186.3	315.1
RWDD = 8	45.6	192.2	348.5
RWDD = 9	46.6	198.2	364.5

Sensitivity Analyses (Worst Case NQ=.7) [not asked Fall 2003]

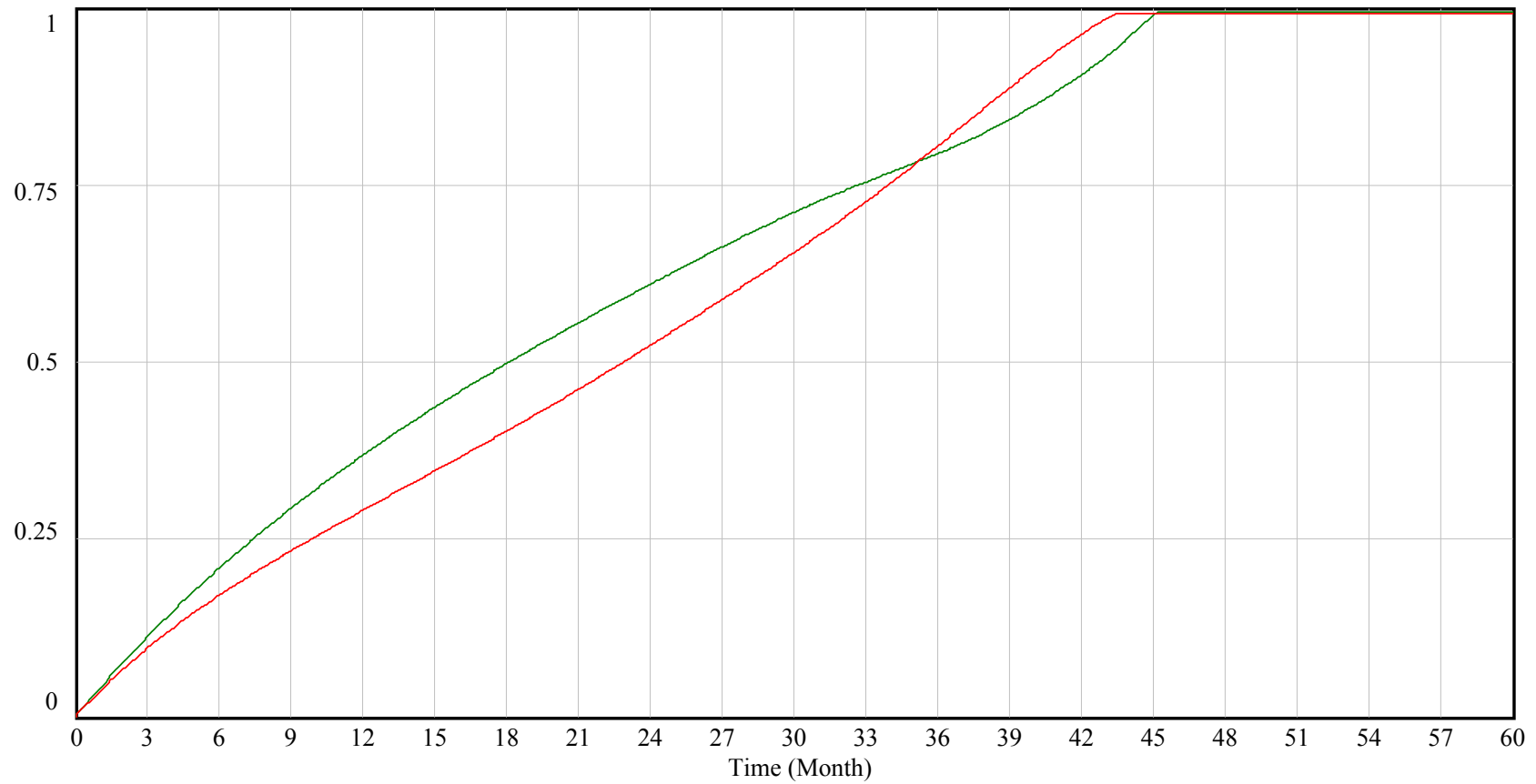
<u>Test</u>	<u>Finish</u>	<u>Dir. Cost</u>	<u>Total Cost</u>
Worst Case	74.9	299.4	748.7
S75H25	60.6	285.3	591.6
RWDD = 6	54.7	234.5	481.4
RWDD = 9	60.4	269.8	573.6
RWDD = 10	62.4	281.8	602.4

4. Delay Progress? (10 Points)

As shown in the following graphs, the review process delays perceived progress, but not real progress --

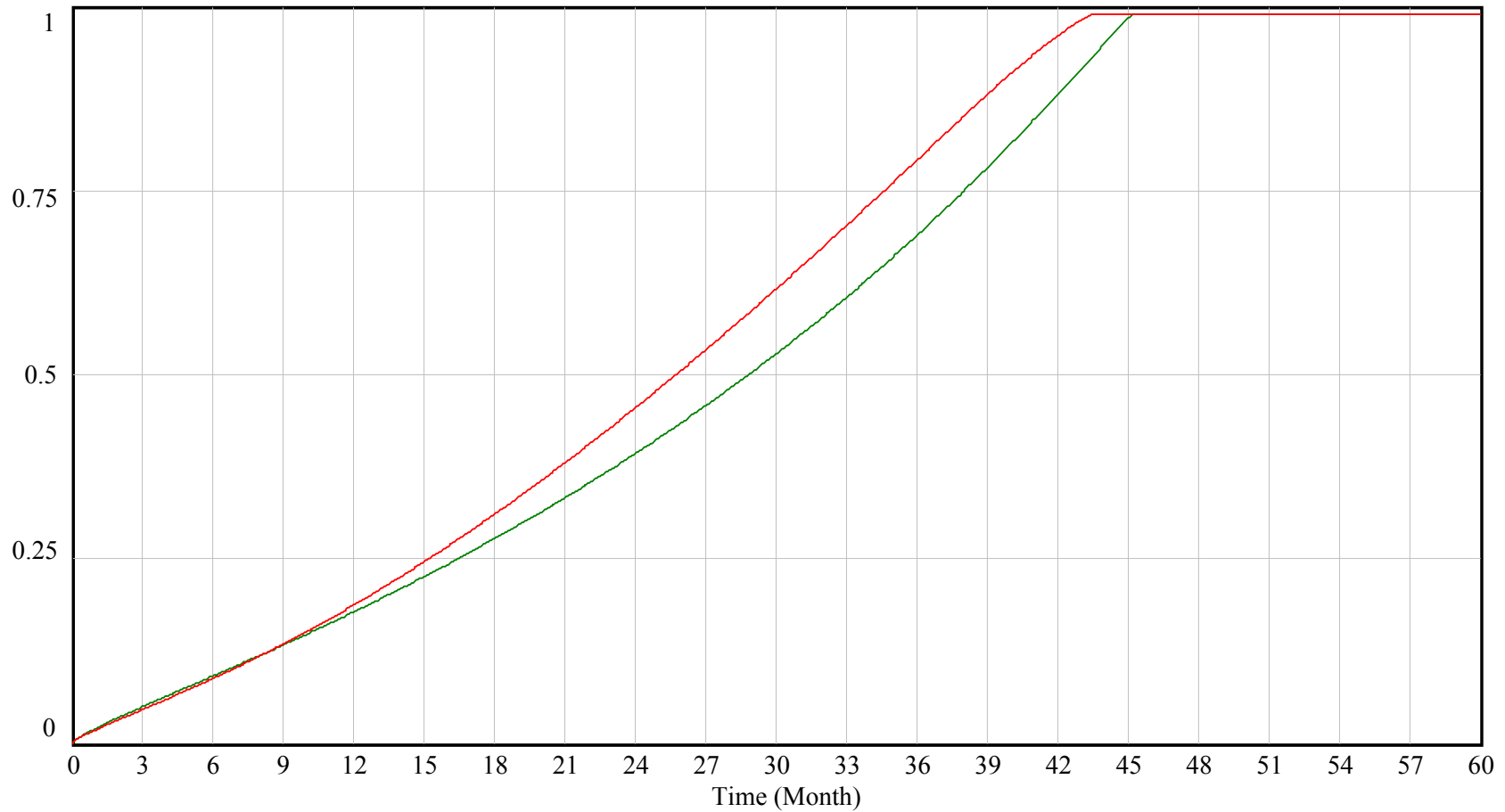
- perceived progress is lower because more total work is getting done without the review, because of the higher productivity
- However, because this work contains more errors which will need to be reworked, real progress is actually lower.

Graph for Fraction Perceived to be Complete



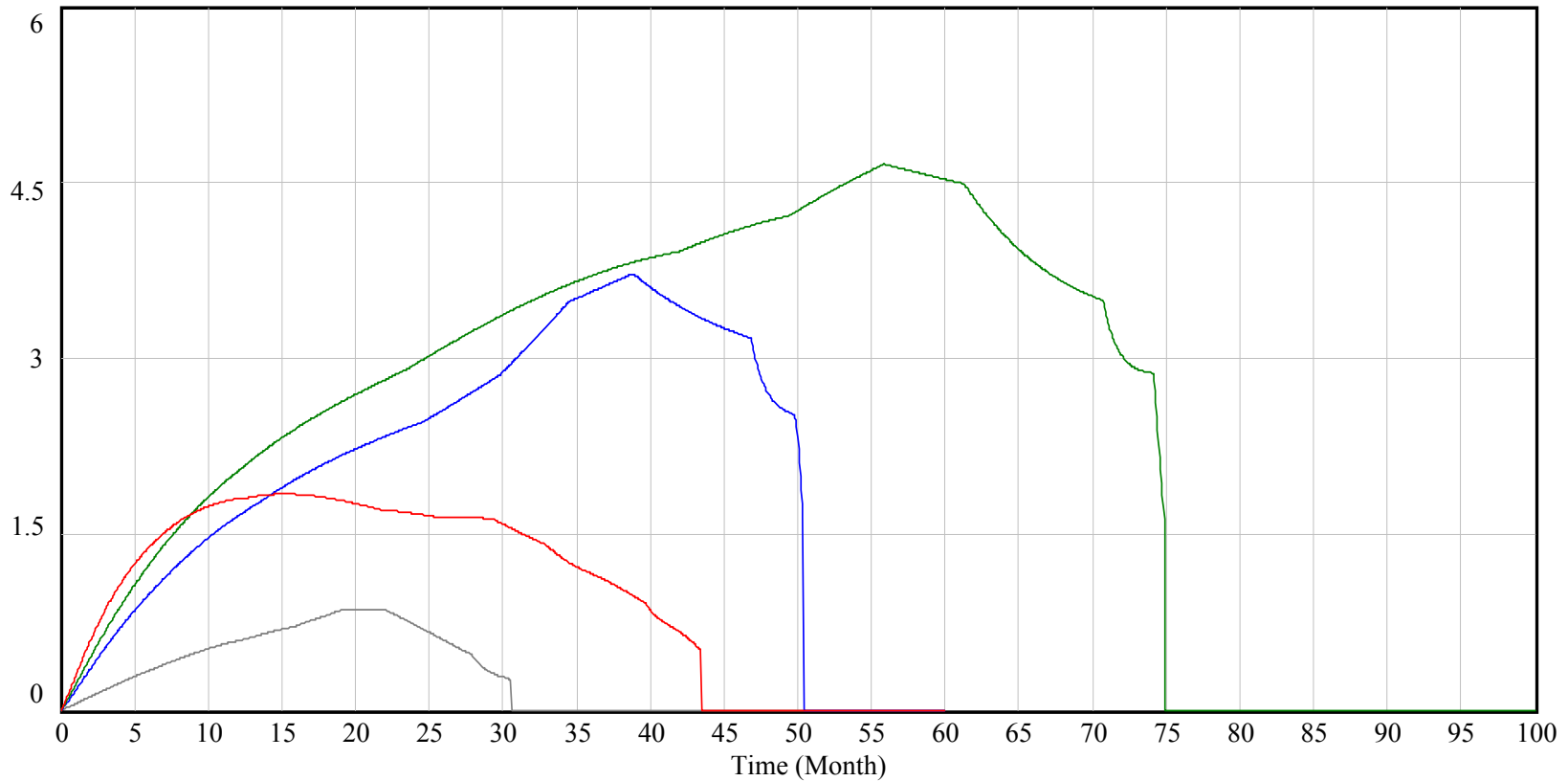
Fraction Perceived to be Complete : Capstone S75H25 Review — Fraction
Fraction Perceived to be Complete : Capstone S75H25 — Fraction

Graph for Fraction Really Complete



Fraction Really Complete : Capstone S75H25 Review — Fraction
Fraction Really Complete : Capstone S75H25 — Fraction

Graph for Rework Discovery



Rework Discovery : Capstone S75H25 Review — Task/Month
 Rework Discovery : Capstone Worst Case — Task/Month
 Rework Discovery : Capstone No Hire — Task/Month
 Rework Discovery : Capstone Bosses Hope — Task/Month