Using Simulation Modeling to evaluate if
Critical Chain Project Management (CCPM) can help a Gas Turbine Manufacturer to
Reduce Project lead times and Improve Reliability.

Presenters from Goldratt Research Labs:

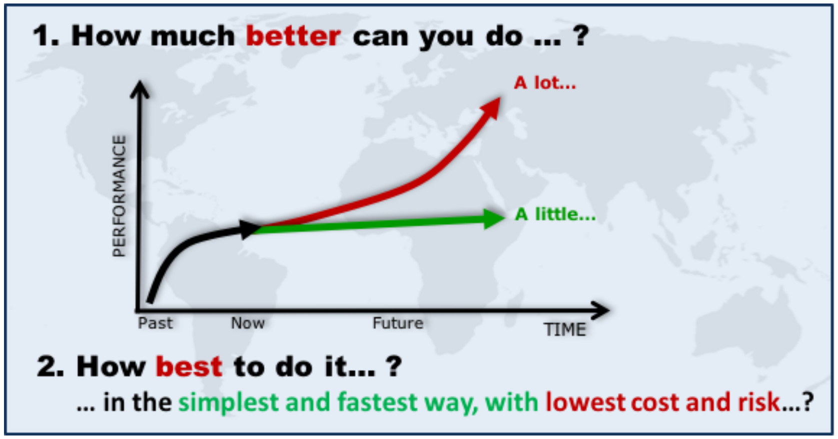
Dr. Alan Barnard, CEO

Jaco-Ben Vosloo, Director Simulation

Goldratt Research Labs

Our vision: Helping organizations and individuals make better faster decisions… when it really matters

We are passionate about helping organizations answer two simple but important questions:



Our CUSTOMERS include…

bhpbilliton, Microsoft, TATA, Cargill, Daiwa House, ABB, FUJITSU, Penguin Random House, macmillan Publishers, Larsen & Toubro, utah.gov, UNDP

Our RESEARCH PARTNERS include…

Amalgama, anylogic, REALIZATION, SAP, MERLYNN, Apple Consulting, Duke Corporate Education, Washington State University

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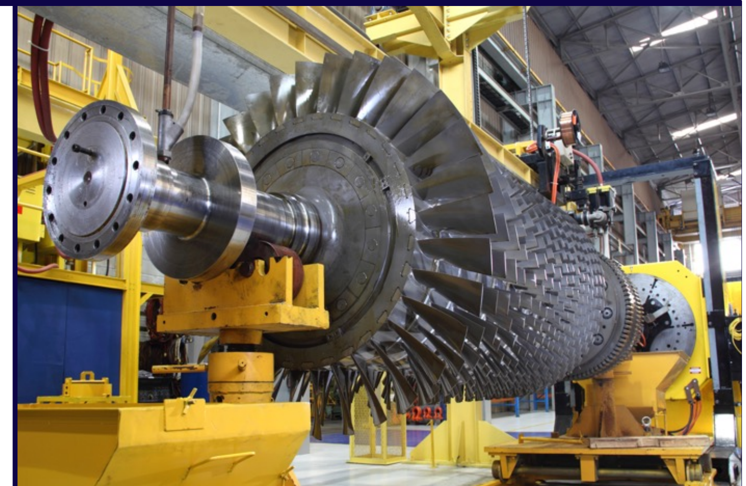
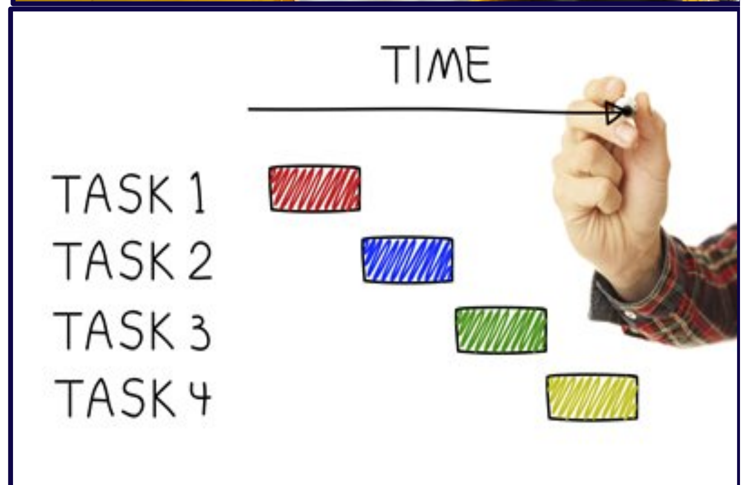




1. Project Introduction

Project Background

- One of the **largest gas turbine manufactures** in the world
- Created Competitive Edge by offering penalties and bonuses
- Growth in demand and backlog raised **concerns about profitably meeting client commitments on Lead Time and Costs**

Project Objectives

- Build a **self-configurable model** that can be used to simulate any portfolio of projects (engineer-to-order, IT, Construction etc)
- The model needs to be able to show:
    - The likely **Operational and Financial impact** of following the current (traditional) Project Management Rules
    - Determine the likely impact of implementing **CCPM rules**
    - Identify and test new, **counter-intuitive global optima** rules to **dynamically control WIP** & **allocate resources to improve flow**

2. Business Challenge

Project managers are responsible for:

- Making **reliable commitments** on project **budget & due-dates**
- Deciding on what **planning and execution rules** to use to ensure projects are delivered on time and in budget

This is challenging because:

- Companies today are subject to more and more **VUCCA** (Volatility, Uncertainty, Complexity, Constraints, Ambiguity)
- In such systems, changes can have **non-linear impacts, making decisions and predictions very challenging**

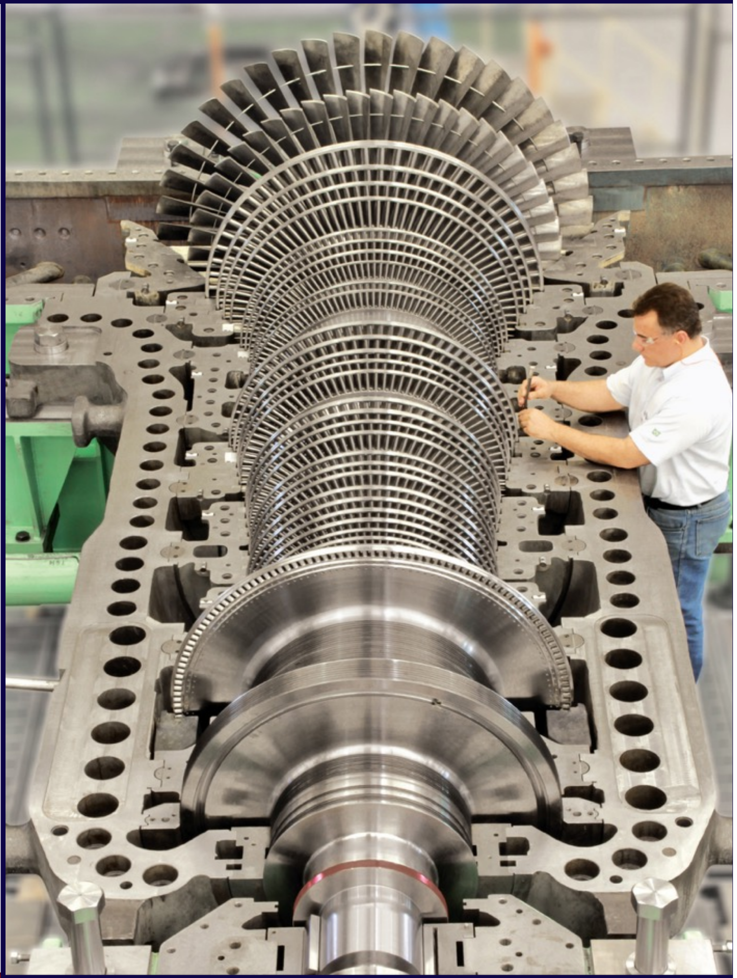
Why current tools are inadequate:

- **Static Project Planning tools** (MS projects, Primavera, spreadsheets etc.) cannot fully consider complexities, constraints, dynamic interdependencies and variability.
- Even when tools have simulations capabilities, it is mostly to **analyze or optimize at a subsystem level (e.g. to achieve higher resource efficiency/utilization)**.

3. Why Simulation, Why Anylogic ?

Why Simulation?

- Can consider all the **critical system interdependencies, constraints, complexities and variability**
- Can provide a range of **likely outcomes** for single scenarios, do **sensitivity analysis** and direct **scenario comparisons**
- Can provide a **low-risk, low-cost** way to test the impact of any changes on both operational and financial performance

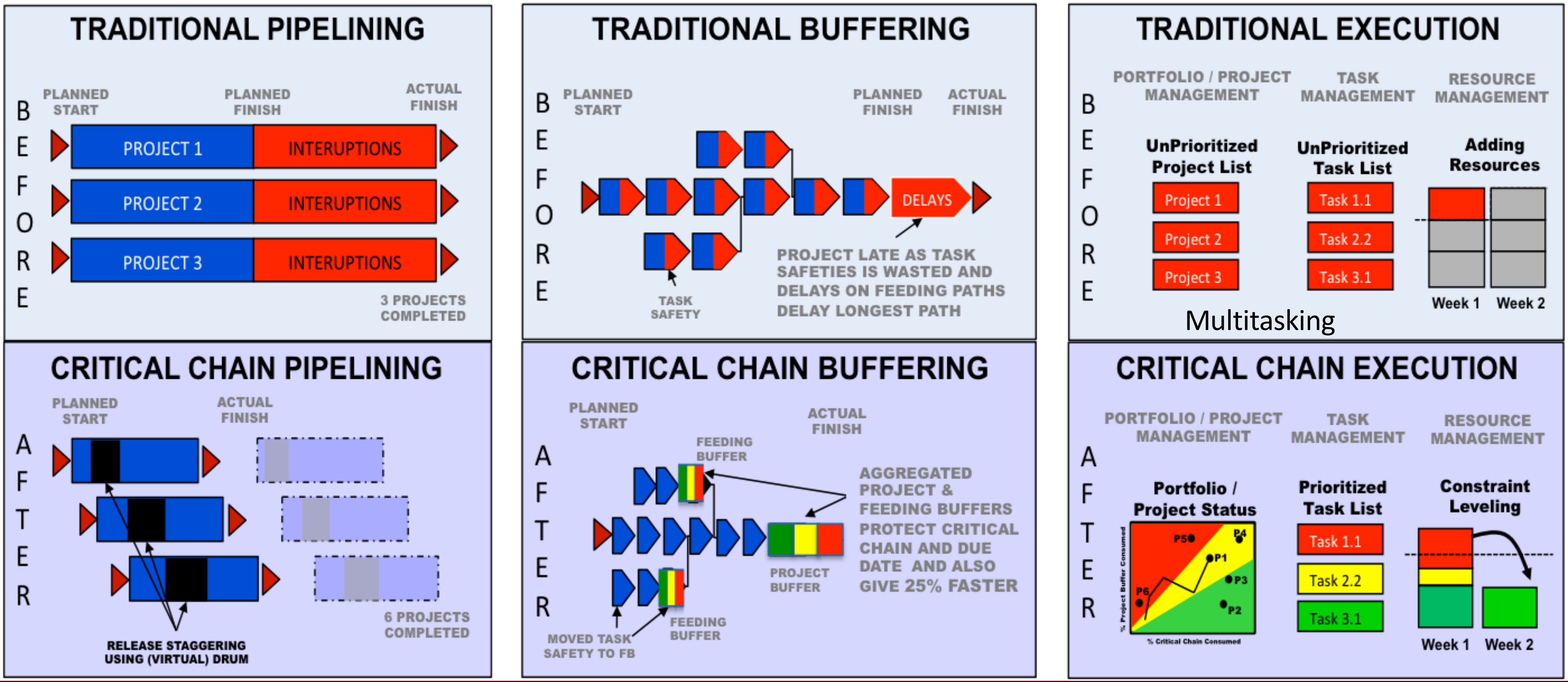


Why AnyLogic?

- Can replicate the **real-world complexity** through the use of both **Agent-based** and **Discrete Event** simulation methods
- Ability to create **Self-Configurable** models to cut dev time, ensure usability and **Scalability** for a range of system configs
- Ability to export the model as a **stand-alone app** and option to use **AnyLogic Cloud** to run resource-intensive models

Traditional vs Critical Chain PM Rules

RULE 1 – PIPELINING RULE 2 – BUFFERING RULE 3 – BUFFER MGT



Model objective and scenarios

Objective:

- Build a scalable self configurable model to be used for any project environment
- Determine for each scenario
  - **Likely portfolio completion date**
  - **Program & project due date performance**
  - **Main causes of delays**
  - **Financial performance**

<u>**Scenario 1**</u>

Traditional Project Management rules

<u>**Scenario 2**</u>

CCPM rules with WIP control at a Project level

<u>**Scenario 3**</u>

CCPM rules with WIP control at a Program level

<u>**Scenario 4**</u>

CCPM rules with Hybrid WIP control (Program and Project

Model setup

Work Break Down Structure
- Program consist of Projects
- Projects consist of Phases
- Resources and duration estimates gets assigned on a phase level

Export Work Breakdown Structure

- Locations
- Resources
- Late completion Penalties
- Early Completion Bonus
- Work Breakdown structure
- Distribution of planned project duration

Excel

Experts

Variability & Uncertainty

User Interface to Manage Scenarios

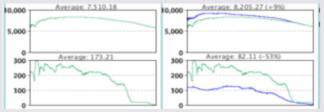
Embedded TOC Best Practices

Processes modeled:
- Task switching
- Prioritization
- Resource allocation
- Bonus for early completion
- Penalties for late completion
- TOC Best Practices

Single Run

Sensitivity Analysis

Scenario Comparison



Analyst

AnyLogic reports

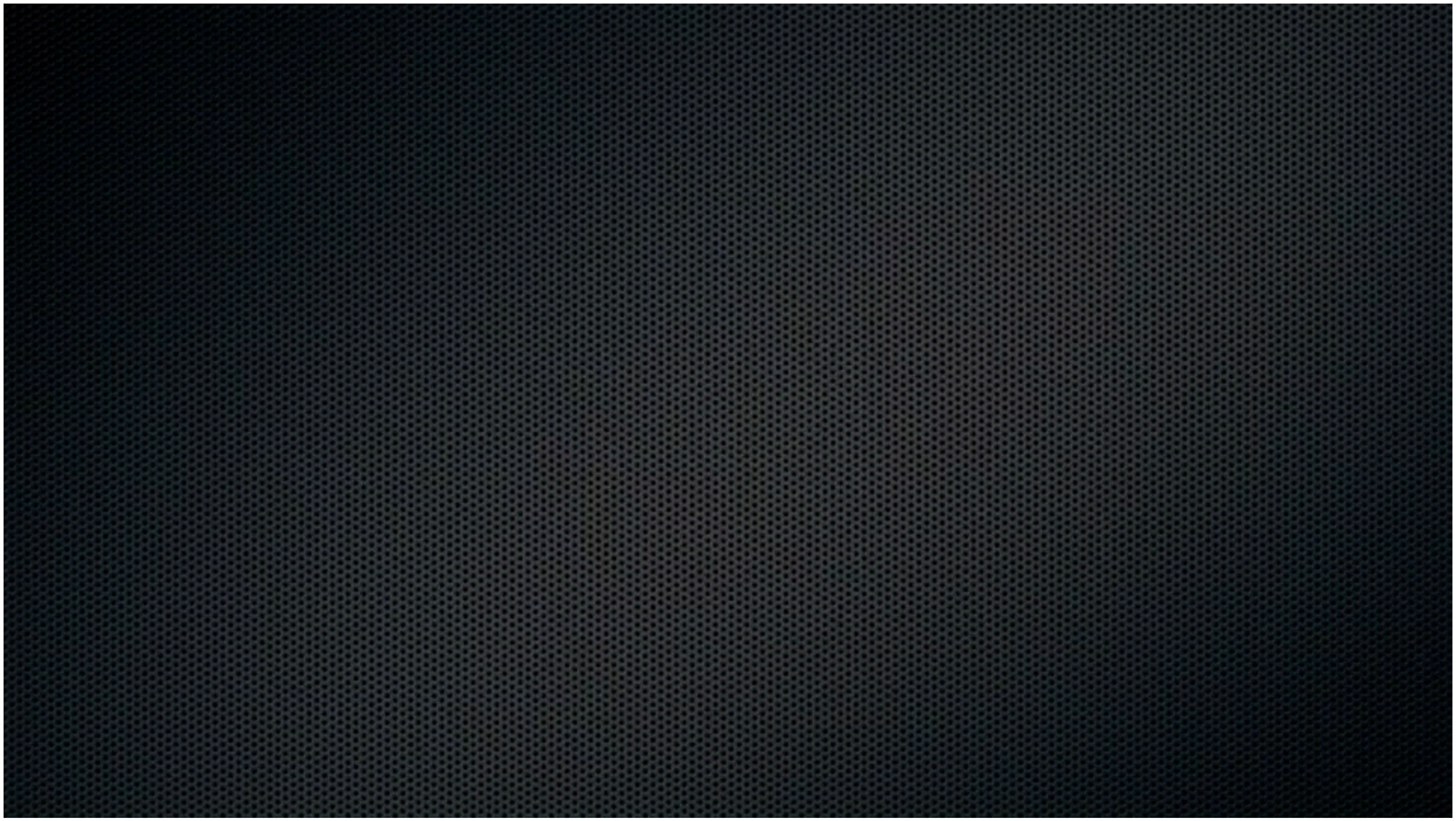
XLSX

Excel reports

TXT

Logs

Model Demo video



Results

Goldratt Project Management Simulation – Results

Main Menu | Run All Rounds | Clear Results | Goldratt RESEARCH LABS

		Scenario 1 (Run Sceanrio 1)	Scenario 2 (Run Scenario 2)		Scenario 3 (Run Scenario 3)		Scenario 4 (Run Scenario 4)	
Show delta as %		No CCPM Rules Used	Apply CCPM Rules WIP Control at Project Level		Apply CCPM Rules WIP Control at Program Level		Apply CCPM Rules Hybrid Rule to Control WIP	
Due Date Performance	Target	Actual	Actual	Delta	Actual	Delta	Actual	Delta
Date all programs finished	01 / 20 / 22	02 / 15 / 24	10 / 27 / 22	(476 days earlier)	01 / 07 / 23	(404 days earlier)	04 / 15 / 22	(671 days earlier)
% programs finished on time	100%	2%	9%	7%	15%	13%	25%	23%
% projects within planned time	100%	19%	78%	59%	54%	35%	52%	33%
% phases within planned time	100%	33%	100%	67%	100%	67%	100%	67%
Financials								
Revenue, $M	413.09	414.56	414.56	0.00	414.56	0.00	414.56	0.00
Costs, $M	284.12	384.76	321.47	-63.28	331.05	-53.71	295.55	-89.21
Penalties, $M	0.00	211.00	33.01	-177.98	75.11	-135.88	88.76	-122.24
Bonuses, $M	0.00	0.00	44.83	44.83	28.74	28.74	24.84	24.84
Net Profit, $M	**128.97**	**-181.19**	**104.91**	**286.10**	**37.15**	**218.34**	**55.10**	**236.29**
Net Profit, %	31%	-44%	23%	67%	8%	52%	13%	56%
Lost sales, $M	0.00	146.66	60.18	-86.47	73.02	-73.64	17.47	-129.19

Work in Progress, Throughput

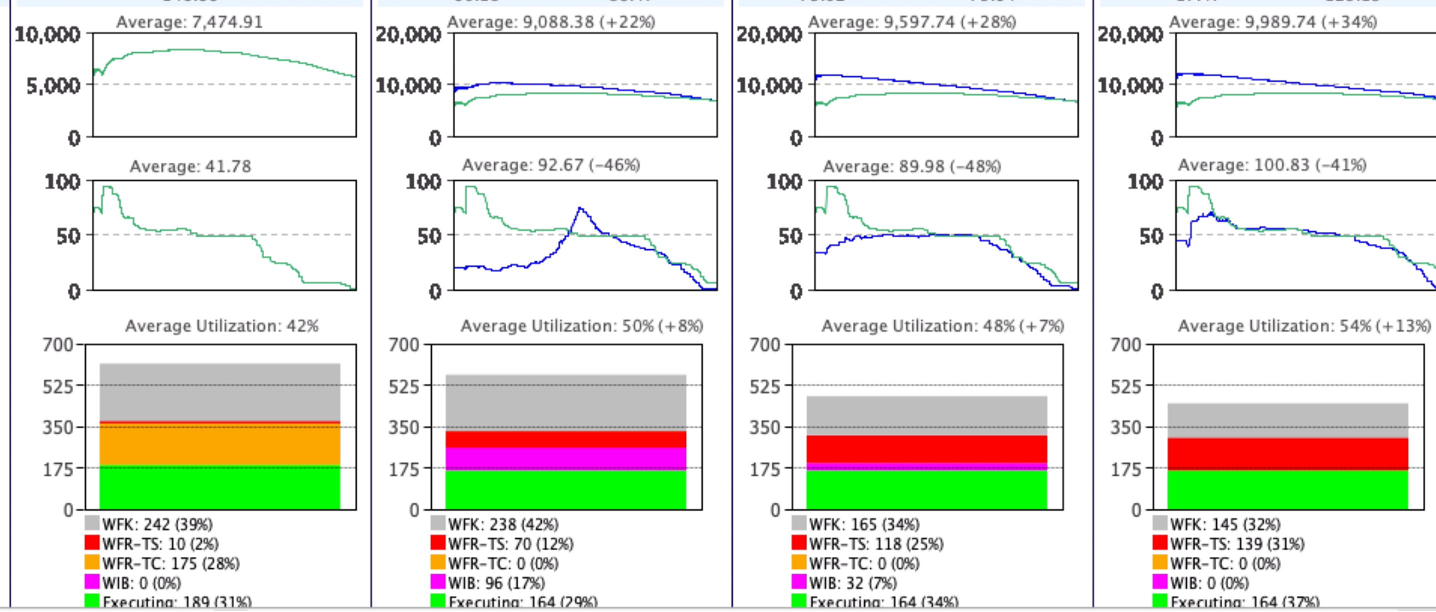
Average Throughput, man-month eqvs / month

WIP: Programs / Projects / Phases

Resources

Resources utilization, %

Delay Analysis



Q&A

Dr. Alan Barnard
alan@goldrattresearchlabs.com

Jaco-Ben Vosloo
jacoben@goldrattresearchlabs.com

Dr Andrey Malykhanov
andrey@goldrattresearchlabs.com