

Leveraging Human Process Knowledge via Process Mining

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Agenda

1

Company introduction

2

Business Process Improvement at Veco

3

How process mining leverages human process knowledge

4

Conclusions

Company profile

Company profile

Related companies

Sales offices

Agents

Veco B.V.

Veco B.V is a world leading manufacturer of precision metal parts and metal filters. To meet customers' specifications and demands, Veco has developed high standards of performance in electroforming, photo-etching and metal finishing. These technologies allow a powerful combination of precision and economical production; for high volumes and prototypes, standard and custom made products. Research and development programs and stringent Quality Control Standards are key to the cutting edge solutions we supply.

Veco started in 1934 as a manufacturer of sieves made by the electroforming process and has been part of the SPGPrints Group since 1975. SPGPrints Group is the global leading company in the textile and graphics printing markets. Veco products are exported worldwide, direct and via sales offices and agents all over the world.

Sales offices

- » SPGPrints Brasil Ltda., Brazil
- » SPGPrints Printing Systems Wuxi Co., Ltd, China
- » Stovec Industries Ltd., India
- » Tecan Ltd., United Kingdom
- » Veco B.V., The Netherlands
- » Veco USA, U.S.A.

Agenda

1

Company introduction

2

Business Process Improvement at Veco

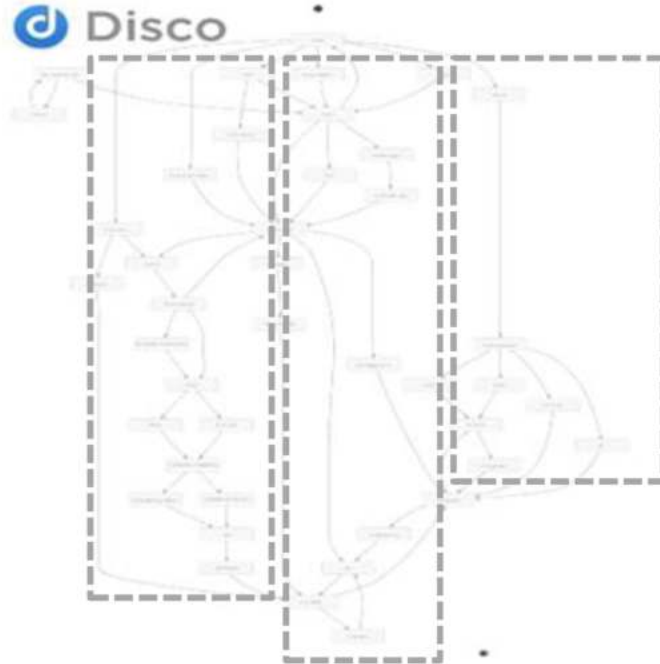
3

How process mining leverages human process knowledge

4

Conclusions

**Majority of defects is not detected before final completion of production;
reduction of lead time means reduction of risk profile and costs**



Product line 1 Product line 2 Product line 3

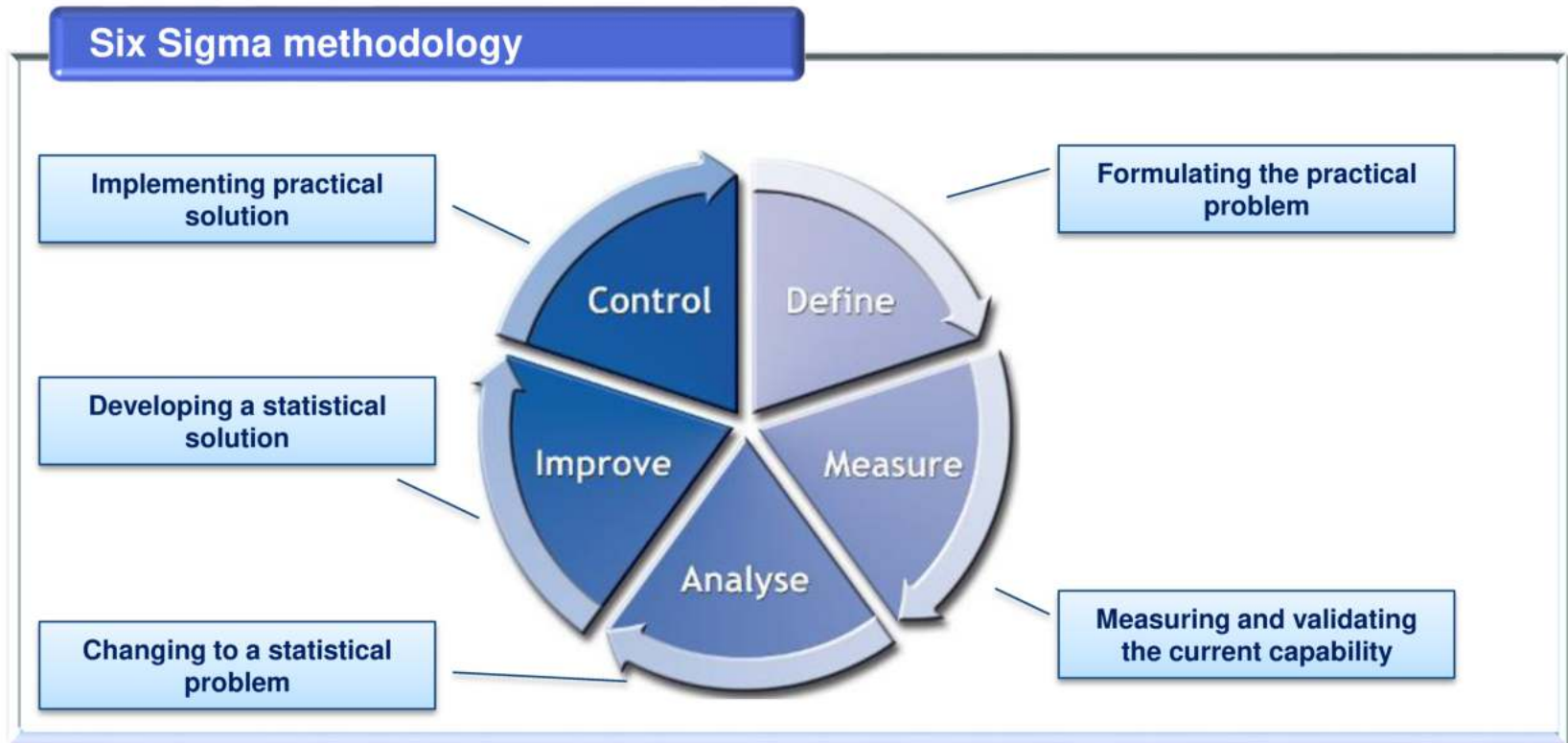
Short production lead times are key as
final quality not known until inspection



“ Improvements within Operations department are driven by delivering our customers better and faster ”



Our improvements at Veco are based on the Six Sigma methodology



Analyse phase: based on our knowledge, our people sketch the process flows, brainstorm on hypotheses and perform analyses using Minitab

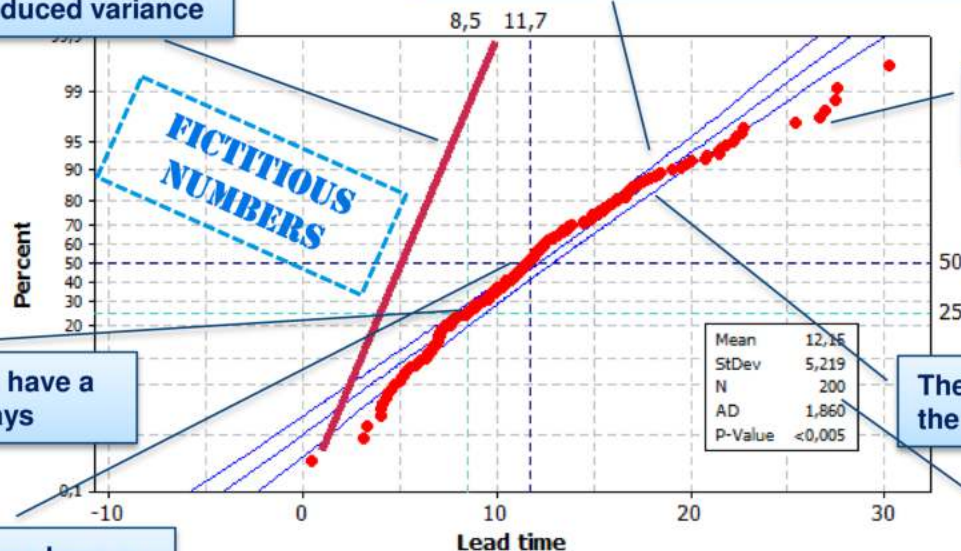


Analyse Phase: for each identified bottleneck workflow, we generate a probability plot of the throughput time and formulate hypotheses

Probability plots

Possible target leadtime with reduced mean and reduced variance

Hypothesis 1: variation is due to production shift
Hypothesis 2: variation is due to product type



Each dot is a production order, with the lead time on the x-axis

The steeper the curve, the lower the variance

Sample consists of 200 production orders

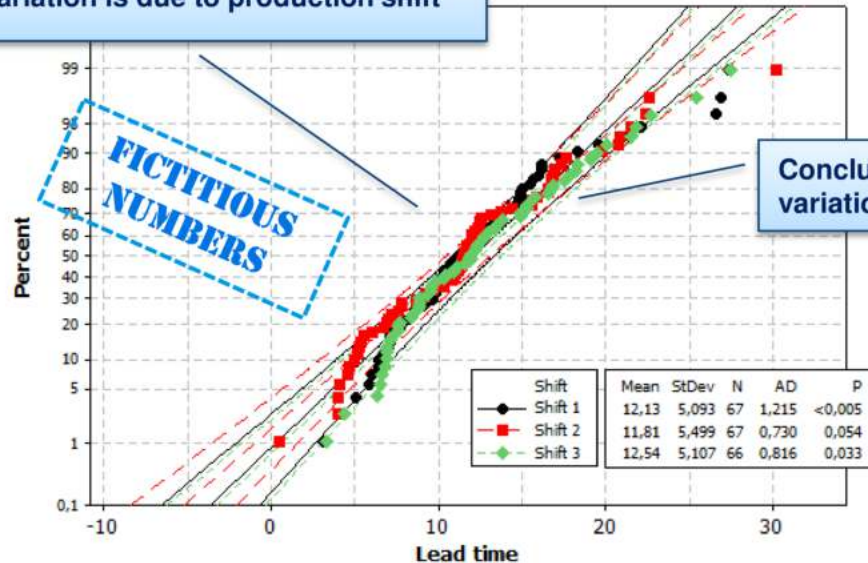
25% of all production orders have a lead time of maximum 8,5 days

50% of all production orders have a lead time of maximum 11,7 days

Analyse Phase: based on identified hypotheses, Minitab shows us the impact of – for example – shift number on lead time...

Probability plots

Hypothesis 1: variation is due to production shift

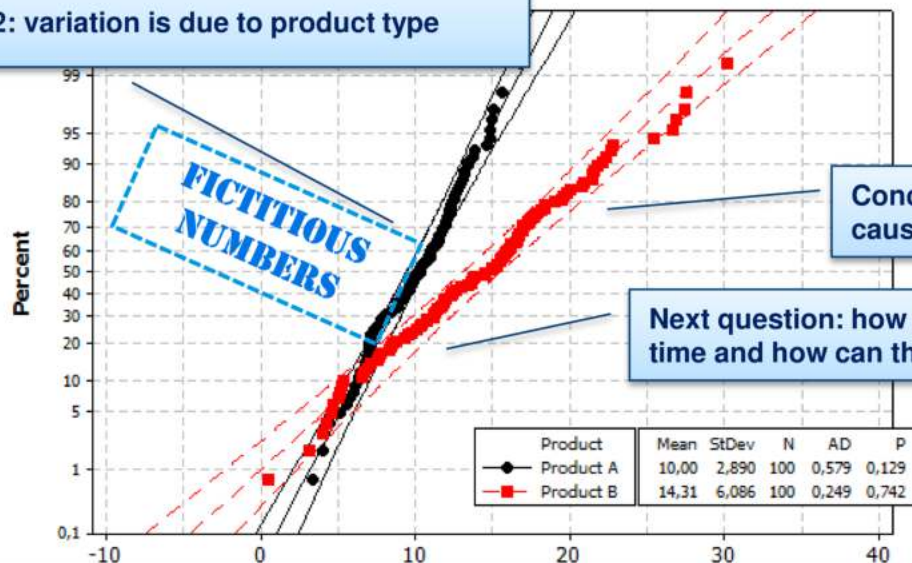


Conclusion: "Shift" is no root cause for variation in throughput time

Analyse Phase:... or impact of Product Code on lead time

Probability plots

Hypothesis 2: variation is due to product type



Conclusion: "Product" is a root cause for difference in variation

Next question: how does Product B impact the throughput time and how can this variation be reduced?

Our analyses have proven to be effective, however the process of analysing is not very efficient and it is hard to get all colleagues with process knowledge on board

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Conclusions

In November 2014, process mining came into our lives; Coursera brought us two “Process Mining certified” people within Veco

Process Mining



The screenshot shows the Coursera course page for "Process Mining: Data science in Action" by TU/e. The page includes a header with the Coursera logo and navigation links. The main content area features the course title, a description of process mining as a link between model-based process analysis and data-oriented analysis techniques, and a "Watch Intro Video" button. The "About the Course" section describes data science as the profession of the future and explains how process mining bridges the gap between traditional model-based process analysis and data-centric analysis techniques. The "Sessions" section shows the course duration from Nov 12, 2014, to Jan 5th 2015, with a "View course record" button. The "Eligible for" section lists "Verified Certificate" and "Statement of Accomplishment". The "Course at a Glance" section indicates a duration of 6 weeks of study.

Process Mining: Data science in Action

Process mining is the missing link between model-based process analysis and data-oriented analysis techniques. Through concrete data sets and easy to use software the course provides data science knowledge that can be applied directly to analyze and improve processes in a variety of domains.

About the Course

Data science is the profession of the future, because organizations that are unable to use (big) data in a smart way will not survive. It is not sufficient to focus on data storage and data analysis. The data scientist also needs to relate data to process analysis. **Process mining bridges the gap between traditional model-based process analysis (e.g., simulation and other business process management techniques) and data-centric analysis techniques such as machine learning and data mining.** Process mining seeks the confrontation between event data (i.e., observed behavior) and process models (hand-made or discovered automatically). This technology has become available only recently, but it can be applied to any type of operational processes (organizations and systems). Example applications include: analyzing treatment processes in hospitals, improving customer service processes in a

Sessions

Nov 12, 2014 - Jan 5th 2015

[View course record](#)

Eligible for

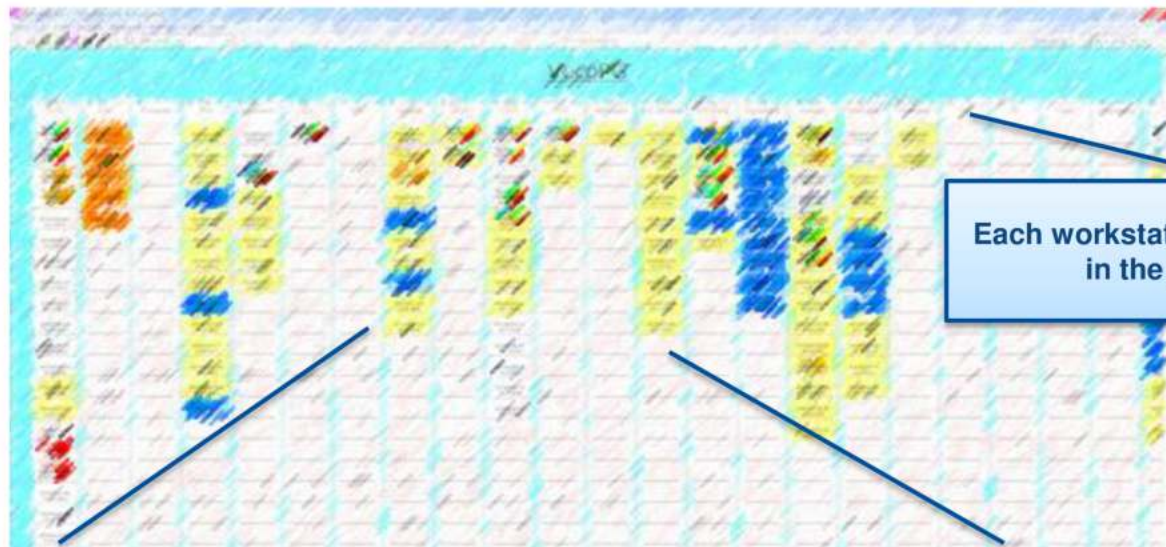
Verified Certificate
Statement of Accomplishment

Course at a Glance

6 weeks of study

Process Mining at Veco is possible due to our planning board which is an extremely usefull way of logging our production order progress

Process Mining



Each workstation has its own column in the planning board

Each ticket in the planning board represents a production order

Operators move the tickets to the next column in the production routing as soon as they finish a production order step in a workstation

Process Mining has changed the way people can apply knowledge and insights towards substantial process improvements

Process Mining

My
ambition

“Reduce lead times from 4 weeks to 2 weeks”

Process Mining: Data
science in **Before**
process mining

After
process mining

“We can give you lead
time of 3 weeks”

“We can give you lead time
between 1 and 2 weeks”

Response of
Operations Team

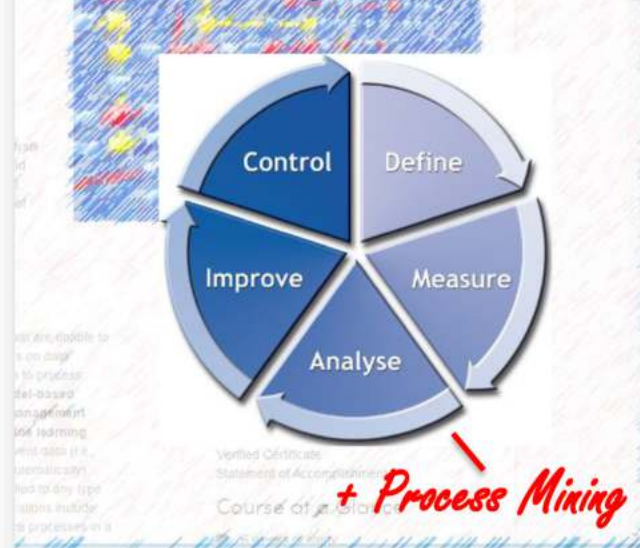
Part 1 of an experiment where we compare lead time improvement based on Minitab analyses versus process mining

Experiment

1 Solely based on Minitab Analysis

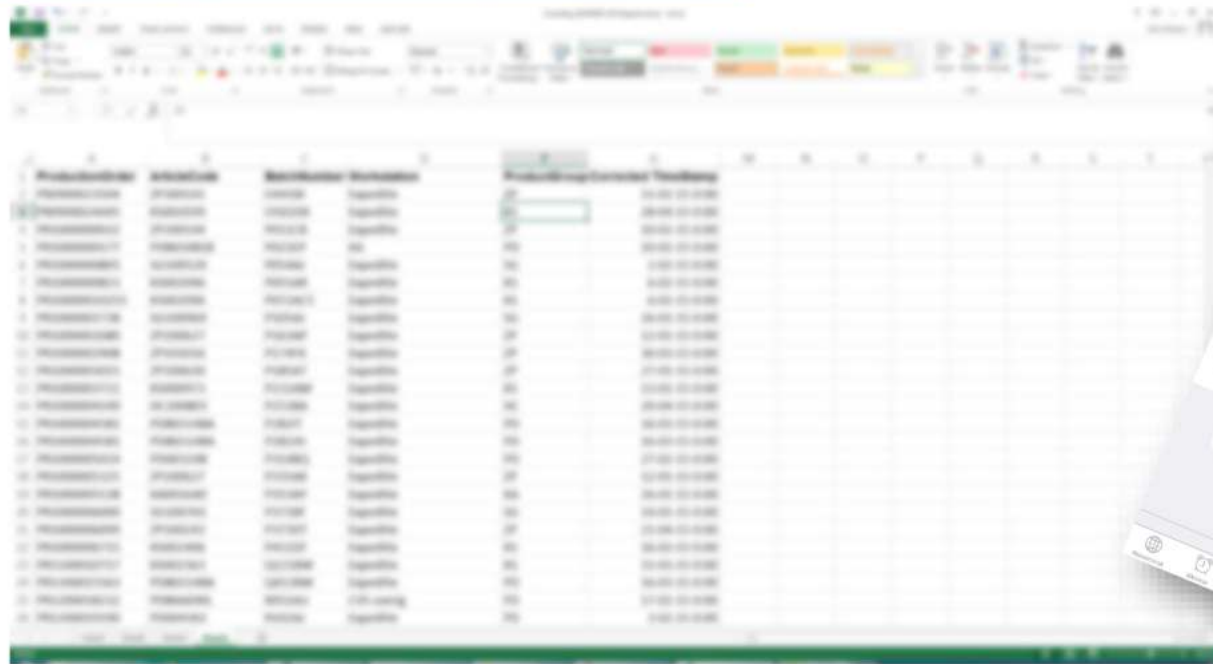


2 Include Process Mining as Analysis tool



I exported my eventlog to Excel - containing 28704 events from the first four months of 2015 - and started to measure progress

Eventlog

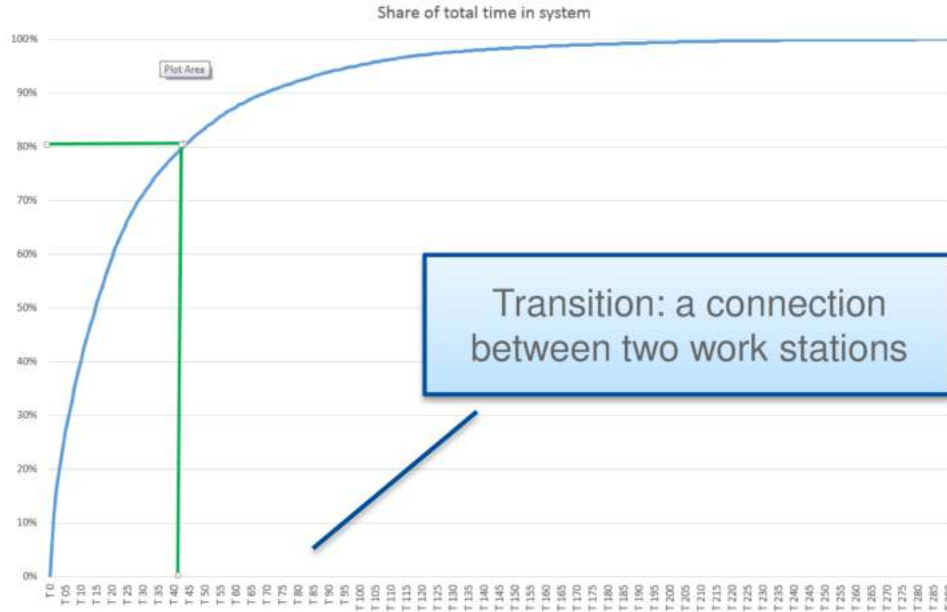


The image shows a screenshot of an Excel spreadsheet. The spreadsheet has several columns, with the first column containing a list of names or identifiers. The subsequent columns contain various data points, likely representing event details. The spreadsheet is titled 'Eventlog' in a blue header bar. The data is organized into a structured table format, typical of an event log export.



After 12 minutes, I knew that my eventlog contained almost 290 transitions; about 40 of them accounted for 80% of total system time

Path selection



After 21 minutes, I had an overview of all individual lead times of the “high traffic” transitions

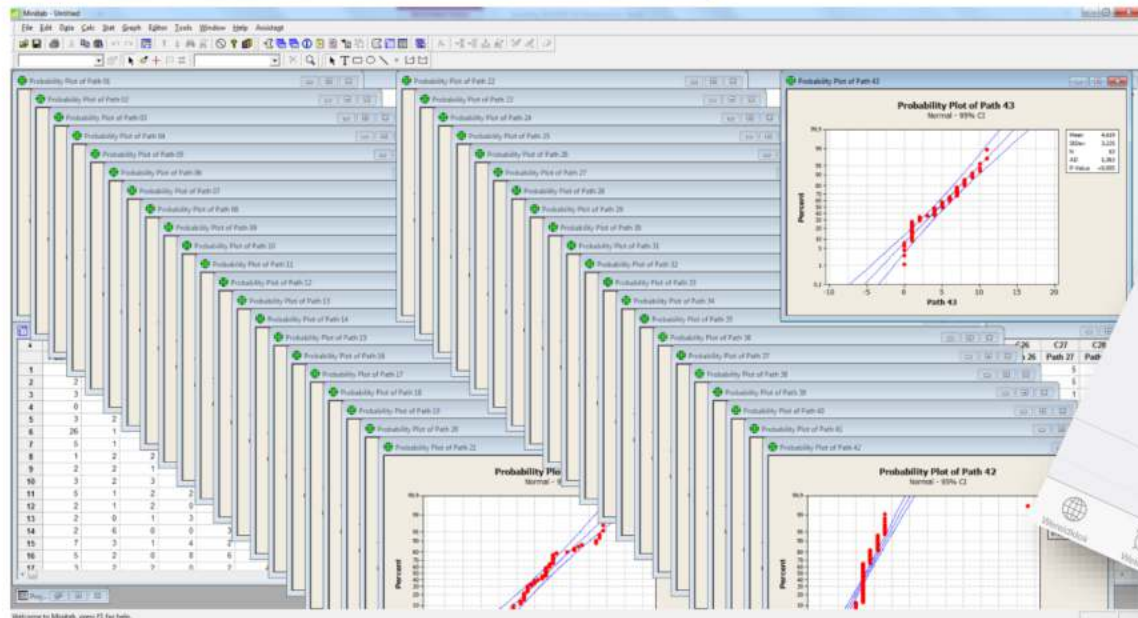
Individual lead times

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI | AJ | AK | AL | AM | AN | AO | AP | AQ | AR | AS | AT |
|-----------------|---------------|--------|--------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|----|----|
| Min of Duration | Column Labels | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Row Labels | T19 | T30 | T11 | T18 | T22 | T10 | T05 | T31 | T15 | T08 | T07 | T26 | T01 | T41 | T24 | T38 | T28 | T20 | T42 | T17 | T16 | T02 | T34 | T03 | T36 | T33 | T35 | T09 | T13 | T06 | T29 | T04 | T32 | T12 | T23 | T39 | T27 | T25 | T14 | T37 | T21 | T40 | T43 | Grand Total | | |
| 6 | 1 | 1 | 1 | 4 | 1 | 2 | 0 | 8 | 3 | 1 | 13 | 0 | 0 | 0 | 1 | 0 | 3 | 1 | 1 | 3 | 0 | 9 | 2 | 1 | 0 | 0 | 0 | 7 | 7 | 2 | 0 | 0 | 1 | 3 | 1 | 1 | 5 | 7 | 2 | 1 | 10 | 1 | 1 | 0 | | |
| 7 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 6 | 2 | 1 | 30 | 0 | 2 | 1 | 0 | 1 | 0 | 2 | 0 | 6 | 0 | 1 | 1 | 4 | 1 | 3 | 0 | 7 | 6 | 11 | 0 | 7 | 4 | 0 | 0 | 1 | 5 | 3 | 0 | 1 | 10 | 1 | 5 | 0 | | |
| 8 | 1 | 1 | 0 | 0 | 1 | 2 | 2 | 5 | 3 | 0 | 38 | 0 | 3 | 1 | 0 | 1 | 0 | 1 | 0 | 4 | 1 | 0 | 2 | 25 | 1 | 2 | 0 | 4 | 1 | 3 | 0 | 0 | 4 | 5 | 1 | 1 | 0 | 1 | 1 | 9 | 6 | 0 | 0 | | | |
| 9 | 4 | 1 | 1 | 1 | 0 | 3 | 1 | 6 | 3 | 0 | 30 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 4 | 14 | 1 | 1 | 2 | 1 | 2 | 3 | 0 | 4 | 0 | 2 | 0 | 1 | 6 | 8 | 1 | 1 | 4 | 3 | 1 | 1 | 15 | 0 | 2 | 0 | | |
| 10 | 5 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 8 | 1 | 33 | 3 | 3 | 11 | 1 | 0 | 1 | 1 | 1 | 9 | 0 | 2 | 1 | 1 | 1 | 3 | 4 | 1 | 3 | 0 | 1 | 2 | 2 | 1 | 1 | 1 | 3 | 1 | 1 | 15 | 4 | 0 | 0 | | | |
| 11 | 6 | 1 | 1 | 0 | 0 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | 0 | 26 | 6 | 1 | 0 | 0 | 5 | 1 | 9 | 0 | 1 | 2 | 1 | 1 | 0 | 1 | 4 | 1 | 6 | 0 | 0 | 8 | 2 | 1 | 1 | 1 | 3 | 1 | 0 | 15 | 2 | 1 | 0 | |
| 12 | 7 | 0 | 1 | 1 | 0 | 1 | 5 | 2 | 1 | 3 | 1 | 22 | 0 | 5 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 4 | 1 | 0 | 0 | 0 | 6 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 15 | 7 | 5 | 0 | | |
| 13 | 8 | 0 | 1 | 2 | 1 | 0 | 4 | 1 | 1 | 4 | 0 | 6 | 0 | 1 | 5 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 2 | 1 | 2 | 1 | 1 | 10 | 4 | 1 | 2 | 1 | 3 | 3 | 2 | 0 | 1 | 6 | 6 | 1 | 2 | 15 | 3 | 5 | 0 | |
| 14 | 9 | 0 | 1 | 1 | 1 | 1 | 3 | 0 | 0 | 4 | 1 | 22 | 0 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | 0 | 2 | 3 | 1 | 1 | 1 | 6 | 1 | 0 | 2 | 0 | 8 | 2 | 0 | 1 | 6 | 8 | 1 | 1 | 14 | 4 | 2 | 0 | | | |
| 15 | 10 | 0 | 0 | 1 | 1 | 3 | 3 | 0 | 1 | 4 | 0 | 1 | 0 | 3 | 6 | 2 | 0 | 2 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 1 | 0 | 0 | 7 | 0 | 0 | 1 | 0 | 8 | 2 | 1 | 1 | 5 | 2 | 1 | 0 | 8 | 3 | 4 | 0 | |
| 16 | 11 | 0 | 0 | 1 | 4 | 3 | 3 | 0 | 0 | 7 | 2 | 0 | 1 | 5 | 8 | 2 | 1 | 4 | 0 | 3 | 0 | 0 | 1 | 10 | 2 | 2 | 1 | 1 | 6 | 1 | 0 | 1 | 2 | 8 | 2 | 1 | 1 | 5 | 2 | 1 | 0 | 6 | 5 | 7 | 0 | |
| 17 | 12 | 0 | 1 | 2 | 4 | 4 | 3 | 1 | 1 | 3 | 3 | 22 | 1 | 2 | 0 | 0 | 0 | 0 | 4 | 0 | 3 | 1 | 4 | 2 | 2 | 1 | 5 | 6 | 0 | 8 | 1 | 0 | 7 | 2 | 1 | 1 | 5 | 4 | 1 | 0 | 12 | 5 | 4 | 0 | | |
| 18 | 13 | 0 | 1 | 2 | 0 | 3 | 1 | 1 | 7 | 1 | 4 | 0 | 0 | 2 | 8 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 3 | 7 | 2 | 1 | 0 | 5 | 5 | 1 | 1 | 12 | 5 | 8 | 0 | | | |
| 19 | 14 | 0 | 0 | 1 | 0 | 0 | 3 | 1 | 4 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 1 | 5 | 1 | 4 | 0 | 6 | 0 | 0 | 1 | 13 | 9 | 6 | 0 | 0 | 1 | 13 | 9 | 7 | 0 | 1 | 1 | 0 | 12 | 4 | 10 | 0 | | | |
| 20 | 15 | 1 | 0 | 0 | 3 | 1 | 2 | 2 | 1 | 7 | 2 | 8 | 0 | 7 | 1 | 1 | 0 | 1 | 1 | 4 | 2 | 3 | 0 | 1 | 1 | 3 | 0 | 5 | 0 | 5 | 0 | 4 | 7 | 0 | 1 | 1 | 4 | 8 | 7 | 0 | 16 | 4 | 11 | 0 | | |
| 21 | 16 | 1 | 1 | 2 | 1 | 0 | 5 | 6 | 1 | 5 | 1 | 22 | 0 | 5 | 4 | 0 | 0 | 0 | 2 | 1 | 7 | 0 | 2 | 4 | 0 | 1 | 1 | 0 | 1 | 5 | 3 | 8 | 10 | 5 | 0 | 1 | 5 | 7 | 1 | 1 | 15 | 0 | 3 | 0 | | |
| 22 | 17 | 1 | 0 | 5 | 1 | 0 | 6 | 2 | 1 | 5 | 3 | 1 | 0 | 3 | 25 | 1 | 0 | 1 | 1 | 1 | 6 | 0 | 2 | 3 | 2 | 1 | 1 | 2 | 9 | 1 | 4 | 1 | 0 | 10 | 5 | 0 | 1 | 5 | 7 | 1 | 0 | 15 | 3 | 8 | 0 | |
| 23 | 18 | 1 | 0 | 2 | 1 | 3 | 6 | 2 | 11 | 7 | 0 | 21 | 0 | 5 | 15 | 1 | 0 | 1 | 1 | 3 | 1 | 0 | 2 | 4 | 1 | 4 | 1 | 4 | 12 | 1 | 1 | 0 | 4 | 11 | 1 | 0 | 1 | 5 | 11 | 1 | 4 | 7 | 0 | 0 | | |
| 24 | 19 | 1 | 0 | 0 | 1 | 1 | 3 | 3 | 9 | 7 | 0 | 3 | 1 | 4 | 0 | 3 | 0 | 1 | 1 | 1 | 7 | 0 | 2 | 2 | 4 | 0 | 0 | 6 | 9 | 1 | 11 | 1 | 4 | 10 | 1 | 2 | 1 | 6 | 1 | 1 | 7 | 3 | 7 | 0 | | |
| 25 | 20 | 0 | 2 | 0 | 0 | 5 | 4 | 1 | 9 | 6 | 1 | 26 | 0 | 5 | 5 | 3 | 0 | 1 | 0 | 1 | 7 | 0 | 7 | 1 | 1 | 1 | 5 | 1 | 2 | 5 | 0 | 4 | 11 | 1 | 1 | 1 | 5 | 6 | 1 | 0 | 11 | 3 | 1 | 0 | | |
| 26 | 21 | 6 | 3 | 0 | 0 | 2 | 4 | 2 | 1 | 5 | 1 | 47 | 0 | 2 | 8 | 3 | 2 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 5 | 6 | 2 | 1 | 9 | 1 | 4 | 0 | 4 | 1 | 1 | 0 | 0 | 7 | 4 | 1 | 1 | 10 | 1 | 7 | 0 | |
| 27 | 22 | 0 | 0 | 1 | 0 | 2 | 4 | 2 | 1 | 6 | 0 | 22 | 1 | 2 | 8 | 3 | 2 | 4 | 4 | 1 | 2 | 0 | 0 | 1 | 3 | 3 | 2 | 1 | 14 | 0 | 6 | 0 | 4 | 1 | 1 | 0 | 0 | 1 | 2 | 1 | 0 | 4 | 1 | 9 | 0 | |
| 28 | 23 | 1 | 0 | 1 | 0 | 5 | 2 | 2 | 4 | 4 | 0 | 1 | 1 | 3 | 7 | 3 | 4 | 4 | 6 | 3 | 9 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 4 | 1 | 1 | 3 | 1 | 8 | 2 | 2 | 1 | 2 | 1 | 0 | 4 | 1 | 10 | 0 | | |
| 29 | 24 | 1 | 2 | 1 | 0 | 1 | 4 | 1 | 0 | 5 | 0 | 18 | 7 | 1 | 0 | 3 | 4 | 2 | 4 | 1 | 7 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 3 | 3 | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 1 | 0 | 7 | 1 | 5 | 0 | | |
| 30 | 25 | 1 | 3 | 1 | 1 | 1 | 4 | 1 | 4 | 1 | 0 | 0 | 0 | 1 | 3 | 0 | 1 | 5 | 1 | 7 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 3 | 0 | 6 | 1 | 1 | 1 | 3 | 6 | 1 | 0 | 2 | 2 | 10 | 0 | | |
| 31 | 26 | 1 | 0 | 4 | 0 | 4 | 2 | 1 | 3 | 4 | 0 | 14 | 1 | 1 | 13 | 0 | 0 | 1 | 6 | 1 | 7 | 1 | 3 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 5 | 1 | 0 | 27 | 5 | 1 | 1 | 3 | 4 | 1 | 0 | 2 | 2 | 7 | 0 | |
| 32 | 27 | 1 | 0 | 4 | 1 | 1 | 5 | 1 | 2 | 5 | 0 | 1 | 1 | 2 | 2 | 0 | 0 | 1 | 6 | 1 | 9 | 1 | 3 | 4 | 4 | 0 | 1 | 0 | 3 | 1 | 1 | 1 | 4 | 1 | 5 | 1 | 1 | 3 | 3 | 1 | 0 | 2 | 0 | 0 | | |
| 33 | 28 | 1 | 0 | 1 | 5 | 5 | 5 | 0 | 0 | 6 | 1 | 14 | 0 | 5 | 0 | 0 | 1 | 1 | 5 | 3 | 2 | 1 | 7 | 5 | 2 | 1 | 0 | 2 | 8 | 0 | 6 | 1 | 6 | 2 | 7 | 1 | 1 | 0 | 4 | 1 | 0 | 7 | 0 | 0 | | |
| 34 | 29 | 1 | 0 | 1 | 5 | 0 | 2 | 1 | 1 | 6 | 0 | 3 | 1 | 3 | 6 | 1 | 1 | 1 | 7 | 1 | 10 | 1 | 3 | 1 | 2 | 0 | 0 | 0 | 7 | 1 | 8 | 1 | 3 | 1 | 1 | 1 | 0 | 1 | 3 | 1 | 1 | 0 | 13 | 0 | | |
| 35 | 30 | 1 | 0 | 0 | 2 | 3 | 2 | 5 | 1 | 6 | 0 | 1 | 2 | 3 | 2 | 1 | 0 | 8 | 6 | 1 | 6 | 1 | 2 | 1 | 3 | 1 | 1 | 4 | 1 | 8 | 0 | 7 | 1 | 0 | 1 | 1 | 3 | 1 | 1 | 0 | 13 | 2 | 0 | 0 | | |
| 36 | 31 | 1 | 0 | 0 | 1 | 2 | 1 | 2 | 1 | 7 | 1 | 28 | 1 | 2 | 5 | 1 | 1 | 1 | 4 | 1 | 10 | 2 | 0 | 1 | 0 | 2 | 3 | 1 | 3 | 0 | 7 | 3 | 3 | 1 | 5 | 1 | 1 | 3 | 5 | 1 | 5 | 13 | 0 | 0 | | |
| 37 | 32 | 1 | 0 | 1 | 2 | 2 | 4 | 1 | 6 | 1 | 0 | 2 | 0 | 3 | 6 | 1 | 1 | 2 | 14 | 1 | 6 | 2 | 0 | 3 | 2 | 1 | 1 | 0 | 4 | 4 | 1 | 7 | 4 | 1 | 1 | 1 | 1 | 4 | 6 | 1 | 0 | 7 | 4 | 0 | | |
| 38 | 33 | 1 | 0 | 0 | 2 | 0 | 0 | 4 | 1 | 1 | 1 | 22 | 0 | 3 | 6 | 0 | 12 | 1 | 10 | 2 | 7 | 2 | 5 | 1 | 3 | 0 | 1 | 0 | 7 | 1 | 0 | 0 | 6 | 6 | 0 | 1 | 1 | 4 | 2 | 3 | 0 | 13 | 1 | 7 | 0 | |
| 39 | 34 | 1 | 1 | 0 | 1 | 0 | 0 | 4 | 1 | 1 | 1 | 1 | 0 | 3 | 5 | 0 | 1 | 2 | 3 | 4 | 6 | 2 | 5 | 1 | 1 | 3 | 1 | 2 | 7 | 3 | 7 | 1 | 6 | 0 | 5 | 1 | 1 | 0 | 3 | 1 | 5 | 13 | 8 | 0 | | |
| 40 | 35 | 1 | 0 | 0 | 5 | 1 | 4 | 0 | 0 | 4 | 0 | 22 | 1 | 0 | 2 | 1 | 1 | 1 | 3 | 4 | 10 | 1 | 3 | 1 | 4 | 1 | 3 | 2 | 7 | 4 | 1 | 0 | 1 | 0 | 1 | 11 | 4 | 0 | 1 | 1 | 0 | 22 | 4 | 9 | 0 | |
| 41 | 36 | 1 | 0 | 1 | 3 | 1 | 0 | 1 | 3 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 1 | 2 | 4 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 4 | 2 | 11 | 0 | 0 | | |
| 42 | 37 | 1 | 0 | 1 | 0 | 3 | 2 | 6 | 1 | 4 | 0 | 14 | 0 | 4 | 2 | 1 | 0 | 2 | 5 | 24 | 6 | 1 | 3 | 1 | 1 | 0 | 0 | 0 | 7 | 0 | 7 | 0 | 5 | 5 | 5 | 1 | 0 | 1 | 2 | 1 | 5 | 19 | 3 | 7 | 0 | |
| | Chart2 | Sheet2 | Sheet3 | Sheet4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| READY | CALCULATE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



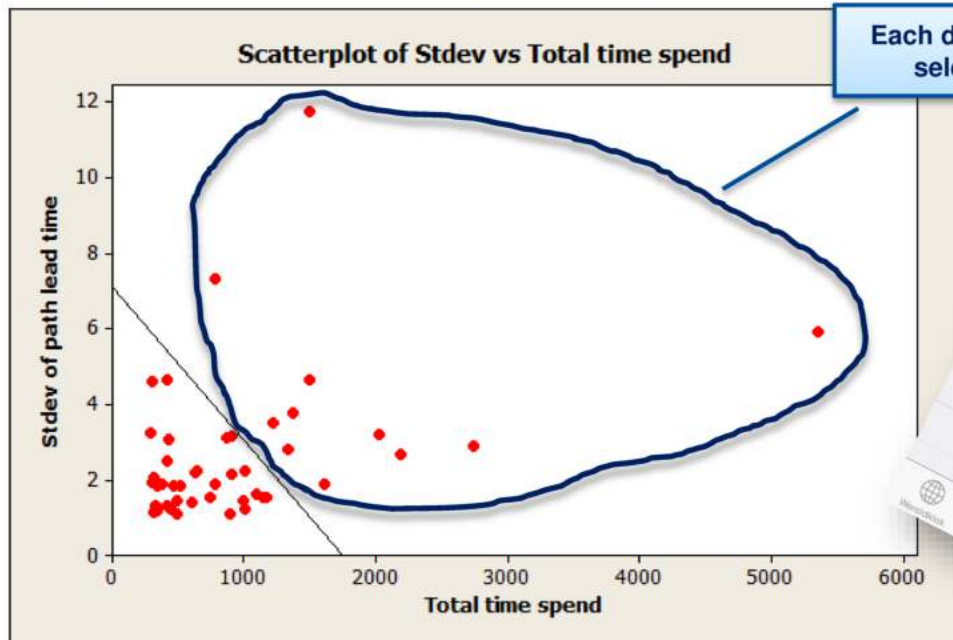
After 24 minutes, I had the excel-data imported into Minitab and had 43 probability plots to analyse....

Probability plots



After 31 minutes, I made a first selection of transitions based on potential and impact

Routing selection

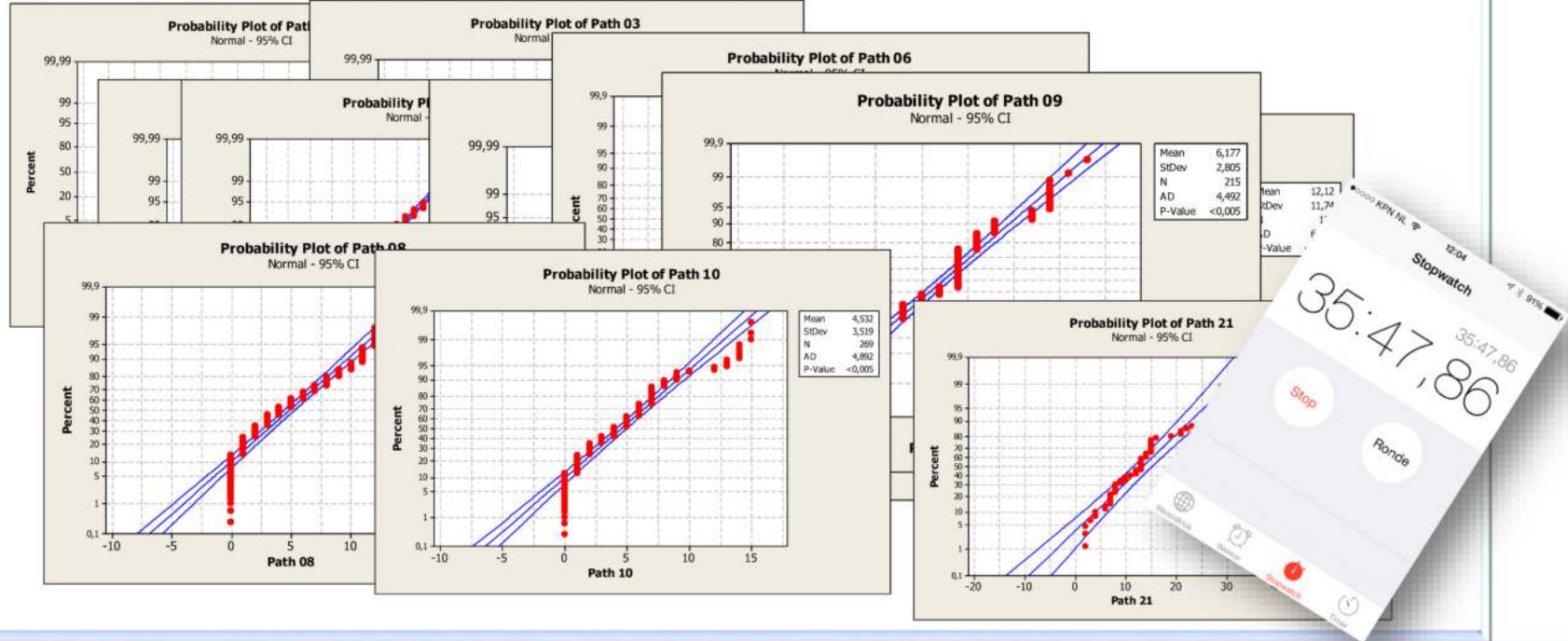


Each dot in this area is a transition, selected for further research



After 35 minutes I was able to present my team 11 probability plots and to ask them: “*Well.... what do you think we have to do to reduce lead time?*”

Probability plots



Challenge: How to leverage all the process knowledge of line management and operators when staring at these abstract Minitab plots?

Probability plots

Maintenance manager: hired for his capability to manage the maintenance crew and develop maintenance concepts in high tech environment

Purchasing manager: hired for his capability to reduce supply risk and source against good terms and conditions

Inspection manager: hired for his capability to deliver requested quantities and qualities within time and budget

Supply Chain manager: hired for his capability to balance demand and supply and roll out supply chain management towards our customers

Production manager: hired for his capability to deliver requested quantities and qualities within time and budget

Part 2 of an experiment where we compare lead time improvement based on Minitab analysis versus process mining

Experiment

1 Solely based on Minitab Analysis



2 Include Process Mining as Analysis tool

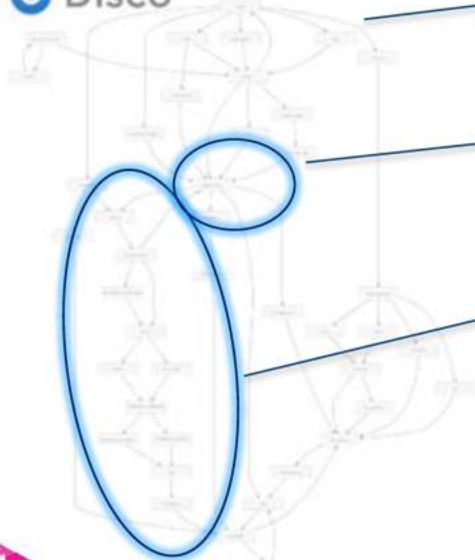


+ Process Mining

Within minutes, we now get a dynamic overview of our process capabilities

Process Mining

Disco



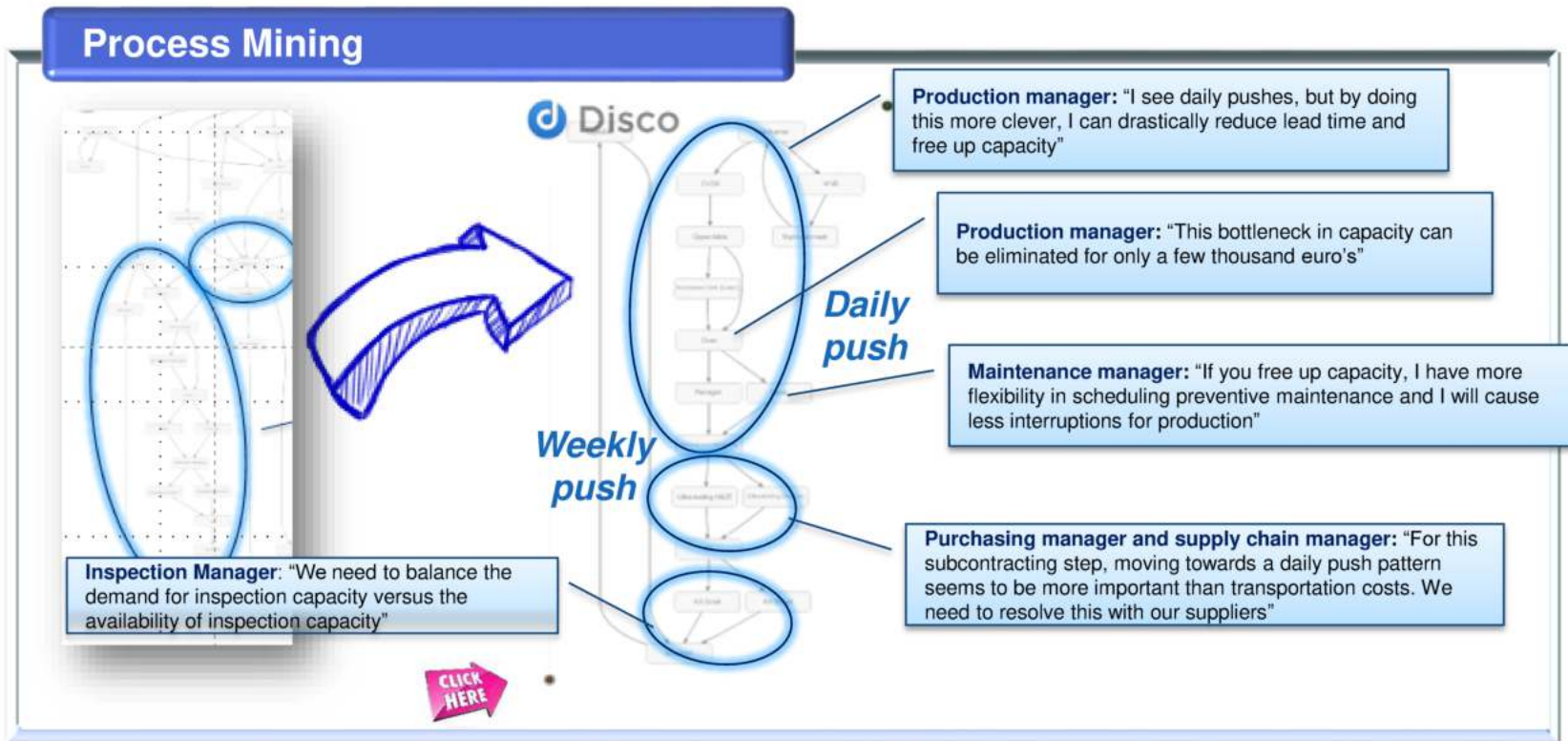
CLICK
HERE

Process conformity is not an issue at Veco, but lead time reduction is an issue for Veco

High traffic process step: Always ensure sufficient capacity and uptime for this step

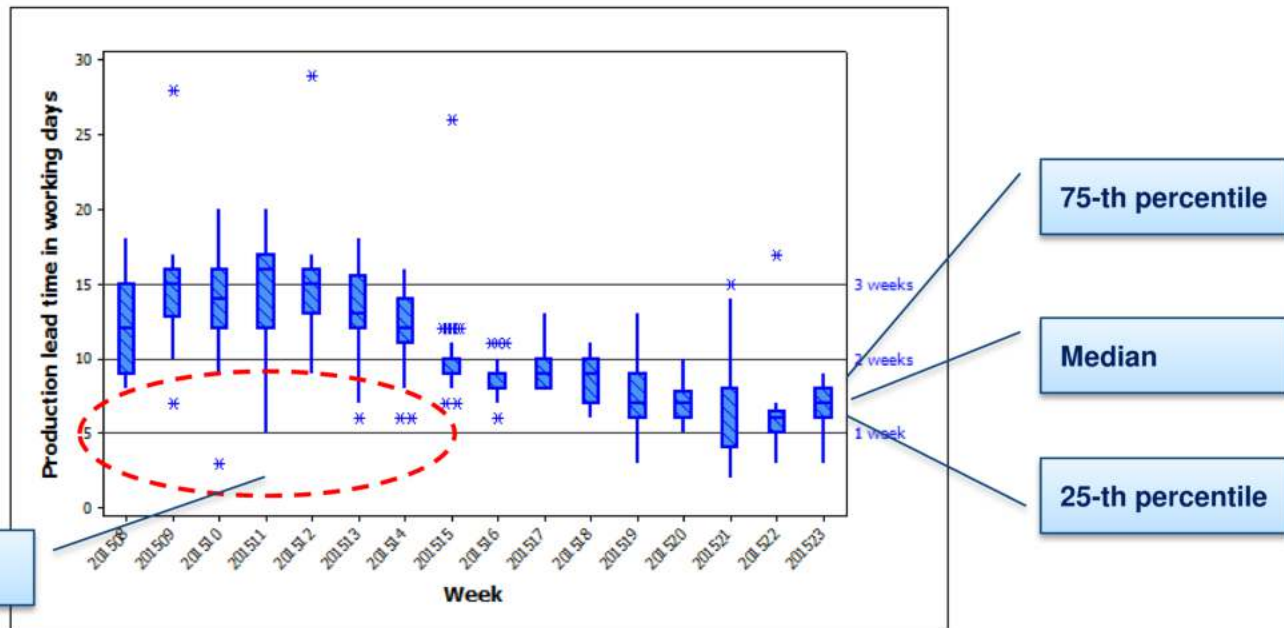
Product Line 1: High costs, relatively long lead times and least stable process. So selected for further research via "Filtering"

After filtering, Process Mining has helped us to do a very powerful exploratory data analysis which leveraged the process knowledge of all departments involved



The improvements in the process have led to a production lead time which now has a substantially lower variation and lower median

Results



How Process Mining has been an enabler for efficiency and impact of our improvement projects via Six Sigma methodology

Six Sigma methodology

Implementing practical solution

Using "Disco" for checking impact

Developing a statistical solution

Changing to a statistical problem

Control

Define

Improve

Measure

Analyse

Formulating the practical problem

Validation of eventlog data very important

Measuring and validating the current performance

More focussed analyses based on "Disco" findings

"Disco" is exploratory tool in Analyse phase

After process mining

Agenda

- 1 Company introduction
- 2 Business Process Improvement at Veco
- 3 How process mining leverages human process knowledge
- 4 Conclusions

Results

Results

- Process Mining is very powerful tool in the exploratory data analysis phase of our improvement processes as it **unlocks the process knowledge of our people that is not easily unlocked via abstract analyses** like e.g. Minitab
- Process Mining is such an efficient tool that it helps us to **treat “improving” as a daily business process** rather than as a project
- Process Mining has helped us with “the last mile” when it comes to lead time improvements. Reduction from 11 to 4 weeks has been done in traditional way; **further reduction towards 1 week based on process mining**
- Process Mining helps us to **stay pro-active towards our key customers** in a very efficient way and is a facilitator for growing our business
- **Process mining is a very powerful tool for internal communication**, both in own department and towards other departments
- **Beware: Process Mining does not replace the traditional way of analyses**, however it helps us to focus the traditional analyses

Thank you for your time!



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Manager Operations



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