How to Transform Your Workforce to Meet the Challenges of Industry 4.0

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Abstract

- Manufacturers are going through intense change to help them deal with a data deluge: more data on more things, more frequently and from more sources. This is expected to continue with the advent of Industry 4.0 and the Industrial Internet of Things (IIoT). Clearly, data analytics is key to the success of these digitalisation initiatives. We will discuss why you should invest in workforce transformation to empower your engineers and democratise analytics, rather than spending on black box or centralised analytics solutions. We will talk about the skills and tools that your people need to thrive in the 4th industrial revolution.

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Digital Change is Hard for Industrial Companies

We "embedded" digital talent in the businesses. But we should have accelerated training.

Jeff Immelt, former Chairman and CEO, GE

https://www.linkedin.com/pulse/digital-change-hard-industrial-companies-jeff-immelt/

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In an article with this name, Jeff Immelt, former CEO of GE outlines some of the mistakes they made in their digital transformation.
"I wrestled, for a long time, on how to build capability in a legacy company"
A key mistake was not building capability from the existing workforce – "we didn't create enough digital migrants"
I am going to show you how to transform your workforce for Industry 4.0

Industry 4.0

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Thought-leaders now recognise that we are entering a new era known as Industry 4.0. Companies that embrace this industrial digital revolution will enable a paradigm shift in terms of speed, efficiency and effectiveness

Faster time-to-market to capture more value
Reduced production cost through improved operational efficiency despite increased design and technology complexity
More effective response to market demands with better understanding of customer requirements and agile production models

4

Accelerating the Pace of Science and Engineering

These improvements are made possible by advances in areas such as:

Automation, robotics and additive manufacturing
Low-cost, connected sensors
Increasing processing speed and power through GPUs
Vast, cheap data storage through the Cloud

Data Deluge

Diversity
Volume
Frequency
Complexity

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All of this means that companies now face a "data deluge": vast amounts of data at lower cost. This data is:

More diverse (of sources and types of data)
More volume (from sensors)
More frequent (due into increased sampling)
More complex (problems)

Data is the new oil?
Let's Separate Hype from Reality

1. What is the business question?

2. How could data analytics help?

3. What data is needed?

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Is data the new oil?
There is a huge amount of hype
A lot of the hype comes from other sectors like retail and media
In any case you need to ask:
  What is the business question?
  How could analytics help?
  What data is needed?
It is a big mistake to instead start by asking what you can do with your data.

Data is the new oil?

We're competing with sleep.

Reed Hastings, Chief executive, Netflix

1. What is the business question?

2. How could data analytics help?

3. What data is needed?

Netflix is a good example of a company that has embraced and won through digital transformation.

What is the business question? – how can we make best recommendations to keep people on our service?
How could analytics help? – understand what a given customer would like based on what similar customers like?
What data is needed? – what have their 100s of millions of customers watched?

This is not complicated.
They have challenges with the amount of data.
And security (I don't want anyone finding out how much my kids watch!)
But this is actually a simple question and they have a wealth of rich data to provide an answer with analytics.

Maybe there are some business questions like this in the process industries?
But not every business question in process industries is like this.

Here is a recommendation from me…

You will see case studies of how companies in the process industries are using data analytics to reduce cost and speed time-to-market.

(This will also be livestreamed)

AI Does Not Replace Science

A/B Testing and Beyond: Improving the Netflix Streaming Experience with Experimentation and Data Science

Netflix Technology Blog [Follow]
Jun 13, 2017 · 13 min read

by *Nirmal Govind*

Golden Globes for *The Crown*. An Oscar win for *The White Helmets*. It's an exciting time to be a Netflix member, with the power to stream such incredible content on a Smart TV or a mobile phone, from the comfort of one's home or

https://medium.com/netflix-techblog/a-b-testing-and-beyond-improving-the-netflix-streaming-experience-with-experimentation-and-data-5b0ae9295bdf

There is a BIG misconception that AI / Machine Learning / Big Data offer some kind of magic that replaces the need for the scientific method
All you need to do is aggregate all this data you already have into a data lake and apply machine learning -> business value
Wrong!
To answer many business questions it is not enough just to passively collect data
You need to introduce variation through experiments
And it is an iterative process: hypothesis –> experiment -> collect data –> test hypothesis –> new hypothesis -> ….

Netflix recognises this :
"…experimentation may be thought of as being superior to most ML approaches that are based on observational data. We do spend a significant amount of effort in researching and building ML models and algorithms.
Carefully exploiting patterns in observed data is powerful for making predictions and also in reaffirming hypotheses, but it's even more powerful to run experiments to get at causation."

Need for Experimentation

Road Photo by Craig Adderley from Pexels

Netflix explains how they experiment to improve Quality of Experience
They show different variations of artwork to random sets of customers and track the effect on audience

These experiments are more or less cost-neutral
For example, some experimental artwork will increase audience, some will have a negative effect
The effect on audience during the experiment is neutral overall and they have learned how to improve their service

Like this they can learn what makes the average customers more likely to view a programme or film
They can extend this to learn what makes different customer segments more likely to view a programme or film

This can lead to some problems

This probably happened because their analytics found that a certain segment of customers was more likely to click on titles with artwork featuring non-white actors

Therefore they conclude they should only ever show them artwork with non-white actors, even if they are just bit parts!

I would suggest this is a case of extrapolating beyond the range of experience

Data is the new oil?

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Let's Separate Hype from Reality regarding data analytics in the process industries
Your scientists and engineers are by far the best placed to ask the right questions because they understand the domain
They understand what is really going on in the lab, in the factory and on the plant.
Our experience is that companies find solutions faster and get more value when they combine data analytics with domain knowledge.
What is missing is the data analytics skills to understand how data analytics can help and what data is needed

The $100M data table

	Monomer/CAT	% CAT (Rou...	Additive A	Additive B	% Bulk Monomer	Water	MW modifier	Agitation	Temp	Pressure	Yield @ Time t
1	-1	100	2	0	0	1	0	1	1	1	1.38
2	1	100	2	0	100	-1	-1	0	-1	1	6.44
3	-1	0	0	2	100	1	-1	1	-1	0	5.96
4	0	100	2	2	100	1	1	-1	-1	-1	4.34
5	-1	100	0	1	0	-1	-1	-1	-1	-1	10.46
6	-1	0	2	0	50	1	-1	-1	-1	-1	6.95
7	1	0	2	0	0	-1	1	1	0	-1	8.58
8	0	0	0	0	0	-1	-1	1	1	1	2.69
9	-1	0	1	0	100	-1	1	-1	1	1	4.3
10	1	100	1	2	0	1	-1	1	-1	-1	0.77
11	-1	0	0	2	0	1	1	0	1	-1	2.87
12	1	0	2	1	100	1	1	1	1	1	1.01
13	-1	50	2	2	0	-1	1	1	-1	1	9.47
14	0	50	1	1	50	0	0	0	0	0	7.49
15	1	100	2	0	0	-1	1	-1	1	0	0.98
16	1	50	0	0	100	1	-1	-1	1	-1	0.86
17	-1	100	2	2	100	-1	-1	1	1	-1	1.25
18	1	0	0	0	0	1	1	-1	-1	1	1.03
19	1	0	2	2	0	0	-1	-1	1	1	1.07
20	0	50	1	1	50	0	0	0	0	0	7.33
21	1	0	0	2	100	-1	0	-1	-1	-1	2.61
22	-1	100	0	0	100	0	1	1	-1	-1	11.39
23	-1	100	0	2	100	1	-1	-1	0	1	12.96
24	1	100	0	2	50	-1	1	1	1	1	1.18

858 bytes

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Big Data analytics is not always the answer
This very small dataset was worth $100M because it enabled a spin-out to commercialise their catalyst technology ahead of their competitors
You need to build capability of how to use the right tools for the right objective

Netflix recognises the value of experimentation and the scientific method
To answer questions in process industries you need to experiment – you cant just expect magic from Machine Learning
Experimenting in process industries is expensive
It is very important to experiment as efficiently and effectively as possible

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Just to reiterate:
A key mistake was not building capability from the existing workforce – "we didn't create enough digital migrants"

Your scientists and engineers intimately understand the business and technical challenges
So they are uniquely placed to understand where data analytics can add value

So what data analytics skills do your scientists and engineers need for Industry4.0?

Does Your Workforce Need to Become Data Scientists?

- Statistics
- Machine Learning
- Data management
- Programming
- Visualisation
- Soft skills
- ...and Science and Engineering!
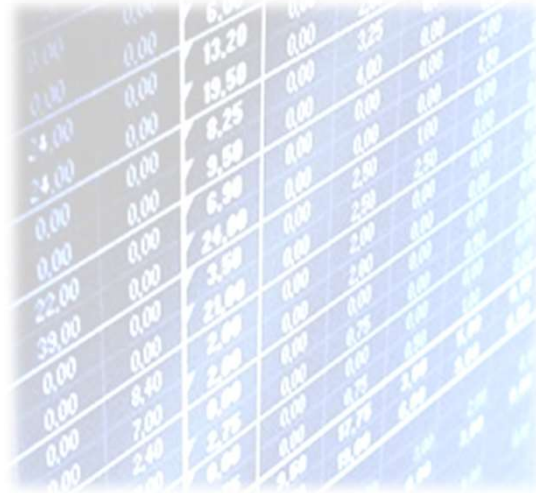
Is it realistic for all of your workforce to be experts in all of these areas?
Is it even realistic for one person to have all of these expertise?
Is that even desirable?
Could you afford to keep them!?

The Solution

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Solution

- Empower scientists to get maximum value from their data

- Power, Speed, Ease-of-Use, Confidence
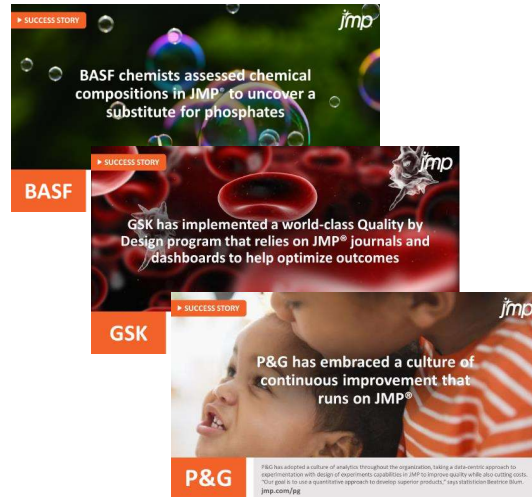
- Actionable Insights

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Empower scientists that are not statisticians, database experts or programmers to get maximum value from their data
With tools that are powerful, fast, easy-to-use and robust
Yielding actionable insights to increase reduce costs and increase business value

Data Analytics Toolset for Industry 4.0

- Statistical Thinking and Problem Solving

- Exploratory Data Analysis

- Quality Methods

- Decision Making With Data

- Correlation and Regression

- Design of Experiments

- Predictive Modelling and Text Mining

BASF chemists assessed chemical compositions in JMP® to uncover a substitute for phosphates

BASF

GSK has implemented a world-class Quality by Design program that relies on JMP® journals and dashboards to help optimize outcomes

GSK

P&G has embraced a culture of continuous improvement that runs on JMP®

P&G

What data analytics tools do scientists and engineers need for Industry 4.0?
Over the last 30 years we have worked with the leading process industry companies.
And we surveyed scientists, engineers, educators and leaders in the process industries and they told us these are the core data analytics skills that their engineers and scientists need.

We recognise that there is a huge gap because schools and universities are often not providing this education to students.

Companies don't give as much time or budget to skills development as they used to.

That is why we have developed a free online course to give scientists and engineers in the process industries a grounding in the tools and skills that they need to reduce cost and create value through data analytics

The aim is to put the tools in the hands of Scientists and Engineers.