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How Company-Specific Production Systems Affect Plant Performance: The S-Curve Theory

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Company-specific Production Systems are essentially Corporate Lean Programs aiming to improve the operational performance of all plants in the company's global network



Does implementing an XPS improve plant performance?

1. The empirical literature says it does

- TQM (e.g. Sila, 2007, JOM; Kaynak, 2003, JOM ; Black & Porter, 1996, DS)
- Lean / JIT (e.g. Shah & Ward, 2003, JOM; Fullerton and Mcwatters, 2001, JOM)
- Six sigma (e.g. Swink & Jacobs, 2012, JOM; Shafer & Möller, 2012, JOM)
- TPM (e.g. McKone, Schröder & Cua., 2001, JOM)

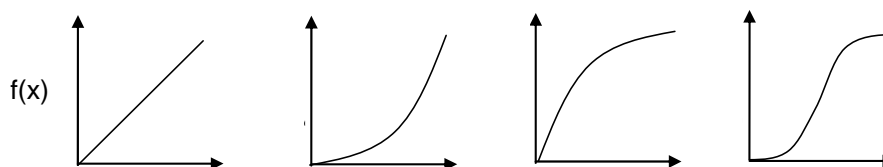
2. Practice says it does

- Companies continue developing XPSs
- Company presentations reporting millions of dollars saved
- Popular literature (The Economist; the Lean Management Journal; etc.)

3. Our own research says it does

- Research in Volvo AB and Jotun AS (Netland & Aspelund, 2013, IJOPM; Netland & Sanchez, 2013, The TQM Journal)
- Our second paper at POMS: "Incentives for implementing corporate lean programs" (Netland, Schloetzter & Ferdows, 2014)

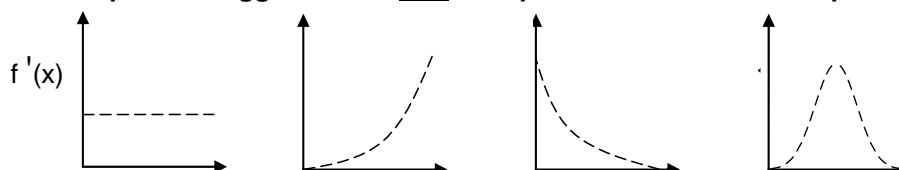
Exactly *how* does the implementation of an XPS affect plant performance?



The relationship between XPS implementation and plant performance



The pattern suggests what rate of improvement we should expect



Why should we care about the pattern?

Misplaced expectations of how quickly these programs can improve performance can make their implementation difficult and reduce their benefits.

From: "How to Implement a Corporate lean Program"
MIT Sloan Management Review, forthcoming Summer 2014

What do existing theories predict?

Four theories predict the total effect of **depth** and **spread**

- | | |
|---------------------------------------|--|
| 1. The learning curve | Effect of depth of XPS implementation |
| 2. The theory of performance frontier | |
| 3. Organizational inertia | Pattern of spread of XPS implementation in a plant |
| 4. Epidemiology theory | |

We hypothesize that the combined effect of these theories is likely to result in an S-shaped performance curve

Our Research Method

In-depth case study research

(Barratt, M., Choi, T.Y., Li, M., 2011, JOM; Yin, 1994; Eisenhardt, 1989, AMR)

VOLVO

The Volvo Group



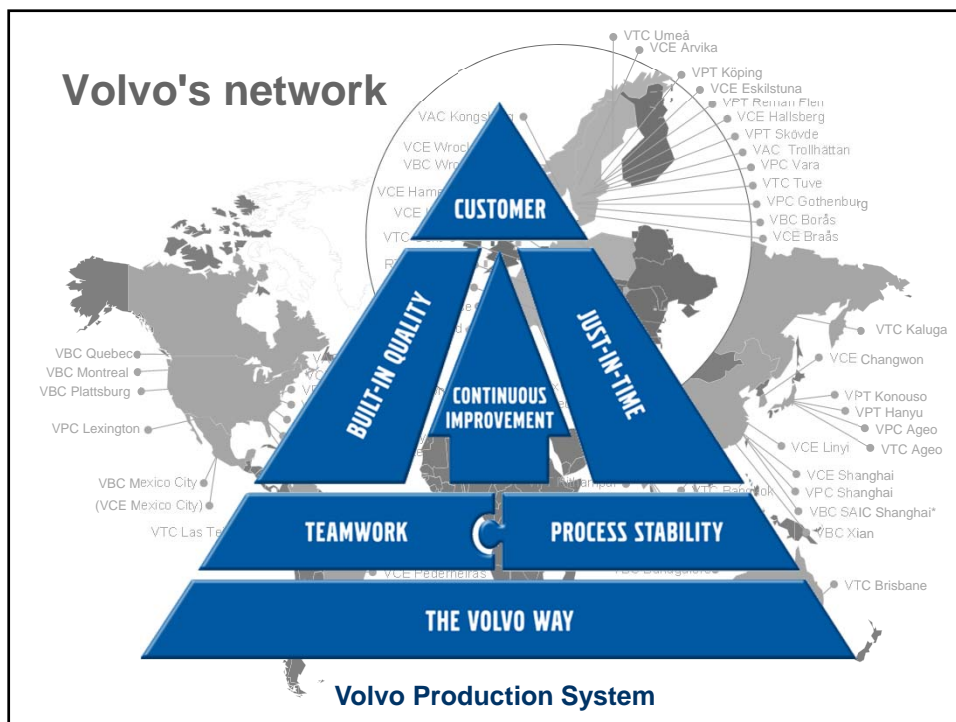
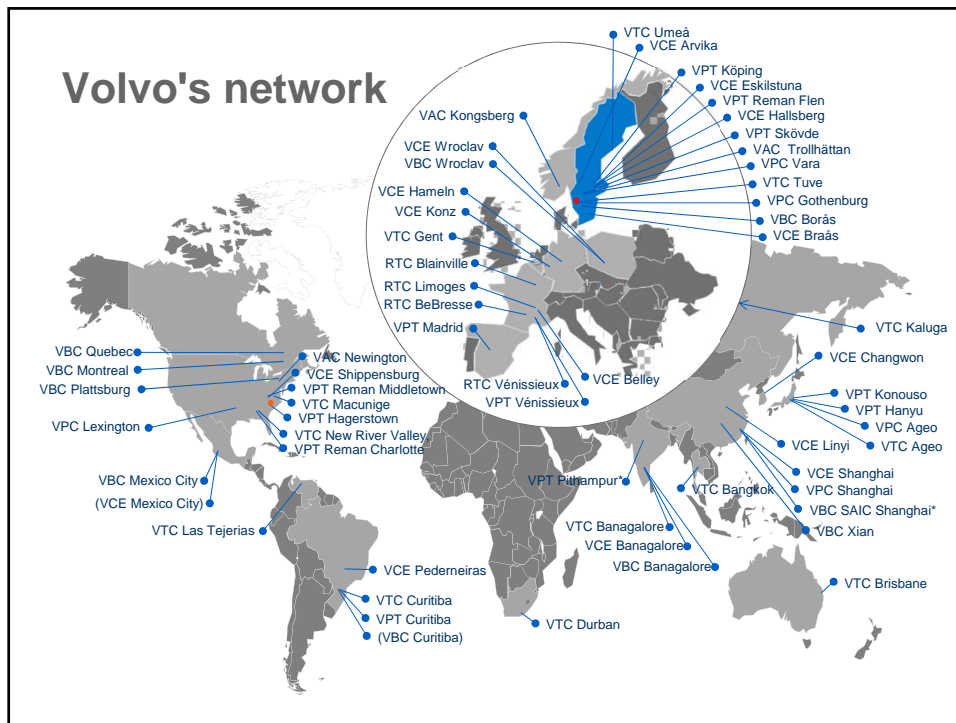
- Still Swedish... but global!
- HQ Gothenburg, Sweden
- Founded 1927
- About 115.000 employees
- Sales in 180+ markets

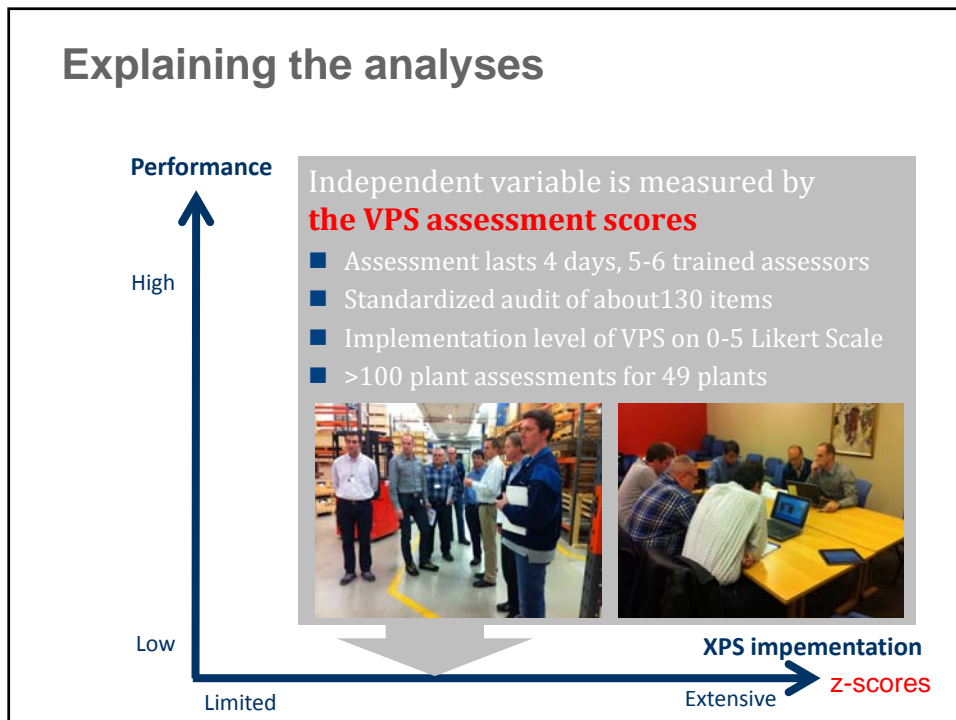


Truck brands:



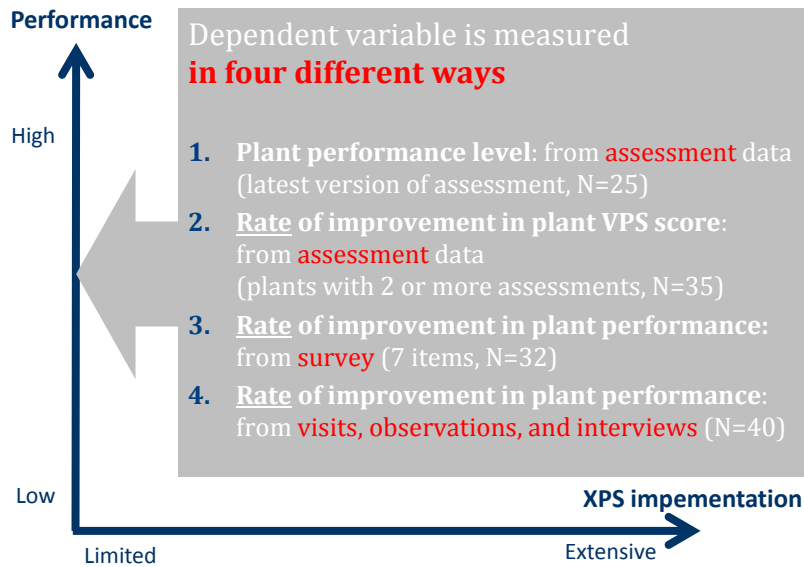
Largest truck manufacturer in the world





Explaining the analyses

Safety | Quality | Delivery | Cost



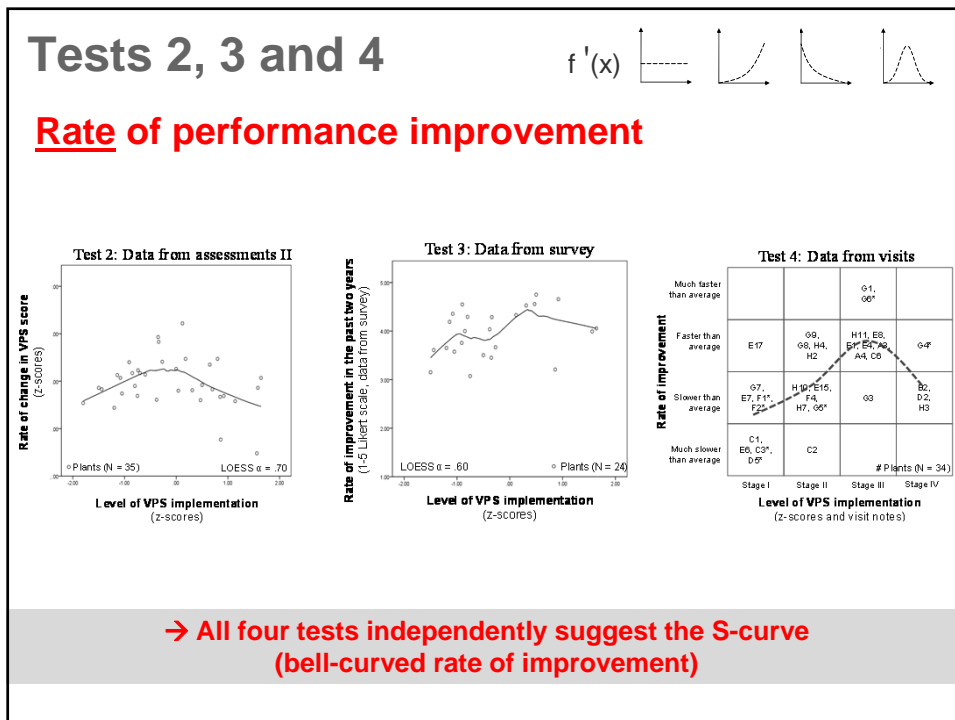
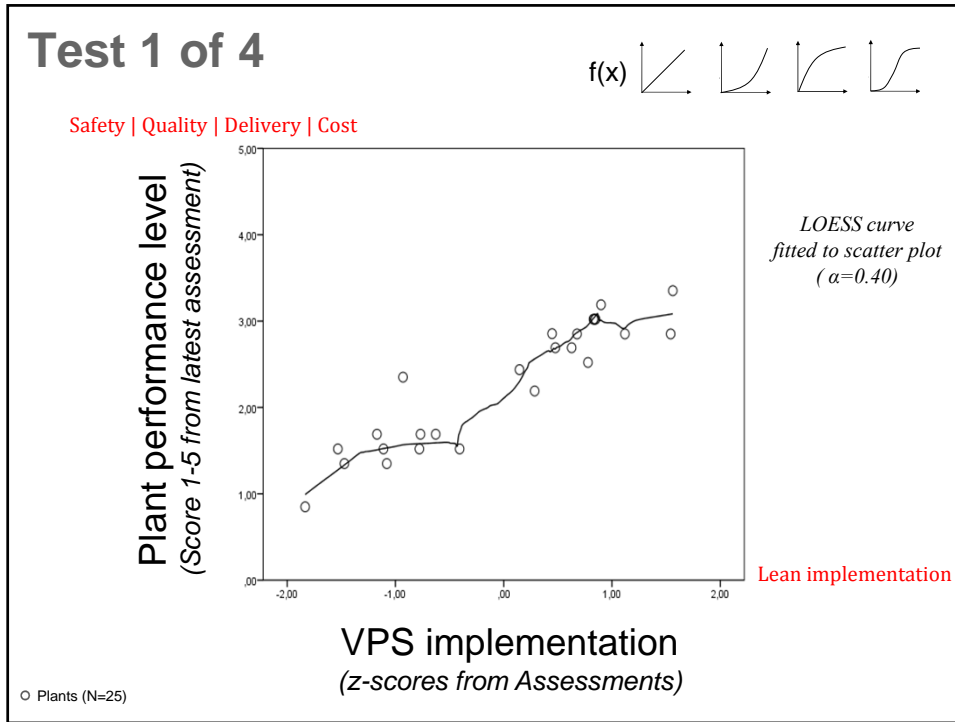
Statistical technique used for pattern recognition

Locally weighted regression (LOESS)

- **LOESS** is a technique for fitting the best curve depicting the shape of the relationship between two variables (Cleveland and Devlin, 1988).
 - A major advantage is that it does not need a priori specification of a fit function: It discovers the form from the data itself.

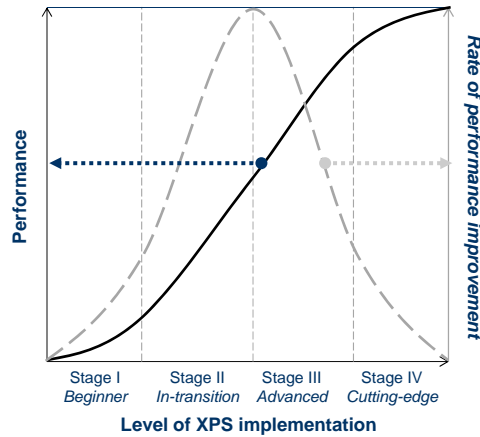
Using a kernel function as a smoothing algorithm, LOESS computes a center for each neighborhood of data points (decided by the smoothing parameter alpha) that minimizes the weighed distances between the center and the points in that neighborhood. It then draws a curve through these local neighborhood centers.

- **Parameters in our analyses**
 - Epanechnikov kernel function has robust properties (Gasser et al., 1985)
 - A reasonable value for alpha is $0.40 < \alpha < 0.80$ (Jacoby, 2000)



Conclusions

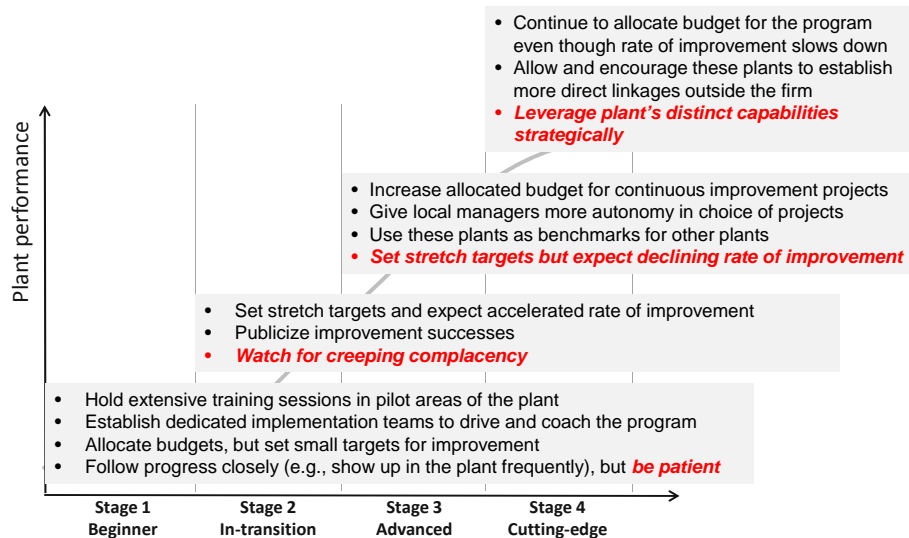
XPS implementation affects performance non-linearly like an S-Curve

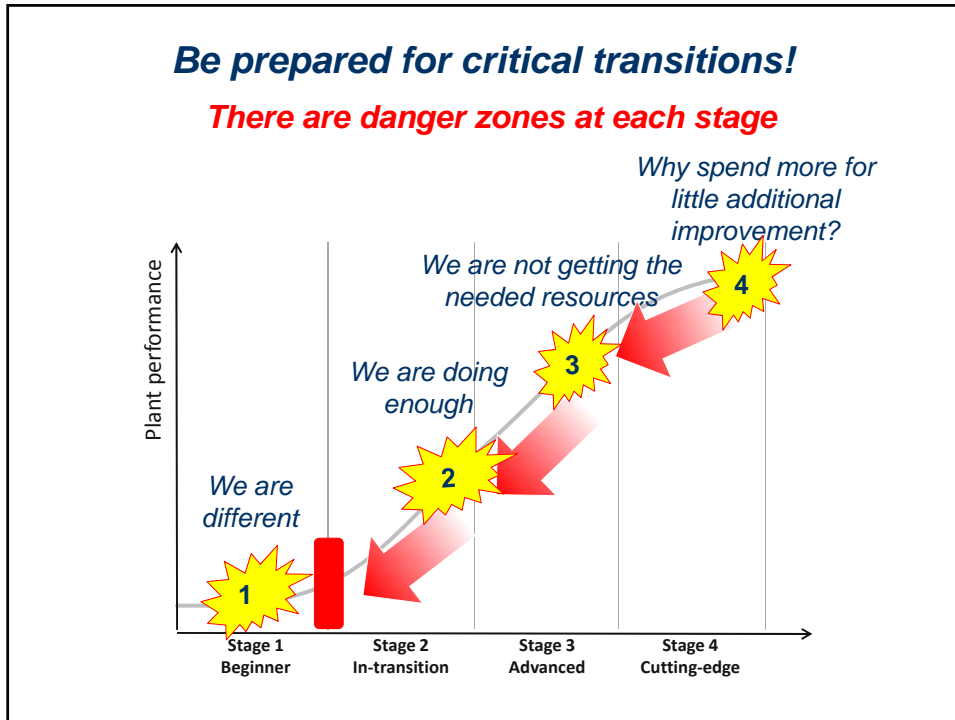


Performance improves slowly in initial stages of XPS implementation, then improves rapidly and eventually improves slowly again

Managerial implications

Plants in each stage should be managed differently *Don't apply the same action plan in all plants in the global network*





Thank you!

Q&A

Torbjørn H. Netland, NTNU
Kasra Ferdows, Georgetown U.
Ebly Sanchez, Volvo

More about this research at:
www.better-operations.com

FULBRIGHT NTNU GEORGETOWN UNIVERSITY McDonough School of Business VOLVO sf1 Center for Sustainable Innovation norman SINTEF