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
   - 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**

<table>
<thead>
<tr>
<th>Theory</th>
<th>Effect of depth of XPS implementation</th>
<th>Pattern of spread of XPS implementation in a plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The learning curve</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The theory of performance frontier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Organizational inertia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Epidemiology theory</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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)

The Volvo Group

- Still Swedish... but global!
- HQ Gothenburg, Sweden
- Founded 1927
- About 115,000 employees
- Sales in 180+ markets

Largest truck manufacturer in the world
**Explaining the analyses**

Independent variable is measured by the VPS assessment scores

- Assessment lasts 4 days, 5-6 trained assessors
- Standardized audit of about 130 items
- Implementation level of VPS on 0-5 Likert Scale
- >100 plant assessments for 49 plants
Explaining the analyses

Dependent variable is measured in four different ways

1. Plant performance level: from assessment data (latest version of assessment, N=25)
2. Rate of improvement in plant VPS score: from assessment data (plants with 2 or more assessments, N=35)
3. Rate of improvement in plant performance: from survey (7 items, N=32)
4. Rate of improvement in plant performance: from visits, observations, and interviews (N=40)

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 weighted 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)

Test 1 of 4

Safety | Quality | Delivery | Cost

Plant performance level
(Score 1-5 from latest assessment)

VPS implementation
(z-scores from Assessments)

LOESS curve fitted to scatter plot
(\( \alpha = 0.40 \))

Tests 2, 3 and 4

Rate of performance improvement

\( \rightarrow \) All four tests independently suggest the S-curve (bell-curved rate of improvement)
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*

- Hold extensive training sessions in pilot areas of the plant
- Establish dedicated implementation teams to drive and coach the program
- Allocate budgets, but set small targets for improvement
- Follow progress closely (e.g., show up in the plant frequently), but be patient

- Increase allocated budget for continuous improvement projects
- Give local managers more autonomy in choice of projects
- Use these plants as benchmarks for other plants
- **Set stretch targets but expect declining rate of improvement**
- **Increase allocated budget for continuous improvement projects**
- **Publicize improvement successes**
- **Watch for creeping complacency**

Be prepared for critical transitions!

There are danger zones at each stage

- Stage 1: Beginner
  - We are different

- Stage 2: In-transition
  - We are doing enough

- Stage 3: Advanced
  - Why spend more for little additional improvement?
  - We are not getting the needed resources

- Stage 4: Cutting-edge

Thank you!

Q&A

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

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