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Discussion of "Quality and statistical thinking in a parliament and beyond"

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Introduction

First of all, we would like to thank Pedro Saraiva for his excellent talk at the Fifth Stu Hunter Research Conference in Copenhagen, Denmark. The topic is highly relevant in practice, and the proposed solutions yield great opportunities. In this article, we provide some remarks and suggestions related to the proposal. We respond to his Stu Hunter Research Conference paper (Saraiva 2018) where the positive effects of statistical thinking (Snee and Hoerl 2003) on political processes in Portugal are demonstrated. In response to the findings and conclusions of Saraiva about the added value of statistical thinking and the application of quality management tools, we share our experience on implementing operational excellence projects in the public (administration) sector.

Since 1996 the Institute for Business and Industrial Statistics (IBIS UvA), an independent consulting bureau within the University of Amsterdam, has been involved in the implementation of many operational excellence projects in organizations in the public sector. This ranges from organizations where unemployment benefits are processed, to agencies responsible for managing the temporarily unfit for work, to local municipality administrations. In all of these organizations we have observed a potential for efficiency and effectiveness improvement and we believe that there is a growing need for organizations in the public sector to further improve their operations. This is corroborated by the international trend of introducing performance measurement and private sector management techniques to increase operational performance (Speklé and Verbeeten 2014) in the public sector.

Exemplary for this growing need are recent processing problems with personal care budgets by local municipalities in the Netherlands (NRC 2015) or the increased disturbances in tax handling processes in the Netherlands (Tax Authority Commission 2017). In our discussion of operational excellence in the public sector, we focus on the Lean Six Sigma (LSS) method (Shah et al. 2008). In the following sections, we briefly introduce the LSS method and discuss the suitability of LSS for the public sector. Then we introduce our experience on implementing LSS projects in organizations in the public sector, and finally we discuss three exemplary LSS projects in this sector. Our contribution is based upon a research on LSS project implementations we have performed by Lameijer et al. (2016a).

Are Lean Six Sigma project implementations suitable for public sector organizations?

To determine the suitability of LSS in the public sector, we first introduce the LSS method and explore similarities and differences in public sector- and other sector organizations where LSS projects are successfully implemented.

The LSS method and its predecessors, which include amongst others Total Quality Management, Business Process Reengineering, Lean Manufacturing, Business Process Management, Six Sigma, and Theory of Constraints, originated early 1900, when Taylor (1914) introduced the concept of measurement and observation with the objective to continuously improve operations. It developed into later embodiments such as Lean (see Shah and Ward 2007 for an elaborate

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Table 1. LSS projects under University of Amsterdam supervision sorted by Standard Industrial Classification code (SIC).

Industry (SIC)	Number of projects	Total benefits (EUR)	Time range of projects
Agriculture, Forestry, Fishing	2	€ 670.000	2007 – 2007
Construction	36	€ 10.778.888	2003 – 2015
Finance, Insurance, Real Estate	63	€ 10.219.144	2006 – 2015
Manufacturing	105	€ 36.267.774	2005 – 2015
Public Administration	**22**	**€ 6.003.891**	**2008 – 2015**
Retail Trade	3	€ 524.000	2014 – 2014
Services (including Healthcare)	52	€ 4.020.377	2006 – 2015
Transportation & Public Utilities	29	€ 6.911.770	2009 – 2014
Total	**312**	**€ 75.395.844**	**2003 – 2015**

history of Lean) and Six Sigma (see Shah et al. 2008 for a detailed description of the history of Six Sigma).

In the recent literature, Lean is usually understood as a coherent system of practices focused on the elimination of waste by concurrently reducing supplier, customer, and internal variability (Shah and Ward 2007). The practices of Lean generally pertain to just-in-time production, quality management, preventive maintenance, and human resources management (Shah and Ward 2003).

The complementary Six Sigma method is strongly focused on defects and variability reduction in business processes and we use the definition of Linderman et al. (2003): "Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates". The systematic method is the project by project structure, as advocated by Juran (1986). These projects are managed according to the five phased define, measure, analyze, improve, and control (DMAIC) cycle (De Mast and Lokkerbol 2012) and use metrics to reduce variation such as defects per million defect opportunities (DPMO), critical-to-quality (CTQ), and process sigma measurements (Schroeder et al. 2008).

In recent years, the Lean and Six Sigma methodologies are applied and studied as one (Shah et al. 2008) and although the LSS method has its origins in manufacturing, it is increasingly used in service organizations (Antony et al. 2007). Studies on LSS project implementations in service organizations stem from several sectors, such as finance (Delgado et al. 2010; Lameijer et al. 2016b), and healthcare (Does et al. 2006; Niemeijer et al. 2011).

In Lameijer et al. (2016a), we studied 312 LSS projects that have been implemented in organizations under the supervision of IBIS UvA in the period 2003–2015. The results show that although manufacturing is an important sector for LSS project implementations, sectors such as finance and insurance, healthcare services, construction and indeed public administration and public utilities are well represented (Table 1).

Although scarce, as confirmed by Antony et al. (2016), LSS project implementations are happening in public sector organizations and we are interested in how suitable LSS project implementations are for public sector organizations? Public sector organizations exist in great variety such as legislative governments, justice departments, and public finance and tax authorities. Despite the broad range of organizations that classify as public administration under the Standard Industry Classification (SIC) system (US Department of Labor 2017), all these organizations share the same objective: to serve society at best on a non-profit basis. To do so, public sector organizations share organizing principles with commercial organizations, such as long-term strategy planning, professional management, and the need for efficient operations. From a technical organizational perspective, we believe that public sector organizations are just as eligible for LSS project implementations as for-profit commercial organizations; these organizations are all characterized by processes, executed to deliver value to customers and these processes can, in general, be optimized by LSS methods.

For another perspective on determining if LSS is suitable for public sector organizations, we look at critical success factors for LSS project implementations. In a study by Coronado and Antony (2002) and Brun (2011), nine essential organizational ingredients for LSS project success are identified. Out of these nine we believe there are three relevant factors for public sector organizations, which are (1) a customer focus in LSS project objectives, (2) clear links of LSS projects to business strategy, and (3) management commitment and support for LSS projects. For these three factors, an underlying characteristic is indisputably different between commercial and public sector organizations when it comes to the implementation of change by LSS projects. That is sense of urgency; a prerequisite for any change according to popular change literature (Kotter 1995). We believe that sense of urgency drives the need for focus on customer requirements, a corresponding ambitious business strategy, and subsequent management commitment to convincingly deploy a method such as LSS. We acknowledge that sense of urgency can also be driven by non-commercial incidental motives such as public scrutiny, although believe lower sense of urgency is an inherent non-profit characteristic. This is corroborated by the finding that public sector efficiency indicators have historically been scarce (Afonso et al. 2005). Hence, we believe LSS project implementation is technically suitable for public sector organizations, when attention is paid to the momentum and governance of LSS project implementations.

When is it feasible to implement Lean Six Sigma projects?

In this section, we constructively respond to the findings of Saraiva (2018) about the added value of statistical thinking in the public sector by presenting our view on LSS project implementations in public sector organizations. Before we move into discussion on how LSS projects can be implemented in the public sector, we need to define the differentiators for LSS project implementation and the application of statistical thinking as demonstrated in the contribution of Saraiva (2018). We therefore turn to Hoerl and Snee (2013) who distinguish two important differentiators for LSS project implementation, namely whether the *solution* for the inefficiency or problem is known or not and whether the *complexity* of the problem at hand is high or low (see Figure 1).

Saraiva (2018) described how the application of statistical quality tools in political processes can lead to a better understanding of the problem at hand, prior to moving into the definition and approval of solutions. Examples of such applications are for instance the measurement of "left" or "right" oriented parliaments and the effects on the public debt deficit. This is categorized as "Six Sigma problem solving: Finding a statistical explanation for certain phenomena." The examples described by Saraiva (2018) also showed how with Lean tools complex issues can be tackled, such as the application of the Ishikawa diagram to find root causes for societal problems. Based on the descriptions in Saraiva (2018) we believe that most of these examples fit into the quadrant "Lean events". Both "Six Sigma problem solving" and "Lean events" are technically different from "Lean Six Sigma project" in the bottom right quadrant. LSS projects additionally seek evidence-based solutions that solve a problem with a high degree of certainty and prevent recurring manifestations of the problem, of which we will present three examples.

How can Lean Six Sigma projects contribute to organizational performance?

The rationale for the application of statistical quality tools or implementing LSS projects are similar and the rationale for LSS project implementations we have supervised are categorized by five strategic collectively exhaustive and mutually exclusive performance dimensions. These five dimensions are grouped by the cumulative capability model (Ferdows and De Meyer 1990; Schroeder et al. 2011; Bortolotti et al. 2015) and are as follows.

- **Quality**: Effectiveness and suitability of the services, quality of the service.
- **Dependability and safety**: Failures, mistakes, rework, punctuality.
- **Speed**: Throughput time, waiting time, time of service.

Complexity	Solution: Known	Solution: Unknown
Low	Just do it *(divide tasks and execute)*	Six Sigma problem solving *(find a statistical explanation for certain phenomena)*
High	Lean event *(find an efficient and effective way to implement solution)*	Lean Six Sigma project *(find root causes of the problem and develop and implement evidence based solutions)*

Figure 1. Problem solving method selection matrix.

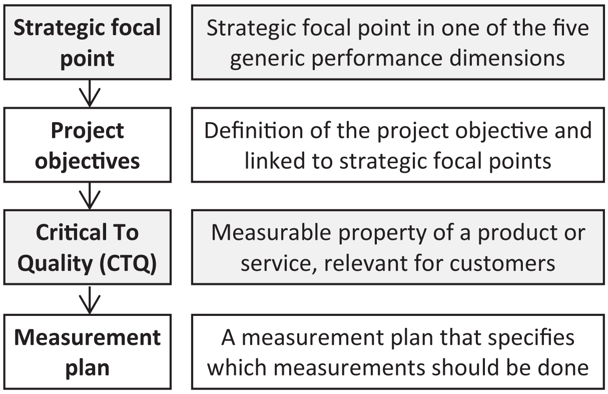

Figure 2. Generic LSS project definition.

- **Flexibility**: Ability to adapt the process to changes in demand.
- **Cost efficiency**: Efficient use of man-hours, facilities, material.

That means, the objectives of LSS projects are linked to strategic focal points in one of these five performance dimensions in which an organization wants to improve or excel and thereby, clear links between LSS project objectives and the organization's strategy are secured.

Subsequently, LSS project objectives are operationalized in measurable critical-to-quality (CTQ) indicators that represent measurable properties of a product or service that are relevant for the customer and need to be improved. These CTQs are then operationalized by measurement plans, which specify the measurements that should be done. These consecutive steps collectively make up the *LSS project definition*; a project initiation documentation with the strategic focal point, the project objectives and the CTQs which are then operationalized in a measurement plan (see Figure 2).

The LSS project definition template above structures our further discussion on exemplary LSS projects that have been implemented in public sector organizations. We provide concrete examples of how LSS projects can contribute to operations improvement and is based on a previously discussed research by Lameijer et al. (2016a), whereby a sample of 312 LSS projects in a variety of industries are analysed. In the public sector, we see that LSS projects generally focus on the performance dimensions cost efficiency, dependability and speed. In the next section we discuss three concrete examples of LSS projects in the public sector that each contributed to one of these three performance dimensions.

Lean Six Sigma project that contributes to cost efficiency of public sector processes

LSS projects that contribute to strategic cost efficiency focal points can have a variety of project objectives. We have analysed that LSS projects that contribute to cost efficiency can be categorized in five different generic LSS project objectives (Lameijer et al. 2016a), being (1) human resource efficiency, (2) overall operating efficiency, (3) inventory optimization, (4) general cost reduction, and (5) margin optimization. Here we will discuss a LSS project with the objective to improve human resource efficiency. This LSS project was executed to optimize an administrative process at a social security authority in the Netherlands with special focus on reducing the processing and idle time in the process (see Figure 3).

The project leader collected a sample of 150 requests and measured the current performance of the CTQs. Statistical analysis of the processing time in a Shewhart control chart signalled too high processing times (on average 3 min). Also, idle times were too high (on average 5 days) in the process. Diagnosis of the process by means of value stream mapping led to a series of root causes, structured by an Ishikawa diagram. After statistical analysis, the significant root causes were (1) non-uniformity in the execution of requests, (2) a low degree of request completeness, and (3) waiting for third-party suppliers. The design of improvement actions resulted in an improved process whereby instead of 4.5 only 2.5 employees were necessary.

Lean Six Sigma project that contributes to dependability of public sector processes

Another example is a LSS project that contributed to the dependability of the unemployment benefits

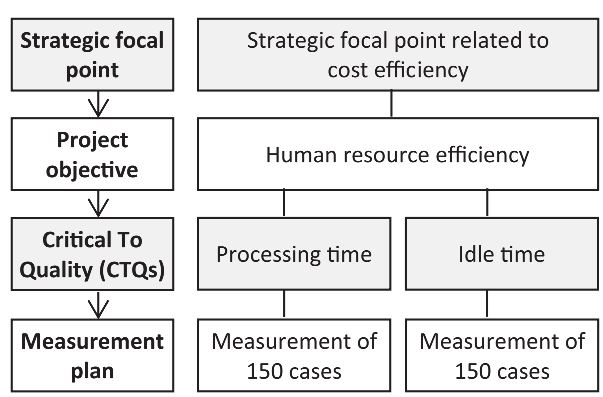

Figure 3. LSS project definition to improve cost efficiency.

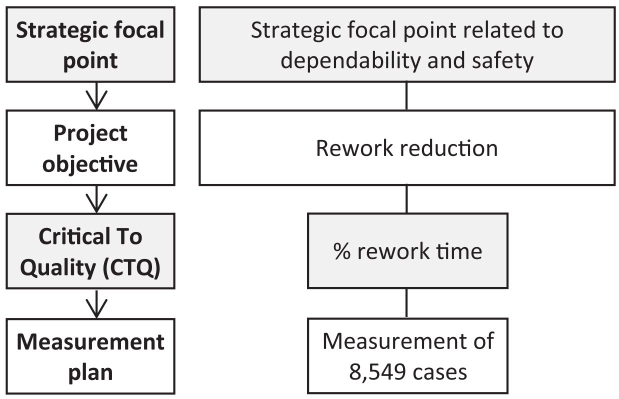

Figure 4. LSS project definition to improve dependability.

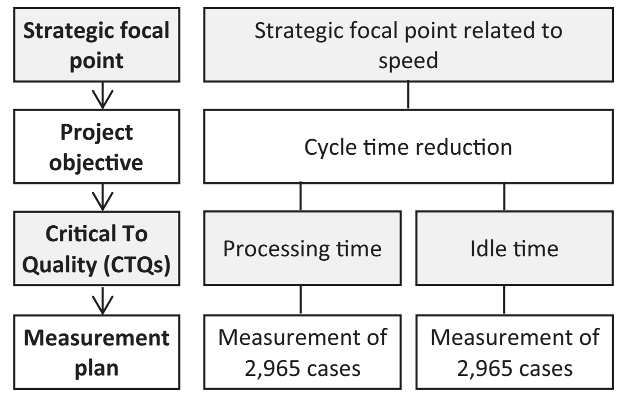

Figure 5. LSS project definition to improve speed.

process at the employee insurance agency in the Netherlands. We have found that LSS projects that contribute to dependability can be categorized in four generic LSS project objectives (Lameijer et al. 2016a), being (1) first time right improvement, (2) rework reduction, (3) operational loss reduction, and (4) process reliability improvement. Here we discuss a LSS project for reducing rework in the process (see Figure 4).

This LSS project was designed to reduce the rework in the unemployment benefits application process that originates from unrightfully granted unemployment benefits. Consequences are, besides rework, time consuming communication efforts, complaints and formal objections. A sample of 8,549 cases was analysed of which 25% needed rework. Subsequent process analysis resulted in a set of root causes that explained 60% of the rework. These were (1) unrightfully applied for benefits, (2) missing client information in the application, and (3) applications that are filed too early to process. The project leader designed improvement actions with the involved department, such as process standardization and improvement of training and instructions for employees in the process. The result is a reduction of rework from 25% to 17% with calculated benefits that exceed half a million euro annually.

Lean Six Sigma project that contributes to speed of public sector processes

The last example we present is a LSS project designed to increase the throughput speed of a social welfare process, which was executed at a local municipality office in the East of the Netherlands. We have found that LSS projects that contribute to speed can be categorized in two generic LSS project objectives (Lameijer et al. 2016a), being (1) cycle time reduction and (2) idle time reduction. This particular project had the objective to reduce the cycle time of the process (see Figure 5).

The project leader analyzed 2,965 cases and determined that only 31% of the applications was actually processed within the desired 14 days, and the process had an average cycle time of 28 days. Subsequent value stream mapping revealed a chaotic current process design, and root cause analysis led to 90 areas for improvement. The most important improvement efforts comprised (1) the design and operationalization of a new customer service desk, (2) the installation of go or no-go judgements earlier in the process, and (3) the deployment of a shorter and simpler application handling process. The result was an improved average process cycle time of 12 days and a reduction in resources needed.

Concluding remarks on implementing operational excellence in the public sector

In conclusion, we can say that although the public sector is not an early adopter of the LSS method, it is possible to implement LSS projects in this sector. We have been involved in improving public sector processes since 2003 and have seen the benefits that implementation of LSS projects can bring. Publications on LSS in the public sector are scarce and start to emerge, such as for instance in Antony et al. (2016), and we encourage LSS academics and practitioners to further apply and study the implementation of LSS projects in public sector organizations.

About the authors

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References

Afonso, A., L. Schuknecht, and V. Tanzi. 2005. Public sector efficiency: An international comparison. *Public Choice* 123 (3–4):321–347. https://doi.org/10.1007/s11127-005-7165-2.

Antony, J., F. Antony, M. Kumar, and B. Cho. 2007. Six Sigma in service organizations. *International Journal of Quality & Reliability Management* 24 (3):294–311. https://doi.org/10.1108/02656710710730889.

Antony, J., B. Rodgers, and E. Gijo. 2016. Can Lean Six Sigma make UK public sector organisations more efficient and effective?. *International Journal of Productivity and Performance Management* 65 (7):995–1002. https://doi.org/10.1108/IJPPM-03-2016-0069.

Bortolotti, T., P. Danese, B. Flynn, and P. Romano. 2015. Leveraging fitness and Lean bundles to build the cumulative performance sand cone models. *International Journal of Production Economics* 162 (2015):227–241. https://doi.org/10.1016/j.ijpe.2014.09.014.

Brun, A. 2011. Critical success factors of Six Sigma implementations in Italian companies. *International Journal of Production Economics* 131 (1):158–164. https://doi.org/10.1016/j.ijpe.2010.05.008.

Coronado, R., and J. Antony. 2002. Critical success factors for the successful implementation of Six Sigma projects in organizations. *The TQM Magazine* 14 (2):92–99. https://doi.org/10.1108/09544780210416702.

De Mast, J., and J. Lokkerbol. 2012. An analysis of the Six Sigma DMAIC method from the perspective of problem solving. *International Journal of Production Economics* 139 (2):604–614. https://doi.org/10.1016/j.ijpe.2012.05.035.

Delgado, C., M. Ferreira, and M. Branco. 2010. The implementation of Lean Six Sigma in financial services organizations. *Journal of Manufacturing Technology Management* 21 (4):512–523. https://doi.org/10.1108/17410381011046616.

Does, R. J. M. M., et al. 2006. Standardizing healthcare projects. *Six Sigma Forum Magazine* 6 (1):14–23.

Ferdows, K., and A. De Meyer. 1990. Lasting improvements in manufacturing performance: In search of a new theory. *Journal of Operations Management* 9 (2):168–184. https://doi.org/10.1016/0272-6963(90)90094-T.

Hoerl, R., and R. Snee. 2013. One size does not fit all: Identifying the right improvement methodology. *Quality Progress, May 2017 Issue* 48–50.

Juran, J. 1986. The quality trilogy: A universal approach to managing for quality. *Quality Progress* 19 (8):19–24.

Kotter, J. 1995. Leading change: Why transformation efforts fail. *Harvard Business Review* 73 (2):59–67.

Lameijer, B. A., R. J. M. M. Does, and J. De Mast. 2016a. Inter-industry generic Lean Six Sigma project definitions. *International Journal of Lean Six Sigma* 7 (4):369–393. https://doi.org/10.1108/IJLSS-11-2015-0044.

Lameijer, B. A., D. Veen, R. J. M. M. Does, and J. De Mast. 2016b. Perceptions of Lean Six Sigma: A multiple case study in the financial services industry. *Quality Management Journal* 23 (2):29–56.

Linderman, K., R. G. Schroeder, S. Zaheer, and A. S. Choo. 2003. Six Sigma: a goal theoretic perspective. *Journal of Operations Management* 21 (2):193–203. https://doi.org/10.1016/S0272-6963(02)00087-6.

Niemeijer, G. C., R. J. M. M. Does, J. De Mast, A. Trip, and J. Van Den Heuvel. 2011. Generic project definitions for improvement of health care delivery: A case based approach. *Quality Management in Health Care* 20 (2):152–164. https://doi.org/10.1097/QMH.0b013e318213e75c.

NRC. 2015. Threat of personal care budget chaos at many counties (in Dutch: En weer dreigt in veel gemeenten de pgb-chaos). [Online] Available at: https://www.nrc.nl/nieuws/2015/11/21/en-weer-dreigt-in-veel-gemeenten-de-pgb-chaos-1558675-a1400018 [Accessed 22 03 2017].

Saraiva, P. 2018. Quality and statistical thinking in a Parliament and beyond. *Quality Engineering* 30 (1), 2–22.

Schroeder, R., K. Linderman, C. Liedtke, and A. Choo. 2008. Six Sigma: Definition and underlying theory. *Journal of Operations Management* 26 (4):536–554. https://doi.org/10.1016/j.jom.2007.06.007.

Schroeder, R., R. Shah, and D. Xiaosong Peng. 2011. The cumulative capability 'sand cone' model revisited: a new perspective for manufacturing strategy. *International Journal of Production Research* 49 (16):4879–4901. https://doi.org/10.1080/00207543.2010.509116.

Shah, R., A. Chandrasekaran, and K. Linderman. 2008. In pursuit of implementation patterns: the context of Lean and Six Sigma. *International Journal of Production Research* 46 (23):6679–6699. https://doi.org/10.1080/00207540802230504.

Shah, R., and P. Ward. 2003. Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management* 21 (2):129–149. https://doi.org/10.1016/S0272-6963(02)00108-0.

Shah, R., and P. Ward. 2007. Defining and developing measures of Lean production. *Journal of Operations Management* 25 (4):785–805. https://doi.org/10.1016/j.jom.2007.01.019.

Snee, R., and R. Hoerl. 2003. *Leading Six Sigma: A step by step guide based on experience with GE and other Six Sigma companies*. New Jersey: FT Press.

Speklé, R., and F. Verbeeten. 2014. The use of performance measurement systems in the public sector: Effects on performance. *Management Accounting Research* 25 (2):131–146. https://doi.org/10.1016/j.mar.2013.07.004.

Tax Authority Commission. 2017. Investigation in the decision making procedures at the Dutch Tax Authority (in Dutch: Onderzoek naar de besluitvormingsprocedures binnen de Belastingdienst), The Hague: Tax Authority Commission (In Dutch: Commissie onderzoek Belastingdienst). Available at: https://www.rijksoverheid.nl.

Taylor, F. 1914. *The principles of scientific management*. New York: Harper & Brothers.

US Department of Labor. 2017. SIC Division Structure. [Online] Available at: https://www.osha.gov/pls/imis/sic_manual.html [Accessed 24 03 2017].