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Lean Six Sigma in knowledge work: A case study from policing and prosecution services

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Abstract – Lean Six Sigma (LSS) continues to greatly interest public sector organizations as a means to continuously improve service performance. However, given the plethora of research and literature on LSS in the public sector, research specifically about LSS in policing and prosecution services, which are dominated by knowledge work, is significantly limited. It is necessary to measure the knowledge work performance, to achieve continuous improvement. This manuscript presents a case study about the use of LSS in the Norwegian police service. It reports on the existing framework of LSS and explicates how to systematically analyse data regarding knowledge work-related waste to identify improvement areas in the criminal justice process. The LSS methodology and framework applied in this study provides a systemic approach that uncovers waste, which gives grounds to holistically analyse and indicate how the current overall process is performing, based on the scope of defects. This study demonstrates the implementation potential of LSS in policing and prosecution services to support managers who are engaged in any form of continuous improvement initiatives. The findings also add evidence to the existing argument on the applicability of LSS in policing services. However, there is a need to further develop and apply the LSS methodology in such a context.

Keywords: Lean Six Sigma, police services, knowledge work

1 Introduction

Lean Six Sigma (LSS) continues to greatly interest and influence management practices in various industries. In more recent times, LSS, which has had and continues to have profound and advanced application in many manufacturing companies, has propagated to public organizations, such as higher education, healthcare, municipalities, and government agencies, in their continuous improvement programmes [1, 2]. However, given the demonstrated utility and impact of LSS in manufacturing and non-manufacturing environments highlighted in the existing plethora of literature, research specifically about the implementation of LSS in the policing and prosecution services, which is dominated by knowledge work, is very limited [3, 4]. Hence, it is important to explore its required adaptation, implementation potential and viability for system-

level continuous improvement, and to contribute to the existing gap in literature regarding this topic.

This paper attempts to report on the following question: How can the existing framework of LSS be extended and applied in policing and prosecution services to systematically identify and analyse waste in crime investigations? The aim of this study is to answer this question and report on key learning points, based on observations and results from the applied LSS methodology in a Norwegian police district. The following section presents the literature background. Section 3 describes the proposed case study research design, while Section 4 presents the results. Finally, Section 5 discusses the findings, draws some conclusions and mentions future research opportunities.

2 Background

2.1 Lean Six Sigma in policing and prosecution services

Lean is a philosophical approach derived from Toyota's operating model, TPS, which consists of a set of principles that drive organizations to continually add value to their operations and services [5]. Toyota problematized waste, overburden and variation (also known as Muda, Mura and Muri), in a way their competitors did not, and made this a central part of their business philosophy [6]. Using various principles and tools, Toyota has built a culture and system that can identify relatively automatically problems that are non-value-adding [5]. The way of thinking and its practices enhance the necessary process steps and eliminate those that fail to add value, thereby improving flow and performance. Since its origin in Toyota, it has been adapted in various industries and sectors and merged with supplementing techniques and tools, such as Six Sigma, for process improvement. LSS strategies have an increased focus on quality and seek to improve the quality of the output of a process, by identifying and removing the causes of defects and minimizing impact variability [7].

While LSS has led to long-term successes in terms of developing a culture for continuous improvement (CI) in both the private and public sectors, failed implementation is also common [8, 9]. For instance, as a response to the general call for reform and austerity and the demand to reduce costs in the public sector [10], police organizations, predominantly in the UK, have explored the application of LSS practices, with consideration being given to their applicability to the police and the extent to which methodologies need to be adapted to individual services [3]. However, [4] states that, although many of the initiatives are undertaken under the banner of "Lean" within individual police forces, short-term successes are reported. In general, the reality is that public sector organizations have tended to be tool-oriented, with full-scale or systemic implementation of rigorous methodologies of LSS not being adopted [1, 9]. The complexity of implementing LSS methodologies in public sector organizations, which are characterized by a contextually different environment from that of manufacturing, is widely recognized [11]. It is therefore important to understand the differences, in order to undertake any tailoring exercise which would support the 'fit' of LSS methodologies to policing and prosecution services, before approaching implementation on a broader scale [4].

In contrast to a manufacturing environment, which is dominated by physical assets and material flow, a policing organization is composed of functional hierarchies,

mainly operated by human resources, whose processes and activities are characterized by knowledge work, to perform the required functions. Knowledge work primarily involves the management and use of information [12]. Moreover, it is characterized by more dynamic and uncertain processes than those generally associated with manufacturing. For instance, once an automobile producer initiates the production of a station wagon, it does not try changing it into an SUV halfway down the line [13]. In police investigations, however, a criminal case can take countless turns, based on the information that is available in advance and that is collected and generated along the way. Furthermore, each criminal case differs in type, complexity and scope, and they are dependent on multiple interconnected activities, disciplines and actors, both internally and externally, to deliver a final product that the prosecutor can take to court.

In the context of knowledge work, researchers have used a services context to document how knowledge work and unstable and uncertain conditions (demands and processes) do not preclude the use of LSS [12]. Furthermore, as indicated in the previous sections, there are traces of the implementation of LSS in police organizations. While these are few, compared to the existing research and LSS and CI in the public sector in general, [3] state that LSS can be embraced by all policing services to create efficient and effective processes, to provide enhanced value at reduced operational costs and, more importantly, to change how the organization learns through hypothesis-driven problem solving [13]. Henceforth, there is a need to continue the research into and the exploration of how LSS can be adapted, implemented, and extended in police organizations, to achieve long-term successes.

2.2 Background to the case organization

In contrast to many countries, the prosecution authority is an integral part of the Norwegian police. The prosecutor has the overall responsibility to manage the criminal proceedings, ensuring that the investigation of a case is purpose-driven and in accordance with current law and regulations. Accordingly, there are demands for high quality and efficiency in all phases of the investigation process, that is, from the first police officer becoming aware of a possible criminal act, to the prosecuting authorities' processing of the investigative material during the main trial. However, in this knowledge work-dominated environment, it is difficult to quantitatively measure and assess quality and efficiency.

In one Norwegian police district, from a strategic level, it was decided that one of the district's short-term strategic priorities should be the reduction of the district's current backlog of cases pending before the prosecuting authorities in the district. This is directly linked to one of the key performance indicators of the Norwegian police. In such, an improvement project was initiated. As LSS support a data-driven approach towards process improvement, which includes both human and non-human factors [14], this initiative included the incorporation of LSS as an integral part of the project management. This was to gain knowledge on LSS implementation in the organization's ongoing CI programme and, more specifically, to provide a classification framework of different sources of waste in the criminal justice process, and a deeper analysis of these as a means to systematically remove them and reduce overall performance variation.

3 Methodology

This case study was conducted in the prosecution service unit in the given case organization. A project team consisting of prosecutors was established for the purpose of this initiative. To align the strategic short-term priorities with the project plan and integrate the overall objectives with daily management, the LSS framework incorporating the five-stage DMAIC problem-solving methodology, described below (Table 1), is used to approach the above problem.

Table 1 DMAIC and framework for waste, adapted from [14]

DMAIC	Description	Tools and techniques
Define	The purpose of the Define phase is to delineate the organizational problem, the impact of the problem, scope of the project and define the process or what needs to be improved.	Project charter, SIPOC, Voice of the customer (VOC) analysis, critical to quality (CTQ) analysis
Measure	The purpose of the Measure phase is to understand, document and baseline the current state of the defined improvement area(s), and validate the measurement system wherever applicable.	Framework for waste, data collection plan and structure, Pareto analysis, performance analysis
Analyse	The purpose of the Analyse phase is to interpret and analyse the data collected in relation to the content described in the previous phases, to deepen the understanding and identify the root causes of the processual problems.	Cause-and-effect analysis, root cause analysis, correlation analysis
Improve	The purpose of the Improve phase is to identify improvement recommendations, design the future state, implement pilot projects, review and document the new processes.	Brainstorming, pilot project, updated data collection
Control	The purpose of the Control phase is to sustain the improved results and value creation of the pilot project by proceeding to manage implementation and change on a broader scale or system level, report the control plan, identify replication opportunities and develop plans for further improvements.	Quality control plan, statistical process control, mistake proofing

4 Findings

It is noteworthy that the sample (criminal cases) used in this study has several limitations; thus, the results presented in this study are mainly used as a means to explicate the proposed LSS methodology in the context of policing and prosecution services for learning purposes. Based on critical to quality characteristics, and central guidelines and policies, the traditional definitions of waste (i.e., muda) were reformulated and adapted to the context of crime investigation as in Table 2. In this study, the different categories of waste are referred to as types of defects that are under consideration; these are non-conformities, deviations, flaws or discrepancies from central directives, specifications or requirements that also do not add value to the overall criminal case and its involved actors. The presence of these were concomitantly and qualitatively assessed by the prosecutors while processing each criminal case.

Table 2 Adapted framework for waste

Waste		Description
Waiting (unwarranted delay)		Inactive processing of case for more than 3 months. That is, backlog ≥ 3 months.
Handover (Ineffective/inefficient)		Responsibility for case is transferred to another organizational unit instead of being decided as it is – possibly decided after minimal additional effort from the submitting unit.
Over-production (or over-investigation)		Creation of self-initiated criminal cases in violation of central/local priorities and over-investigation in existing criminal cases. Over-investigation involves both the implementation of an investigation, in cases without clarification potential, and the lack of delimitation of the amount of investigation, in cases to be investigated.
Error		Clear deviations from instructions when registering and processing a case or absence of / incorrect assessments during investigation/prosecution decision.
Interaction	Case management	The lead investigator and the prosecutor are responsible for leading the investigation. Their roles are to manage both the need for prioritization among the different cases and the scope of activity in cases that are to be investigated. There are several meeting or follow-up points where these will interact (the shape and form depend on the complexity and character of the case).
Knowledge		Lack of knowledge regarding local/central priorities. Lack of case processing and/or portfolio competence.
Capacity		Lack of resources compared to the task portfolio leads to all the above – or the above deviations lead to the capacity being challenged more than necessary.

A total of 505 criminal cases was processed and assessed for waste by the prosecution team. Of these, 177, or 35 %, were characterized by waste. Fig. 1 displays a Pareto chart, in which the most present or frequently occurring categories of waste are registered to be Waiting, Interaction and Handover. These were identified as being located primarily in the initial phases of the criminal justice process (Fig. 2). It is notable that the visualized process, which is a result of the SIPOC analysis, only provides an overall snapshot of a highly dynamic and complex processual system.

Moreover, a total number of 242 defects was assessed and found in the 177 criminal cases. Accordingly, Table 2 provides metrics that indicate how the current overall process is performing. That is, based on the calculated Defect Per Million Opportunity (DPMO) (and defect rate and yield), and a sigma shift of +1.5, the current process sigma level is approximately 3. However, only seven categories for waste, which represents the types of defects under consideration in this study, are defined. Considering the highly complex, dynamic, uncertain and knowledge-work dominated nature of the overall criminal justice process, which are characterized by multiple specifications, guidelines and directives, these may not be representative for all forms of activities, non-conformities, flaws or deviations that are non-value-adding. This also challenges the applicability and validity of detailed process performance- or capability-related analysis.

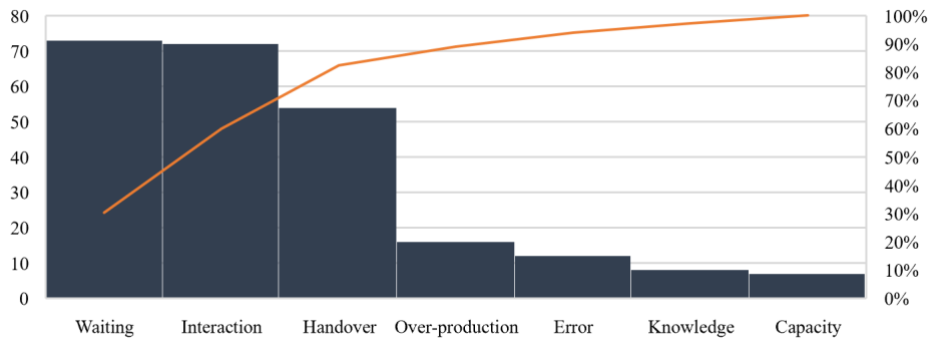


Fig. 1 Pareto analysis

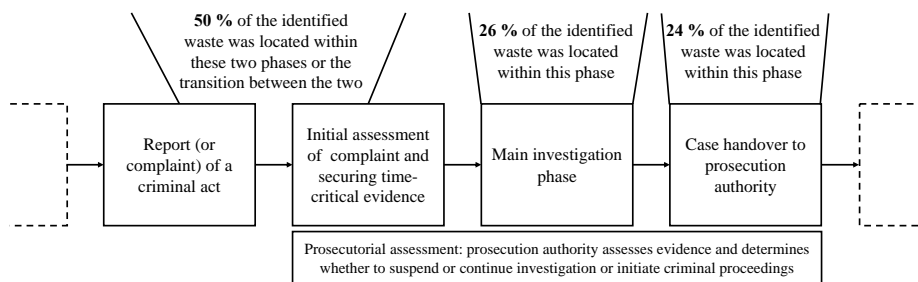


Fig. 2 Location of identified waste

Table 3 Performance metrics

Phase: Measure	
Total criminal cases	505
Number of non-conforming cases	177
Types of defects under consideration	7
Total number of defects found	242
Opportunities for a defect in the sample	3535
DPMO	68458
Defect rate	6.85 %
Yield	93.15 %
Process sigma level	3

As part of the Analysis phase of the DMAIC methodology, the interconnectedness or relationship between the various waste categories was qualitatively analysed from a cause-and-effect perspective. Accordingly, what is argued as the main overall cause, rooted in the majority of the remaining wastes, is Interaction, which is a central part of the case management (Table 1). Henceforth, the key improvement area to further engage in is argued to be the overall case management, in which the lead investigator and the prosecution authority interact to set a purpose-oriented direction. Inadequate or absent interaction is believed to have a major negative effect on criminal proceedings – in terms of time, resource use and quality of the final product. Figure 3 illustrates possible interconnectedness between the provided categories, impacting time and quality throughout the process.

However, based on this qualitative analysis, a more detailed data collection plan with an expanded and updated sample is found necessary for the Analysis phase, in order to utilize statistical methods, such as correlation and/or regression analysis and hypothesis

testing to state whether the calculated values are statistically significant. This can deepen the understanding and knowledge regarding the potential interconnectedness and relationships between these variables.

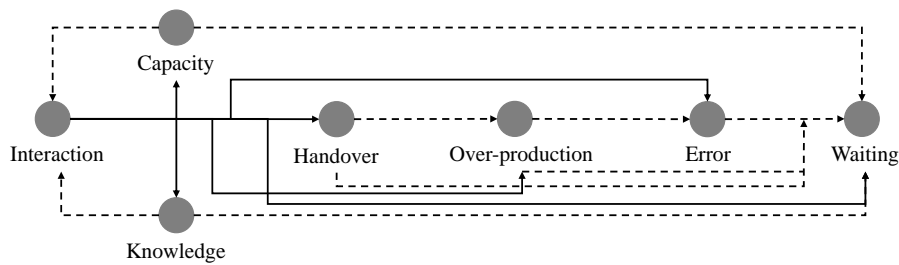


Fig. 3 Possible relationship between the defined wastes

Given the contextual differences between manufacturing processes and crime investigation and prosecutorial activities, the LSS methodology and framework provided the project manager with a systemic approach to uncovering waste, which gave grounds to holistically interpret and indicate how the current overall process is performing, based on the scope of defects. LSS can have significant value and support managers in systematically identifying and analysing waste and addressing improvement areas in the police, as also concluded by [10, 14, 15]. However, in contrast to the manufacturing industry, where process waste and defects in physical products or materials are arguably more visual, pre-defined, automatically controlled, with data on them collected, in the policing and prosecution context, these are less visible and currently dependent on manual data collection. Furthermore, such data collection and analysis are to a greater extent characterized by a qualitative approach, which is based on disciplinary expertise and knowledge. This makes it subject to human subjectivity and variation due to different knowledge basis, assessments, opinions and judgments.

5 Conclusion

This study contributes to the literature on LSS practices in police organizations, by extending and applying the existing framework of LSS in policing and prosecution services. This paper has practical implications and can be of value to managers, in any public organizations, who are engaged in any form of continuous improvement initiatives. The results of the study also add evidence to the existing argument on the applicability of LSS in police services, which are dominated by knowledge work, and, through this, contribute to filling a current research gap. Although the applied LSS methodology is not a novel approach, evidence of its successful application in policing and prosecution services is scant in the literature, emphasizing the growing importance of fieldwork that reports the application of such an approach. Further research shall interpret, adapt and develop the content of LSS to such a context. Followingly, report on the remaining phases of the DMAIC methodology, tools and techniques. Moreover, it shall develop a detailed data collection plan and structure in order to apply statistical methods, which can deepen the understanding and knowledge regarding the potential interconnectedness and relationships between the various wastes.

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