Enhancement of a Data Management System using Design for Lean Six Sigma

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Abstract. The purpose of this study is to outline a transformation model that can help commercial enterprises to design, develop and launch a transformation program of change for their data management system applying Design for Lean Six Sigma - Define-Measure-Analyse-Design-Verify methodology. Design for Lean Six Sigma methodology was chosen to develop/implement a five-year roadmap to enhance a data management system to effectively predict and react to customers' needs and competitors' actions and survive in a constantly changing financial services industry. Companies seek to enhance their level of data quality to comply with regulatory requirements, reduce uncertainty and improve the quality of decision-making with more accurate and timely data available. The model used conveys how the organisation will implement and sustain a standardised data management system to reduce the Cost of Poor-Quality data by 27.33%, decrease the electronic data retention cycle time to a maximum of 7 years, previously stored long-term, and achieve/sustain a 90% deletion target for emails older than seven years. Data deemed nonvalue added does not contribute to satisfying customer requirements, therefore Design for Six Sigma methodology was used as a vehicle to systematically identify, manage and delete same. This study is one of the first studies on Design for Lean Six Sigma application in a financial data management system,

Keywords: Data Management System, Financial Services, Design for Lean Six Sigma, DMADV, Continuous Improvement,

1 Introduction

Financial service organisations operate in a heavily regulated industry and have fire fought continuously increasing their data storage capacities to accommodate storage of all data. However, in 2018, there was a strict requirement passed under Article 5(1) of the European General Data Protection Regulation (GDPR) for companies to only retain data for as long as necessary, regarding the purpose for which it was collected. Data should be leveraged as an organisations strategic asset to reduce uncertainty, improve performance and profitability by learning or gaining insights from correct, comprehensive, consistent data to improve business processes and for analysing customer needs [1]. Organisations that increase the level of data quality improve the quality of decision-making, reducing uncertainty to provide more timely and accurate results [2], [3], [4], thus are better equipped to apply a reactive approach to both customer and competitors' actions more efficiently and effectively [5].

This research sets out to improve upon the current data management approach many companies adopt whereby only Value-add (VA) data is retained. The purpose of the study is to conceive and implement an data enhancement program with Lean Six Sigma tools and techniques using the Define for Lean Six Sigma (DFLSS) phases of Define-Measure-Analyse-Design-Verify (DMADV) methodology, which could potentially be used by other commercial businesses to decrease data cycle time, cost of poor quality (COPQ)data and enhance data integrity and control. For enhanced operational efficiency, the ultimate objective of any organisational Information Management Program is to have all data classified as Non-Value Add (NVA) and removed/deleted. Fulfilment of that vision successfully, entails the ongoing management of current, new and historic data over time to have automatic removal/deletion of unnecessary stored items. This research will combine Lean philosophy to determine the current state and eliminate waste and Six Sigma to achieve the future state and validate findings by focusing on

improvement areas using statistical analysis. Additionally, De Koning, Does, and Bisgaard[5] argues financial service organisations need to manage culture to encourage process innovation/improvements. The researcher will seek to investigate the most suitable culture required for implementing a change program successfully.

2. Literature Review

Turban and Volonino [1] posit data management is one of the most difficult challenges facing organisations. With increasing global competition many companies are inspired to consider enhancing quality expectations, eliminate waste and prioritise customer satisfaction [6], [7], [8], [9], [10], [11], [12], [13]. Heckl, Moormann and Rosemann [14] claims the catalyst for financial organisations seeking transparent processes with zero defects at lower costs was initiated by new regulatory requirements, to exploit unforeseen market opportunities and to increase customer satisfaction.

Many financial service organisations are focused on hard numbers i.e., profit margins, often losing sight of what is important to the customer. However, Turban and Volonino [1] argue that profitability increases when employees use data to increase revenues, reduce expenses or a combination of both. Nonetheless, Kumar [15] proposes data is increasing with the evolution of new technology requiring increased storage capacities and extra costs to facilitate same. Additionally, companies that move paperless need to manage the increase of data subsequently stored electronically in their cloud and servers. De Mast [16] suggests most organisations have no organisational infrastructure, plan or budget in place for managing incremental innovations. Lean Six Sigma (LSS) provides an infrastructure to 'improve operational efficiency and effectiveness' [17], [18], [19] combining the strengths of Lean and Six Sigma. De Koning, Does, and Bisgaard [5] claims Six Sigma facilitates the measurement of process performance while Lean enhances flow visibility. The main challenge facing financial service organisations attempting LSS implementations is the lack of research available which deters learning from and implementing same [14], [20], [21], [22], [23]. Alblooshi, Shamsuzzaman, Khoo, Rahim, and Haridy [24] argue there is little or no evidence of the sustainability of LSS benefits in areas such as customer satisfaction, financial outcomes and process excellence. Francis, Bessant and Hobday[25] claims risks and challenges are inevitable for any organisation implementing radical change. According to Qiu, Gai, Zhao and Liu [26] with more data and more processing comes greater risk hence scrutinising information and demanding it meets certain criteria are paramount to achieving sustainable organisational performance. Financial service organisations need to focus on increasing productivity, increasing efficiency, reducing operational expenses and focusing on value adding activities to cope with change [18]. However Duarte Montgomery, Fowler, and Konopka [27] argues the success and failure of LSS is dependent on how and where it is applied. Many organisations fail to achieve the real benefits and anticipated results from LSS implementation [28], [29]. Many studies prove that poor, incomplete, delayed or lost information is the most serious quality problem [30], [31], [32]. A concerning statistic proposed by Redman [33] and Haug, Zachariassen, and Van Liempd [34] highlight the impacts of poor data quality in large companies can affect revenue by an average of 10 percent. On the contrary, English [30] estimated the costs of poor-quality data accounts to 10 to 25 percent of revenue. Redman [35] claims an estimated 5% of data found in companies are of poor quality and Malcolm[36] posits the average anticipated Cost of Poor Quality (COPQ) data in companies comprise of 10% of revenues. Low quality data may result in loss of revenue, waste of money, loss of opportunity and a tarnished image [37]. On the other hand, Keenan[38] claims financial service organisations are weak in information processing in comparison to other industries, when this should be considered a critical core competency requiring an integrated, centralised data infrastructure capable of storing far higher volumes of data than firms have held historically.

2. Methodology

A case study approach was used and within that a DFLSS methodology. As part of the DFSS methodology the DMADV approach was utilised. The problem in scope in this single case study was to identify and improve upon the current data management process and apply disciplined steps to identify and resolve the key factors/noise variables influencing the primary key performance indicator (KPI), data stored. To outline the problem the researcher gathered output (data) of the process

retrieved from the organisation's Microsoft Azure portal and then input and analysed data using JMP software to understand process stability, explore patterns of variation and determine if the process was improving/deteriorating over time. Figure 1 visualises the primary problem/effect on the output of the process when the company migrated paperless in September 2020 which significantly increased electronic data stored by 60%. While the mean of data deleted remained stable at an average of 64,605 artefacts per month, the problem accelerated when the mean of data stored on the company cloud/servers increased from 115,002 emails/documents monthly to 176,712 in September 2021. With electronic data forecast to expand by 50% respectively over the next two years, the current data management system required a reactive approach to delete NVA data to meet the needs of a rapidly increasing data estate.

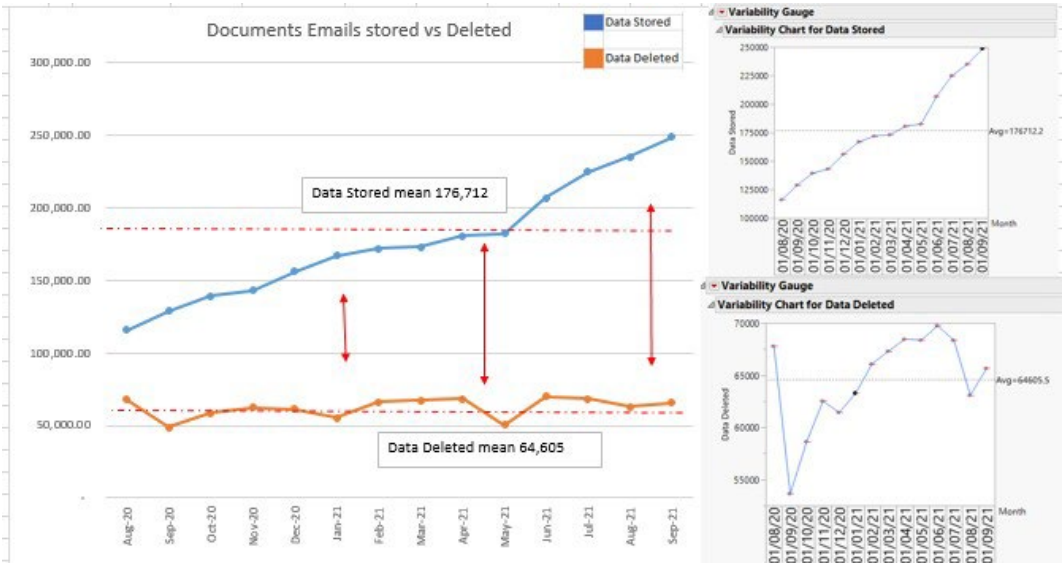

Figure 1: Data stored vs data deleted in the business

Therefore, the leadership recognised the importance of implementing a systematic approach to begin downsizing the continuously increasing data infrastructure in the company, thus formulated a cross-functional core team required for the rollout of a five-year/tranche Data Enhancement Program.

The process improvement manager, as part of the core team, recommended the method proposed by Pepper and Spedding [40], integrating Lean and Six Sigma as a comprehensive approach for the process improvement. Moreover Pepper and Spedding [40] argue if Lean is implemented without Six Sigma, tools are underutilised to gain full potential to solve problems whereas Six Sigma provides a framework to implement tools systematically. A Lean approach focuses on the flow of a product through its value stream identifying NVA steps in processes with the objective to streamline the flow and eliminate waste [41]. Six Sigma then provides a systematic improvement methodology to achieve the future state by focusing on the improvement areas.

Ganesh and Marathe [42] posit that there is an abundance of research available on the successful applications of LSS in the manufacturing industry, however academic research and publications are lacking for LSS efforts in banking and financial service organisations. Furthermore, Heckl, Moormann and Rosemann [14] propose LSS has only been implemented in the financial services sector over the last decade. Heckl, Moormann and Rosemann [14] reported nine out of ten companies use Define-Measure-Analyse-Implement-Control (DMAIC) methodology for process improvements. Having synthesised the literature research and conducted interviews on previous transformation programs, DMADV was recommended by the researcher as the optimal methodology for the program, as this approach is most suitable when a process is not in existence, and one needs to be developed right first time. However, DMADV approach has been less frequently applied to financial services [43], [44], thus there is little, or no research documented on it. The main reason for applying DMADV methodology to process improvements is that it applies a systematic and proactive approach to foresee any potential issues to implement preventative measures and controls for the design and verification phases with LSS methodology and tools. DMADV involves understanding the customer requirements before deploying the improvement, which are mostly expressed qualitatively. Due to the intangible nature of services, service delivery and process performance are often difficult to measure,

relying on the customer interaction and feedback to determine the quality of the service. Note the customer in the Information Management Program were the internal staff. The explicit and implicit wants and needs of the customer were identified throughout the program with staff engagement surveys, feedback and issues reported. Each phase of the program ended with a toll gate review approved by the project sponsor to facilitate review of progress of the previous phase and approve progression to the next phase. The DMADV phases, tools and their purposes used by the researcher to support the core team understand and achieve the program objectives systematically will be described below (table 1).

Table 1: Methodology, tools and techniques applied to the Information Management Program

Phase of DMADV	Phase Deliverables	Tool/Technique applied	Reason for tool/technique
Define	To define project charter/resources before scope/objectives of the DMADV program.	Interviews and engagement survey with the core team	To determine acceptance for the transformation at the outset of the program.
		SIPOC	Identifies the key inputs/outputs, process and stakeholders to support scope.
		Pareto Diagram	Assists to identify the most significant opportunities to target/prioritise in the program.
		Project Charter	Outlines the objectives, scope, and deliverables of the program.
		House of Quality	Determines customer requirements/Critical to Quality (CTQ) attributes.
Measure	To understand business requirements/customer requirements.	Brainstorming	Techniques used to support the program.
		Histograms, Statistical Process Control Charts	Displays the program output investigating process stability/capability.
		Cause-and-effect diagram	Supports brainstorming outlining the potential process factors effecting the response.
Analyse	Analyse the options designing the concept and high-level design for the program	Process Maps	Provides a visual to outline the process.
		Histograms, Statistical Process Control Charts	Displays the program output investigating process stability/capability.
		Work Breakdown Structure	Breaks down the program into components that will be addressed in the verify phase.
Design	Develop a detailed design, control plan and roadmap for the program	Histograms, Statistical Process Control Charts	Displays the program output investigating process stability/capability.
		Gantt Chart	Establishes a sequenced timeline and anticipated roadmap for the program.
		Risk Assessment	To determine potential risks prior to rollout of the program.
		Roadmap Design	Lists the key transformation steps for the program.
		Program Communication Plan	Mediums of communication to inform all stakeholders of progress/actions.
Verify	Test, verify, design with pilot group rolling out company-wide when pilot groups proves successful.	Histograms, Statistical Process Control Charts	Displays the program output investigating process stability/capability.
		Staff engagement survey	To determine acceptance for the transformation at the end of the program.
		Lessons learned	Documentation from the core team and pilot group to improve other projects in the organisation.

For DMADV to be carried out effectively, extensive knowledge of JMP software assisted to measure progress by conducting statistical analysis in closing the gap between current/new data classified for automatic deletion (tranche 1) and historic data (tranche 2). Additionally, Brainstorming and Kaizen workshops were held with the core team and pilot users throughout the program.

3. Results

Data investigation, analysis and interpretation formed the basis for this study. The impact of the implementation process was to establish a design for a simplified, streamlined and stable practice to convert data into information indifferent to noise variables. According to Holsapple and Joshi [46] data is a collection of facts, measurements and statistics whereas information is organised or processed data that are timely and accurate.

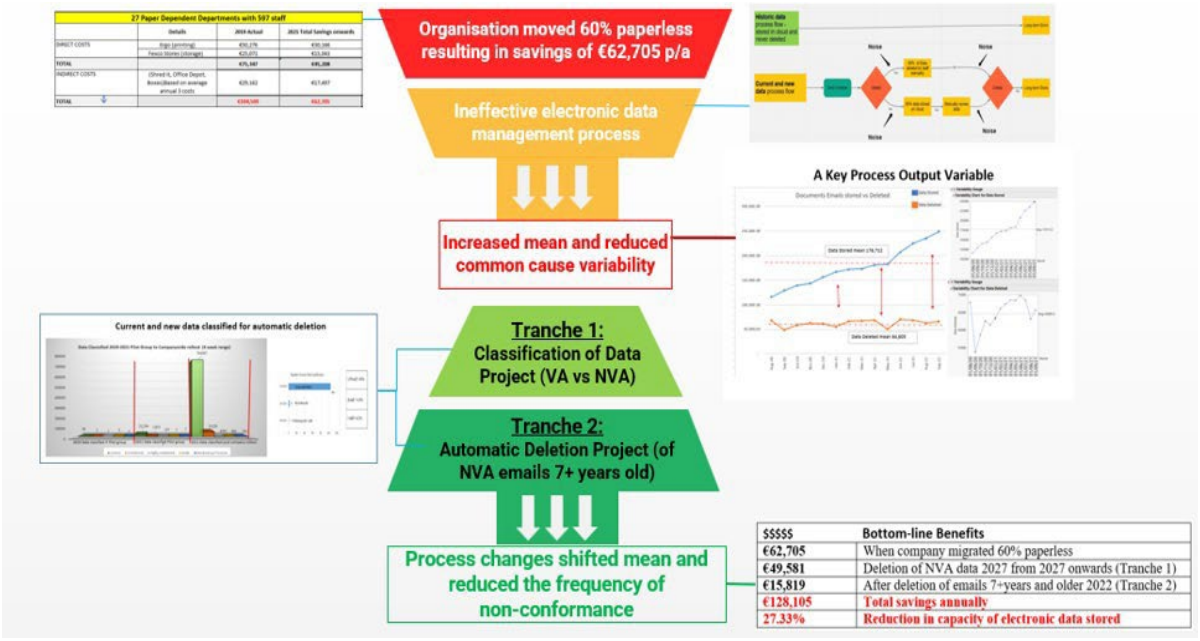

Figure 2: Process improvement and impact to key process output variable

The bottom-line benefits of €128,105 savings per year, detailed in figure 2 targeted and achieved in the program to date consist of:

- €62,705 savings were achieved on direct and indirect print costs (paper, print and maintenance costs, lead time, staff costs for storage/retrieval/transport and Shred It) when the company migrated paperless.
- After completion of tranche 1 of the program, €49,581 are the anticipated cost savings through the classification of all new/future data processed in the company enabling automatic deletion of NVA data from 2027 onwards.

Despite this, there were also benefits achieved that were not originally targeted from the program. A standardised approach was implemented for data management companywide. The company can now apply a reactive approach to customers, competitors and market opportunities with VA data available when required for decision-making. A control plan was developed for managers of departments in scope, to monitor emails their staff stored/deleted aged 7 to 30 years, and flag when capacity of VA data exceeded 10% during the pilot phase to ensure optimal performance was maintained. Data analysis from the pilot phase conveyed only 6% of data was categorised as VA and archived for long-term retention (figure 3).

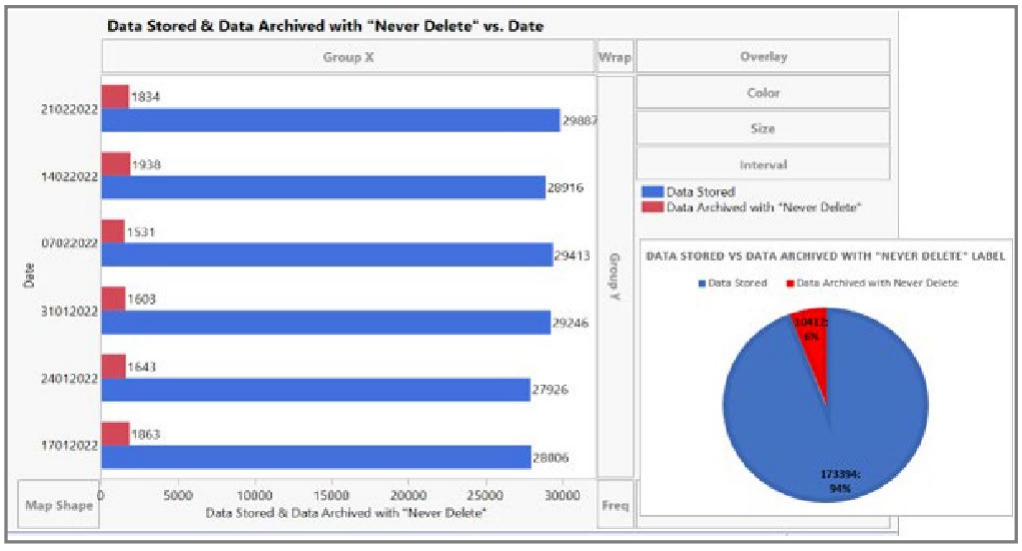

Figure 3: Bar chart/Pie chart of data stored vs data labelled "Never Delete" for long-term retention

4. Discussion

This research conveys how to design and implement an integrated company-wide transformation program using DMADV methodology. It conveys the successful utilisation of LSS principles and methodologies to design and implement a five-year data transformation roadmap for a global company in the financial services sector. Fang and Zhang [51] argue traditional data management approaches distributes data across systems for specific functions, lacking a seamless holistic view, forcing companies to firefight installing custom cloud and archive solutions to accommodate same. DMADV was the chosen methodology, utilised for the first time for both the researcher and the company. The core team worked backwards from the customer, establishing that data security/management were CTQ's/unspoken needs in the service delivery, through the completion of the HOQ in the define phase. This approach ensured high quality information satisfied criteria specified by the user [53], [30], [54].

Redman [35] claims that organisations have 5% poor quality data. Results from the pilot phase conveyed that 94% of emails aged seven years and older were categorised as NVA for deletion. Surprisingly, results gathered from this research conveyed that only 6% of data was deemed as VA, requiring long-term retention. Strong [55] propose the most appropriate measure for success is when staff intend to implement the solution. Tranche 1 of the program was successfully delivered in 2021 with staff trained to mandatorily classify new electronic data received or authored, to identify and begin automatic deletion of NVA data from 2027 onwards using DMAIC methodology. The results of this research project highlighted the importance of first rolling out to a pilot group to achieve Design for Reliability correcting any issues encountered before companywide rollout, equipping pilot users to become change champions. Selvi and Majumdar [49] say it proves beneficial to use a pilot group to set the standard within the company, to teach everyone the benefits of the project and then to be held responsible as leaders to these high standards. Furthermore, Bicheno and Holweg[39] propose the use of a pilot group 'reduces the cost of making mistakes'.

Pepper and Spedding [40] argue to build a Lean Learning Enterprise is extremely difficult and begins by starting from the top. The 5-year transformation roadmap utilising DMADV and change management techniques represents the first attempt in academic literature to convey the design, implementation and sustainment of an integrated data management system with LSS tools and techniques in the financial services sector.

5. Conclusion

Only 3% of organisations have successfully implemented company-wide digital transformations thus the novelty of this research is that this is a unique approach that could be adopted by any organisation pursuing the design and implementation of a major transformation/enhancement program utilising DFLSS DMADV methodology. Despite this, there are significant research gaps in academic literature due to the proliferation of Financial Technologies over the last 5 years, with little or no research completed on topics of identity, security, data privacy, cyber security and their regulation in financial services. This study will aid academics and financial services organisations in providing evidence of how DFLSS can be applied to data management. The next priority opportunity for the organisation to focus on, is the implementation of an email alerting system that will flag data that is breaching regulations/company policies to the IT Data Security team for review. This research provides a new comprehensive, structured paradigm to leverage the capabilities of LSS tools and techniques to support, complement or iterate any existing transformation methodologies or change programs.

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