



Web-based Visual Decision Support System (WVDSS) for letter shop

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ABSTRACT

Decision Support Systems (DSS) is one of the key tools to transform data to decisions. In this paper, a successful implementation of a web based DSS in a direct mail (letter shop) is explained. Utilizing continuous improvement framework, we provide how the Web-based Visual Decision Support System (WVDSS) helped the organization to successfully turn around the scheduling and capacity planning function along with extending the success to customer service, and warehouse operations. The outcome of implementing the WVDSS were (1) attainment of 100% scheduled delivery date, (2) improved efficiencies across the value stream, and (3) real-time notification of shipment to the customer service representatives. The unique contribution of this work is the original implementation of a web based decision support system in a high variety and low volume letter shop environment spanning transactional and manufacturing value streams.

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1. Introduction

In manufacturing industries, adopting the Toyota Production System (TPS) has become the mantra for survival in the 21st century where the key drivers to market position are quality and cost. TPS paradigm lays the foundation to various lean manufacturing initiatives and one such fundamental building block is Continuous Improvement (CI). According to a recent United States Department of Defense (US DOD) report, "Continuous Process Improvement provides organizations a method for analyzing how work is currently being done and how processes can be improved to do the job more efficiently and effectively on an ongoing basis" [1]. Under this band-wagon of CI initiatives, there are many widely used concepts such as 5S, kanban, kaizen (referred also as rapid process improvement), standard-work, Value Stream Mapping (VSM), and Overall Equipment Effectiveness (OEE) [2–22]. The success of any CI program lies in establishing synergy between the process initiatives, the technology deployed and the people [23,24]. Particularly the Front Line Supervisors (FLS) play a pivotal role in sustaining the CI momentum. Their proximity to the operations provides a unique advantage to tweak the process under focus to deliver the desired results. While there are various decision support systems in the literature (Table 1), there is a gap in addressing multiple domain decision support systems that is provided to the FLS. Many of the existing DSS used in literature are

provided to the key management level stakeholders. The focus of this paper is to enumerate the development and successful implementation of a decision support systems encompassing quality, customer service and warehouse operations. The model was designed to fit the needs of a letter shop which is an assemble-to-order system where customers own the inventory. The company provides value added service by assembling the components and sending it to end customers. This paper is organized as follows, first we provide a brief overview of how DSS has been applied to various domains in literature, followed by the methodology section where we cover CI methodology adopted and an overview of the letter shop process. Next, we present the various modules of WVDSS. Finally, the benefits and lessons learned from the implementation are summarized along with future research.

2. Literature review

Decision Support Systems (DSS) have been in existence since the proliferation of computers and it has been used as an enabler for business decision-making [25]. DSS's serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance [26–28]. Shim et al. [29] provide a comprehensive overview of DSS technology. Wan [30] proposes an adaptive DSS for lean practitioners enabling them to make better decision in the CI journey who are often challenged with providing status updates on the roadmaps, selection of appropriate tools and

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Table 1
Application of Decision Support System.

Area of application	Methodology used	Reference
Electrical energy	X-R model (X – set of feasible solutions and R – set of fuzzy preference relations)	[31]
Course and classroom scheduling	udpSkeduler based on mathematical programming models	[32]
University ranking	Data Envelopment Analysis (DEA) Multi-criteria decision method ELECTRE III	[33]
Supply Chain Management (Collaborative Planning, Forecasting and Replenishment (CPFR)	Service oriented framework (resources, location, lifecycle and time)	[40]
Service delivery	Big-data cloud based Service Oriented Architecture (SOA)	[41]
Cybersecurity risk planning	Genetic algorithm determines risk to assets and cost of the assets in portfolio	[42]
Information security planning	Multi-criteria decision framework based on decision theory.	[43]
Investment evaluation high tech business	System dynamics and non-linear behavior	[44]
Mould industry	Genetic algorithm based hybrid system supporting process planning	[45]
Blood center platelet production	Linear programming model	[46]
Bank rating	PROMETHEE II to determine bank's stability, performance and risk	[47]
Vehicle routing	Ant colony combined with Google maps	[48]
Asset allocation	Simulation and stochastic programming	[49]
Inventory management	Spreadsheet based simulation	[50]

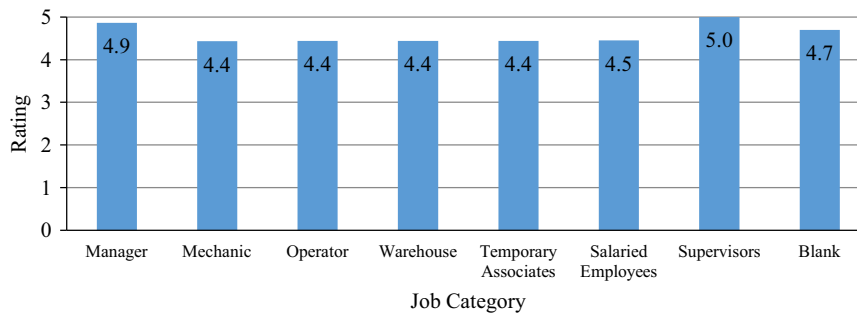


Fig. 1. Need for continuous improvement across employee job type/employment classification.

communicating to stakeholders. Kokshenev et al. [31] proposes a decision support center for planning and management of various processes for energy companies. Miranda et. al [32] highlights how DSS could be used to schedule course timetables and classroom assignments. Giannoulis and Ishizaka [33] demonstrate ranking of universities in United Kingdom, using the ELECTRE III multi-criteria decision system. Key variables that underpin these DSS's are (1) the number of criteria's involved in the decision making process, (2) the number of stakeholders involved, (3) the decision making algorithm, and (4) the output format or representation needs of the business. DSS has evolved from simple models to complex multi-criteria systems [34]. Next generation DSS's are mainly web enabled and thus could be delivered to any device that can access the web [35,36]. Renu et al. [37] utilizes the latest trend of big data to create backbone Methods–Time Measurement (MTM) tables for consistent product planning of assembly time. Various factors such as scalability, data security, web-performance are highlighted as few performance parameters for a successful outcome [38,39]. Table 1 summarizes few different areas of application of DSS and the methodology used.

3. Methodology

3.1. Baseline survey

A pilot study via a 25 question survey was used to establish base line CI culture. A 0–5 Likert scale was used (0 – representing no need for CI and 5 – representing high need for CI). It had 25 questions and was made available in three different languages (English, Spanish, and Vietnamese). It was distributed through the

employee pay check distribution process. The questions in the survey addressed eight categories such as Training, CI, Quality, Performance, Finance, Communication, Trouble Shooting, and Standard Work. For example, four CI focused questions were (1) continuous improvement of process is needed to ensure highest customer satisfaction and meet our mail dates, (2) are you aware of lean manufacturing tools and concepts such as 5S, Setup reduction, Standard Work, Value Stream Mapping, and Just-in Time? (3) we can improve the current OEE / 5S and other improvement activities or process, and (4) are you aware of lean manufacturing tools and concepts such as 5S, Setup reduction, Standard Work, Value Stream Mapping, and Just-in Time? Out of the eight categories, the paper focuses more on the CI because of the fact that this was one of the factors that had consensus across all employment categories. Fig. 1 indicates the summary of response that shows the consensus among all levels of organization for the need of CI to satisfy the customer requirements. The range is very small (0.6) between the various job type/employment classification and indicates that the total workforce is willing to undertake the CI journey which is a very positive sign to implement new initiatives.

3.2. Overview of the letter shop process

Scheduling in a letter shop is a complex process due to the volume and high variety of products. Fig. 2 shows a high-level overview of the letter shop process. A project starts after a successful bid to deliver services. The client sends job instruction to the customer service (CS) and the raw material to the warehouse. The scheduling team manually schedules the job and allows the CS team to create the Work Order (WO). The production team processes the work based on the WO and the quality team audits the

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