

# Quality Management System in Web-Fed Offset Print Production: Advancements and Challenges in Printing Technology

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## Abstract:

This research paper explores the critical role of Quality Management Systems (QMS) in the context of web-fed offset print production within the rapidly evolving landscape of printing technology. As the demand for high-quality printed materials continues to rise, ensuring the consistency and excellence of web-fed offset printing processes becomes paramount. This paper examines the key components of QMS, its implementation and the challenges and opportunities it presents in the dynamic field of Printing Technology.

**Keywords:** Quality Management System, ISO, Key Performance Indicators, Web-fed Offset.

## Introduction:

The evolution of web-fed offset printing represents a fascinating journey through advancements in printing technology, spanning several decades. Web-fed offset printing, a subtype of offset printing, is characterized by its continuous feed of paper from rolls. This method is particularly well-suited for high-volume printing applications. The origins of offset printing can be traced back to the early 20th century. In traditional letterpress printing, the image was transferred directly from a plate to the paper. Offset printing introduced an intermediate step, transferring the image first to a rubber blanket before making contact with the paper. This innovation paved the way for more consistent and higher-quality prints. The transition from sheet-fed offset to web-fed offset printing began in the mid-20th century. This shift allowed for continuous printing from rolls of paper, increasing printing speed and efficiency. Early web-fed offset presses were manually operated, limiting their production capabilities compared to modern, automated systems. Web-fed offset printing is a widely utilized technique for high-volume printing, particularly in the production of newspapers, magazines, and packaging materials. With the increasing demand for print quality and consistency, the implementation of an effective Quality Management System is crucial to meet and exceed customer expectations (Lourenco, 2013).

## Importance of Quality in Printing Technology

The importance of quality in printing technology cannot be overstated, as it directly impacts the final output and the overall success of printed materials. Quality in printing technology encompasses various aspects, and its significance extends to both the printing industry and the end-users. High-quality printing results in visually appealing and professionally finished products. Whether it's a brochure, packaging, or marketing materials, customers are more likely to be satisfied with the end result if the print quality meets or exceeds their expectations. Print materials often serve as tangible representations of a brand. The quality of printed materials reflects directly on the perceived quality of the brand itself. Consistent and high-quality printing contributes to a positive brand image, fostering trust and credibility among consumers. The primary purpose of many printed materials is to communicate information. Whether it's a message, instructions, or promotional content, the effectiveness of communication is compromised if the print quality is poor. Clarity, readability, and color accuracy are essential for conveying the intended message successfully. In competitive markets, businesses strive to stand out. High-quality printing can give a company a competitive edge by making its materials more attractive and memorable. Whether in marketing collateral, packaging, or promotional items, superior print quality can make a lasting impression on potential customers. Quality printing involves using durable materials and inks that resist fading, smudging, or deterioration over time. This is especially critical for items like product labels, packaging, and outdoor signage, where longevity and resilience to environmental factors are essential. High-quality printing reduces the likelihood of errors, misprints, and defects. This, in turn, minimizes the need for rework and the generation of wasted materials. Efficient and accurate printing processes contribute to sustainability and cost-

effectiveness. Many industries have specific standards and regulations governing printed materials, especially in areas such as packaging and labelling. Quality printing ensures compliance with these standards, avoiding potential legal or regulatory issues. The importance of quality in printing technology extends beyond aesthetics—it influences the success of communication, brand perception, and customer satisfaction. As technology continues to advance, maintaining and improving print quality remains a priority for the printing industry (Virmo, 2014).

## **2. Quality Management System in Printing:**

A Quality Management System (QMS) is a set of coordinated activities and processes within an organization that are designed to ensure that products and services consistently meet or exceed customer expectations. The primary objective of a QMS is to establish a framework for quality-oriented practices, continuous improvement, and customer satisfaction. QMS is often based on international standards, with ISO 9001 being one of the most widely adopted frameworks.

Components of Quality Management System (QMS): The quality policy is a high-level statement that outlines the organization's commitment to quality and customer satisfaction. It sets the tone for the entire QMS and provides a framework for establishing quality objectives. The quality manual is a document that describes the overall structure of the QMS. It outlines the processes, procedures, and responsibilities within the organization related to quality management. While it may not be a mandatory component in every QMS, it is often included as a reference document. Documented procedures detail the steps to be followed in performing specific processes within the organization. These procedures help ensure consistency and standardization in activities that impact the quality of products or services. Visual representations, such as process maps and flowcharts, illustrate the sequence and interactions of various processes within the organization. These tools help stakeholders understand the flow of activities and identify areas for improvement. Quality objectives are specific, measurable goals set by the organization to achieve desired levels of quality performance. These objectives are aligned with the overall business strategy and may cover areas such as customer satisfaction, process efficiency, or product conformity. Identifying and managing risks is an integral part of a QMS. Organizations assess potential risks to quality and develop strategies to mitigate or eliminate them. This proactive approach helps prevent quality issues before they occur. The QMS includes processes for monitoring and measuring key performance indicators (KPIs) that are relevant to quality (Jagannathan, 2008).

This may involve regular inspections, testing, and data analysis to ensure that products and processes meet specified requirements. Training programs are established to ensure that employees have the necessary skills and competence to perform their roles effectively. This includes training related to quality standards, procedures, and the use of quality tools. Internal audits are systematic reviews conducted within the organization to assess compliance with quality management standards and procedures. Audits identify areas for improvement and help maintain the effectiveness of the QMS. Processes for addressing non-conformities and preventing their recurrence are essential components of a QMS. Corrective actions deal with existing issues, while preventive actions aim to stop potential problems before they occur. The QMS incorporates mechanisms for collecting and analyzing customer feedback. Customer satisfaction surveys and other feedback channels provide valuable insights that can be used to improve products and services. A fundamental principle of QMS is continuous improvement. Organizations establish processes for regularly reviewing and enhancing the effectiveness of the QMS, ensuring ongoing adaptation to changing circumstances and evolving customer needs. By integrating these components, a QMS provides a systematic and structured approach to quality management, fostering a culture of excellence and continuous improvement within the organization.

### **QMS Standard and its Application in Web-Fed Offset Printing**

It provides a systematic approach to ensuring that organizations consistently meet customer and regulatory requirements while striving for continual improvement. In the context of web-fed offset printing, adherence to QMS is essential for achieving and maintaining high levels of quality in both processes and final printed products. These principles are applicable to web-fed offset printing: Meeting customer expectations is paramount. In web-fed offset printing, understanding customer requirements for print quality, consistency, and delivery schedules is essential. Leadership commitment to quality is crucial. Management within a printing facility must actively promote and support the implementation of QMS standards. Involving employees at all levels is key to success. Training and engaging staff in quality management processes ensure everyone understands and contributes to the organization's quality objectives. QMS encourages a process-based approach to quality management. In web-fed offset printing, this involves mapping and optimizing processes from prepress to printing and finishing. Continuous improvement is integral to QMS. Regularly reviewing and enhancing printing processes helps in achieving higher quality and efficiency. Decision-making within a QMS should be based on data and evidence. Monitoring and measurement of Key Performance Indicators (KPIs) are critical components of a well-implemented Quality Management System (QMS) in web-fed offset printing. This process

involves systematically assessing and analyzing relevant performance indicators to ensure that the printing processes meet established quality standards (Andronikidis et. al, 2009).

**Identification of Key Performance Indicators:** KPIs are print quality consistency, On-time delivery performance, Waste reduction, Equipment downtime and Customer satisfaction.

**Establishing Measurement Criteria:** Print quality may be measured using color accuracy, registration, and defect rates. On-time delivery may be measured against agreed-upon schedules. Waste reduction may be measured in terms of material usage efficiency. Equipment downtime may be measured in hours of non-productive time.

**Data Collection Processes:** Using sensors and monitoring devices on printing equipment. Collect data from production records and logs. Utilize employee input and feedback. Employ customer surveys and feedback.

**Frequency of Monitoring:** The continuous monitoring for real-time data on equipment performance. Regular customer satisfaction surveys on a quarterly or annual basis and assessments of waste reduction and print quality.

**Data Analysis and Interpretation:** Using statistical analysis tools to identify variations. Conduct root cause analysis for deviations from established standards. Compare current performance with historical data for trends

**Reporting and Communication:** Communicate the results of the monitoring and measurement activities to relevant stakeholders within the organization. Methods are generating regular reports highlighting KPI performance. Conduct periodic review meetings to discuss results and implications. Use visual aids, such as charts and graphs, for effective communication.

**Corrective and Preventive Actions:** Implement corrective actions for identified deviations and preventive actions to address potential issues. Methods are establishing a systematic process for addressing non-conformities. Develop action plans for continuous improvement based on KPI analysis. Monitor the effectiveness of corrective and preventive actions. Monitoring key performance indicators (KPIs) in printing processes ensures informed decision-making. Establishing and maintaining relationships with suppliers and customers is emphasized. In web-fed offset printing, collaboration with material suppliers and clear communication with clients contribute to overall quality (Shin & Shin, 2023).

### Benefits of Implementing QMS in Printing Processes

Implementing a Quality Management System (QMS) in printing processes offers a range of benefits, contributing to enhanced efficiency, customer satisfaction, and overall business success. QMS implementation ensures a systematic approach to quality, leading to consistently high print quality and customer satisfaction. Standardized processes and continuous improvement initiatives result in increased operational efficiency in web-fed offset printing facilities. QMS certification enhances the credibility of a printing facility, making it more competitive in the market. Identification and mitigation of risks contribute to minimizing errors in printing processes, reducing waste, and preventing customer dissatisfaction. QMS certification signals to customers that a printing facility is committed to delivering quality products and services (Vanko & Prikhodko, 2018).

QMS provides a robust framework for implementing and maintaining a quality management system in web-fed offset printing. By embracing the principles and requirements of this standard, printing facilities can optimize their processes, enhance customer satisfaction, and ensure their competitiveness in the dynamic printing industry. The implementation of a QMS in printing processes brings about a multitude of benefits, ranging from improved print quality to cost savings and enhanced customer satisfaction. It serves as a strategic tool for achieving operational excellence in the competitive and dynamic printing industry (Sharma, 2015).

### 3. Technological Advancements in Web-Fed Offset Printing

- i. **Automation and Robotics:** The latter half of the 20th century saw significant advancements in automation and speed for web-fed offset printing. Automated features such as automatic plate changing, computerized color control, and improved ink distribution systems were introduced. These innovations enhanced print quality, reduced setup times, and increased overall productivity.
- ii. **Advanced Color Management Systems:** As demands for high-quality color prints increased, advancements in color management systems became crucial. Spectrophotometers and sophisticated color measurement tools were incorporated into web-fed offset presses, enabling precise color control and consistency throughout the print run.

- iii. **Digitalization of Printing Processes:** The late 20<sup>th</sup> and early 21<sup>st</sup> Centuries witnessed the integration of digital technologies into web-fed offset printing. Computer-to-plate (CTP) technology replaced traditional film-based methods, allowing for direct digital transfer of images to printing plates. This not only improved precision but also streamlined the prepress process.
- iv. **Hybrid and UV Printing:** Hybrid printing systems that combine offset and digital technologies emerged to offer enhanced flexibility and personalization in print jobs. Additionally, the adoption of UV curing technology allowed for faster drying times, reduced energy consumption, and expanded substrate options.
- v. **Integration of Industry 4.0 Technologies:** In recent years, the printing industry has embraced Industry 4.0 principles, integrating smart technologies for data-driven decision-making. Internet of Things (IoT) devices, real-time monitoring, and predictive maintenance systems have become integral parts of modern web-fed offset printing facilities, optimizing efficiency and reducing downtime.
- vi. **Sustainability Considerations:** With a growing emphasis on sustainability, the latest developments in web-fed offset printing include environmentally friendly practices. Waterless offset printing, eco-friendly inks, and recycling initiatives contribute to reducing the environmental impact of the printing process. The evolution of web-fed offset printing reflects a continual quest for efficiency, speed, and quality. Technological advancements, coupled with industry demands, have driven the transformation of web-fed offset printing into a highly sophisticated and versatile printing method.

#### 4. Challenges in Implementing QMS in Web-Fed Offset Printing

Various challenges associated while implementation of Quality Management System in Web-fed Offset Printing is enlisted as below:

- i. **Resistance to Change:** This resistance can pose challenges to the successful implementation of the QMS. Employees might resist changes if they are used to the current way of doing things, even if those methods are not optimal. The familiarity of existing processes can create a reluctance to adopt new practices. Employees may worry that the QMS implementation could lead to job changes or restructuring, causing concerns about job security. This fear can result in resistance. If employees don't fully grasp the purpose and benefits of the QMS, they may resist change due to uncertainty. Clear communication about the objectives of the QMS is crucial to overcome this challenge. Employees may resist changes if they believe that the QMS will make their jobs more challenging or complicated. Ensuring that employees understand how the QMS streamlines processes is important. If employees feel unprepared to adapt to the changes, they may resist the QMS implementation (Opoku et al, 2021).

Providing proper training and ongoing support is essential to address this challenge. If there is a lack of trust between employees and management, resistance to change is likely. Building trust through transparent communication and involving employees in decision-making can help mitigate this challenge. The existing organizational culture can influence how change is perceived. If the culture is resistant to change, employees may be hesitant to embrace the new QMS. Employees who have experienced failed change initiatives in the past may be hesitant to engage in new efforts. Addressing past issues and demonstrating the benefits of the QMS can help overcome this challenge. Employees may resist change if they feel that their efforts are not acknowledged or rewarded. Providing recognition and incentives for embracing the QMS can motivate employees to overcome resistance. Poor or unclear communication about the reasons for implementing the QMS, its benefits, and the support available can lead to resistance. Open and transparent communication is crucial to address this challenge.

- ii. **Addressing Resistance to Change:** Involve employees in the planning and decision-making processes related to the QMS to make them feel part of the change. Provide comprehensive training programs to equip employees with the skills and knowledge needed to adapt to the new processes. Ensure visible and active support from leadership to demonstrate a commitment to the success of the QMS. Establish feedback mechanisms to allow employees to express concerns and provide input. Addressing concerns in a timely manner builds trust. Recognize and reward employees who actively contribute to the successful implementation of the QMS (Ali et al, 2022).

Implement changes gradually, allowing employees to adapt and adjust over time. Clearly communicate how the QMS is designed to enhance job roles and contribute to the overall success of the organization. Align the QMS with the existing organizational culture and values to facilitate smoother integration. Highlight early successes and improvements resulting from the QMS implementation to build confidence and enthusiasm. By proactively

addressing concerns, communicating effectively, and involving employees in the process, organizations can overcome resistance and facilitate the successful implementation of a QMS in web-fed offset printing (Cornelison, 2013).

- iii. **Cost Implications:** The implementation of a Quality Management System (QMS) in web-fed offset printing comes with various cost implications, and these can pose challenges for organizations. While the long-term benefits of a QMS often outweigh the initial costs, it's essential to recognize and address the financial considerations associated with implementation. Implementing a QMS requires an initial investment in terms of software, technology, training, and infrastructure. These upfront costs can strain financial resources, especially for small or medium-sized printing businesses. Properly training employees on QMS procedures and principles is crucial. Training programs may involve costs related to materials, instructors, and potentially downtime as employees participate in training sessions. Engaging external consultants for QMS implementation guidance or seeking certification from relevant quality standards bodies (such as ISO) involves additional expenses. Certification costs can include audits, assessments, and compliance verification. Upgrading or implementing new technologies to support the QMS, such as quality monitoring systems, automation tools, or information management software, may incur substantial costs. Adjusting existing processes to align with QMS requirements may require investments in process optimization, which can include changes to equipment, workflows, and materials. These changes may have associated costs. Properly managing data and documentation as required by the QMS involves investments in information systems, document control software, and data storage solutions. The cost of maintaining accurate and accessible records can be significant. Regular monitoring and auditing of QMS processes to ensure compliance and effectiveness may require additional resources, including personnel, tools, and time. These ongoing costs contribute to maintaining QMS integrity. Employee resistance to change can result in productivity losses during the transition period. Reduced productivity can translate to indirect costs that organizations need to account for during the implementation phase. Identifying and addressing non-conformities through corrective actions may incur additional expenses. This can include resources needed to investigate issues, implement corrective measures, and verify their effectiveness. The time and resources invested in QMS implementation could divert attention and resources from other business priorities. The opportunity costs associated with focusing on QMS may need to be carefully managed.
- iv. **Addressing Cost Challenges:** Conduct a thorough cost-benefit analysis to assess the long-term advantages of QMS implementation. This helps in justifying initial expenses by highlighting potential savings and improvements. Implement the QMS in phases to distribute costs over time and allow the organization to realize benefits gradually. This approach can help manage financial strain and facilitate smoother transitions. Develop a strategic budget that allocates resources effectively. Prioritize critical elements of the QMS implementation to ensure that essential areas receive the necessary financial support. Optimize training programs to be cost-efficient while ensuring effective knowledge transfer. Utilize a mix of in-house and external resources to balance costs and training quality. Prioritize investments based on critical needs and consider scalable solutions that can adapt to the organization's growth. Explore potential funding opportunities or grants that support quality improvement initiatives. Some government programs or industry associations may offer financial assistance. Involve employees in the QMS implementation process to minimize resistance. Engaged employees are more likely to contribute positively to the transition, potentially reducing productivity losses. Apply Lean principles to eliminate waste and inefficiencies in processes. This approach can lead to cost savings and improved overall efficiency. Learning from the experiences of similar organizations can provide valuable insights. While implementing a QMS involves costs, organizations can navigate these challenges by adopting a strategic and systematic approach. By carefully planning, prioritizing, and engaging stakeholders, the organization can position itself for long-term success in achieving quality objectives and satisfying customer requirements.

## Conclusion:

This research paper underscores the indispensable role of Quality Management Systems in enhancing the quality and efficiency of web-fed offset print production. By exploring the integration of QMS with cutting-edge printing technologies, the paper provides insights into the challenges faced by the industry and potential avenues for future growth and improvement.

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