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Impact of 5s workplace organization on dredging productivity: A plot field case study in swamp operations

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Abstract

This study investigates the effect of implementing the 5S workplace organization methodology on the operational performance of a cutter suction dredger in a Nigerian swamp environment. The research adopts a single-site before–after field intervention design, where the 5S principles—Sort, Set in Order, Shine, Standardize, and Sustain—were systematically introduced to improve workplace organization, material handling, and operational efficiency. Ten matched observations of hourly dredger output were collected under comparable operating conditions before and after the intervention.

Descriptive assessment of operational inefficiencies across 5S categories indicated that issues related to "Set in Order" were most prevalent, followed by "Sort" and "Shine," suggesting their relative importance in influencing workflow disruptions. A paired-samples t-test was used to evaluate the effect of the intervention on dredger output. The results showed that mean hourly production increased from $520.65m^3/h$ before implementation to $606.14m^3/h$ after implementation, representing an average improvement of $85.49m^3/h$. The mean difference was statistically significant, $t(9) = 8.97$, $p = 0.001$, with a 95% confidence interval ranging from 71.41 to 99.57.

These findings indicate that structured workplace organization through 5S implementation can enhance operational performance in dredging activities. However, given the limited sample size and single-site design, the results should be interpreted as indicative rather than broadly generalizable. Further studies with larger datasets and multi-site validation are recommended to confirm the robustness of these findings.

Keywords: 5S Methodology; Work Place Organization; Lean Operations; Dredging Productivity; Operational Efficiency

1. Introduction

Dredging operations in swamp environments are characterized by complex and highly variable working conditions, including restricted accessibility, unstable terrain, and operational constraints associated with equipment deployment and material handling. These environmental and logistical challenges frequently contribute to reduced operational efficiency, increased downtime, elevated operational costs, and project delays. Unlike controlled industrial settings, dredging performance is influenced by multiple interacting factors such as soil characteristics, sediment density, cutter head performance, pump efficiency, pipeline configuration, water depth, weather conditions, and crew operational competence. As a result, maintaining consistent productivity in such environments requires not only technical capability but also effective workplace organization and process control.

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From an operations management perspective, Lean thinking provides a structured approach for improving efficiency by systematically identifying and eliminating non-value-adding activities (waste) within production systems. Within the Lean framework, the 5S methodology represents one of the most widely adopted workplace organization tools. It consists of five interconnected principles: Sort (removal of unnecessary items), Set in Order (systematic arrangement of materials), Shine (cleaning and inspection), Standardize (establishing consistent procedures), and Sustain (maintaining discipline and continuous compliance). Collectively, these principles aim to improve visual management, reduce operational inefficiencies, and enhance workflow stability.

Empirical evidence from manufacturing, construction, healthcare, and mining sectors indicates that 5S implementation can lead to improvements in productivity, safety performance, equipment utilization, and reduction of operational waste. These benefits are primarily achieved through reduced search time, improved material accessibility, enhanced maintenance readiness, and better coordination of work activities. However, the magnitude and sustainability of these outcomes are highly dependent on contextual factors such as workforce discipline, management commitment, and the complexity of the operational environment.

Despite the growing body of evidence supporting 5S in industrial and service systems, its application in dredging operations—particularly in swamp-based environments—remains limited in the academic literature. This gap is significant because dredging operations differ substantially from conventional manufacturing systems due to their dynamic field conditions and high sensitivity to environmental and mechanical variability. Consequently, the transferability of Lean workplace organization principles to such settings requires empirical validation.

This study therefore investigates the implementation of the 5S methodology in a cutter suction dredging operation within a swamp environment and evaluates its effect on operational performance. The study specifically examines whether structured workplace organization can improve dredger output under field conditions and identifies the key workplace inefficiencies that influence operational flow. The research contributes to the limited literature on Lean applications in marine and dredging operations by providing empirical field-based evidence from a real operational setting.

1.1. Problem Statement

Dredging operations in swamp environments are often constrained by disorganized workspaces, inefficient equipment layout, and the absence of standardized operational procedures. These deficiencies contribute to increased downtime, reduced productivity, and elevated operational costs. Although structured workplace organization approaches such as the 5S methodology have demonstrated effectiveness in manufacturing and related sectors, their application within dredging operations—particularly in swamp conditions—remains limited and insufficiently documented. This gap creates a need for empirical investigation into the extent to which 5S principles can improve operational performance in such contexts.

1.2. Research Objectives

The main objective of this study is to evaluate the impact of 5S implementation on the operational performance of a cutter suction dredger in a swamp environment.

1.2.1. The specific objectives are to

- Quantify the change in hourly dredger output before and after the implementation of the 5S methodology.
- Identify and categorize workplace inefficiencies according to the 5S framework prior to intervention.
- Assess the relative prevalence of different categories of workplace disorder and their potential impact on operational workflow.
- Evaluate the short-term effect of 5S implementation on operational efficiency under comparable working conditions.

1.3. Research Hypotheses

To support statistical analysis, the following hypotheses are formulated:

- Null Hypothesis (H_0): There is no significant difference in the mean hourly dredger output before and after the implementation of 5S.
- Alternative Hypothesis (H_1): There is a significant difference in the mean hourly dredger output before and after the implementation of 5S.

- Does the implementation of the 5S methodology significantly improve the hourly output of a cutter suction dredger in swamp operations?

2. Literature Review

The 5S methodology is a foundational element of lean operations management, widely applied to improve workplace organization, process efficiency, and operational reliability (Alfarhan, 2022). Originating from Japanese manufacturing systems, 5S comprises five principles—Sort (Seira), Set in Order (Seaton), Shine (Seiso), Standardize (Suketus), and Sustain (Shinsuke)—which collectively aim to eliminate non-value-adding activities and enhance workflow consistency (Nemati et al., 2019). While early applications were concentrated in manufacturing environments, contemporary studies have extended its relevance to construction, mining, healthcare, auto-care and other service systems, where operational efficiency is strongly influenced by workplace organization and resource accessibility (Zaveri, 2024; Budiyanto and Nuricabyono, 2022; Singh et al., 2022; Kanabar et al., 2024;)

Empirical studies consistently show that 5S implementation contributes to improvements in productivity, safety, and operational control. However, these outcomes are not uniform across contexts. In industrial settings, improvements are often linked to reductions in search and set up times, improved tool accessibility, and better spatial organization (McDonald, 2023). In contrast, in field-based operations such as construction and mining, the effectiveness of 5S is mediated by environmental constraints, workforce discipline, and variability in operational conditions. This suggests that the transferability of 5S benefits depends on contextual adaptation rather than direct replication.

From an operations perspective, the mechanisms through which 5S influences performance can be understood in terms of workflow efficiency and interruption reduction. Poor workplace organization typically leads to increased search time, unnecessary motion, equipment misplacement, and minor stoppages. These inefficiencies accumulate to reduce effective operating time and overall system throughput. By enforcing structured arrangement (Set in Order), eliminating unnecessary items (Sort), and maintaining equipment condition (Shine), 5S directly targets these sources of inefficiency. Standardization and sustainment further ensure that improvements are consistently maintained, reducing performance variability over time. Training plays a crucial role as far as sustenance is concerned. (IADC, 2023; Correla et al., 2020).

In heavy engineering and resource extraction sectors, such as mining, studies have reported that 5S contributes to reduced equipment downtime, improved maintenance responsiveness, and enhanced safety compliance (Zaveri, 2024; Nemati et al., 2019). These improvements are particularly important in environments where operational disruptions carry significant cost implications. However, existing literature also highlights key challenges in 5S implementation, including resistance to change, inadequate training, weak supervision, and difficulty sustaining improvements over time. The "Sustain" component is frequently identified as the most challenging, as it requires continuous behavioral reinforcement and organizational commitment.

Despite the growing body of research in industrial and mining contexts, there is limited empirical evidence on the application of 5S in dredging operations. Dredging, particularly in swamp environments, presents unique operational challenges, including difficult terrain, limited accessibility, equipment congestion, and high susceptibility to downtime. These characteristics make workplace organization a critical determinant of operational performance. However, the absence of structured studies in this domain represents a significant gap in the literature.

Conceptually, the impact of 5S on dredging output can be framed through its effect on effective production time. Improved organization reduces time lost to searching for tools and materials, minimizes obstruction around critical equipment, and enhances access for maintenance activities. Regular cleaning and inspection improve equipment readiness and reduce minor faults, while standardization ensures consistent operational practices among crew members. Together, these factors contribute to reduced interruptions, improved coordination, and increased hourly production output. Indeed, 5S is created to provide measurable solutions to problems (Diego, 2023).

Based on this reasoning, the present study positions 5S as an operational intervention that influences dredger performance through multiple pathways: reduction in non-productive time, improved equipment accessibility, enhanced maintenance readiness, and better workflow coordination. Besides housekeeping, it provides tangible quantifiable solutions to site problems by empirically evaluating these effects in a swamp dredging context, this study contributes to bridging the gap between lean management theory and its application in marine and dredging operations.

2.1. Conceptual Framework diagram:

5S Implementation

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Workplace Organization Improvement

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Reduced Search Time

Reduced Obstruction

Improved Maintenance

Better Safety Access

Improved Coordination

↓

Increased Effective Operating Time

↓

Higher Dredger Output (m^3/h)

3. Materials and Methods

3.1. Research Design

This study adopted a single-site pilot field case study using a pre–post (before–after) intervention design to evaluate the effect of 5S implementation on dredging performance. The design compares operational output before and after the intervention under matched operating conditions. This approach is suitable for exploratory evaluation in real operational environments where controlled experimentation is not feasible. The approach follows a flow process (Figure 3).

3.2. Study Site and Operational Context

The study was conducted at a swamp dredging project operated by Astra Group Ltd, a contractor engaged by a local oil field operator in Nigeria. The operation utilized a cutter suction dredger (CSD) under typical swamp conditions characterized by soft soil formation, limited accessibility, and variable working conditions.

3.3. Participants and Training

A total of 10 operational personnel (including dredger operators, technicians, and support staff) participated in the study. These personnel were directly involved in dredging activities and workplace organization.

A 5S training handbook was developed specifically for the site and used to train participants on the principles and practical application of 5S. The training covered all five elements (Sort, Set in Order, Shine, Standardize, and Sustain) and included site-specific implementation guidelines (Table 4).

3.4. Intervention Procedure (5S Implementation)

The implementation followed a structured sequence

Baseline Assessment: Preliminary site inspections were conducted to document existing workplace conditions, identify non-value-adding activities (waste), and assess operational practices.

Problem Identification: Observed inefficiencies were categorized according to 5S elements using a structured checklist (Table 5).

Training and Deployment: Personnel were trained using the 5S handbook, after which 5S practices were introduced across the work areas (Table 4).

Implementation Period: The site operated under the 5S framework for a period of six months, allowing stabilization of practices.

Post-Implementation Assessment: Follow-up site visits and data collection were conducted to evaluate changes in operational performance.

3.5. Data Collection and Measurement

Data were collected using a combination of:

- Operational records (hourly dredger output in m^3/h)
- Structured observation checklists for workplace inefficiencies (Table 5)
- Field reports on non-value-adding activities

3.5.1. Outcome Variable

- Primary outcome: Hourly dredger output (m^3/h)

3.5.2. Observation Structure

- A total of ten matched observations were obtained before implementation and ten matched observations after implementation.
- Each observation represents average hourly output measured over a defined operational shift under stable working conditions.
- Observations were matched based on comparable dredging conditions, including:
    - Similar dredging location/soil characteristics
    - Similar equipment configuration
    - Consistent crew structure
    - Similar operational periods

3.6. Control of Confounding Factors

To improve internal validity, efforts were made to ensure comparability between pre- and post-intervention observations. Matching was based on:

- Dredging zone characteristics
- Equipment operating condition
- Crew composition
- Work schedule

However, due to the field-based nature of dredging operations, it was not possible to fully control all sources of variability such as minor geological differences, weather conditions, and equipment wear. These limitations are acknowledged in the study.

3.7. Assessment of Workplace Inefficiencies

A descriptive problem-mapping approach was used to assess workplace inefficiencies prior to intervention. Observed issues were categorized under the 5S elements and their frequency recorded across key work areas. This analysis was used to identify dominant sources of operational inefficiency and guide implementation priorities.

3.8. Data Analysis

A paired-samples t-test was employed to evaluate the effect of 5S implementation on dredger output. This method is appropriate for comparing means of related observations (before vs after).

3.8.1. The analysis included

- Computation of mean output before and after intervention
- Calculation of mean difference
- Estimation of standard deviation of differences
- Hypothesis testing at $\alpha = 0.05$ (95% confidence level)

3.8.2. Validity and Reliability

Measurement validity: Output data were obtained from operational records routinely used for performance monitoring.

Consistency: Observations were matched to ensure comparability of conditions.

Procedural reliability: Standardized checklists were used during site inspections to ensure consistent identification of inefficiencies.

4. Results and Discussion

This presents the results and discussion of the analysis of the relationship between dredging operational performance.

Descriptive Analysis of 5S Related Operational Inefficiencies

Table 1 Frequency-Based Ranking of 5S Elements Deficiencies

Unit	**Sort**	**Set in order**	**Shine**
Main Deck	4	6	4
Control Room	3	3	2
Store	6	11	5
Engine Room	5	7	5
Total	18	27	16

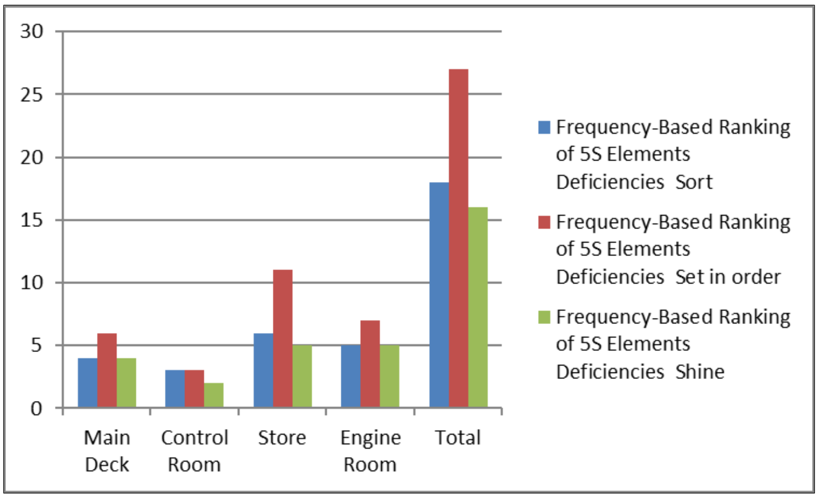

Figure 1 5S Elements Deficiencies Analysis Result

4.1. Results of 5S Workplace Inefficiency Assessment

Table 1 and Figure 1 showed a descriptive assessment conducted to identify workplace inefficiencies prior to 5S implementation. Observed issues were grouped according to the 5S framework (Sort, Set in Order, Shine, Standardize, and Sustain) based on frequency of occurrence across operational activities.

The results indicate that inefficiencies were most frequently associated with Set in Order, followed by Sort, while Shine showed comparatively fewer issues. These findings reflect the relative prevalence of workplace organization challenges rather than a direct measure of their statistical impact on dredger output.

It is important to clarify that this ranking represents a frequency-based diagnostic assessment, not a causal or sensitivity analysis of dredger productivity.

4.2. 5S Implementation Evaluation

The effectiveness of the 5S intervention was evaluated using two approaches:

- Descriptive comparison of pre- and post-intervention conditions
- Paired-samples t-test of dredger output

4.3. Pre–Post Dredger Output Comparison

Table 2 Before and After 5S Hourly Output

Actual output Rate (m^3/h) -after 5S	**Actual output Rate (m^3/h) -before 5S**	**Difference (d)**
590.12	480.25	109.87
550.08	440.31	109.77
580.10	520.12	60.01
660.12	560.09	100.03
610.21	530.15	80.06
640.15	550.01	90.14
585.16	500.01	84.92
670.02	570.08	99.94
600.20	540.15	60.05
575.16	515.12	60.04

Table 3 Paired Sample t-test Result

Statistics	Sum Output After	Sum Output Before	Mean Output After	Mean Output Before	Mean Difference	Std. Dev. of Difference	t-Statistics	Degree of Freedom (df)	p-Value (2-tailed)	95% CI of Difference
Value	6061.32	5206.29	606.14	520.65	85.49	19.68	8.97	9	.001	71.41 99.57

Ten matched observations of hourly dredger output were recorded before and after the intervention under comparable operating conditions.

The results show a consistent increase in output across all paired observations following 5S implementation.

Mean output before implementation: 520.65m^3/h

Mean output after implementation: 606.14m^3/h

Mean improvement: 85.49m^3/h

All observed pairs showed improvement after the intervention, indicating a consistent directional effect of 5S on operational performance.

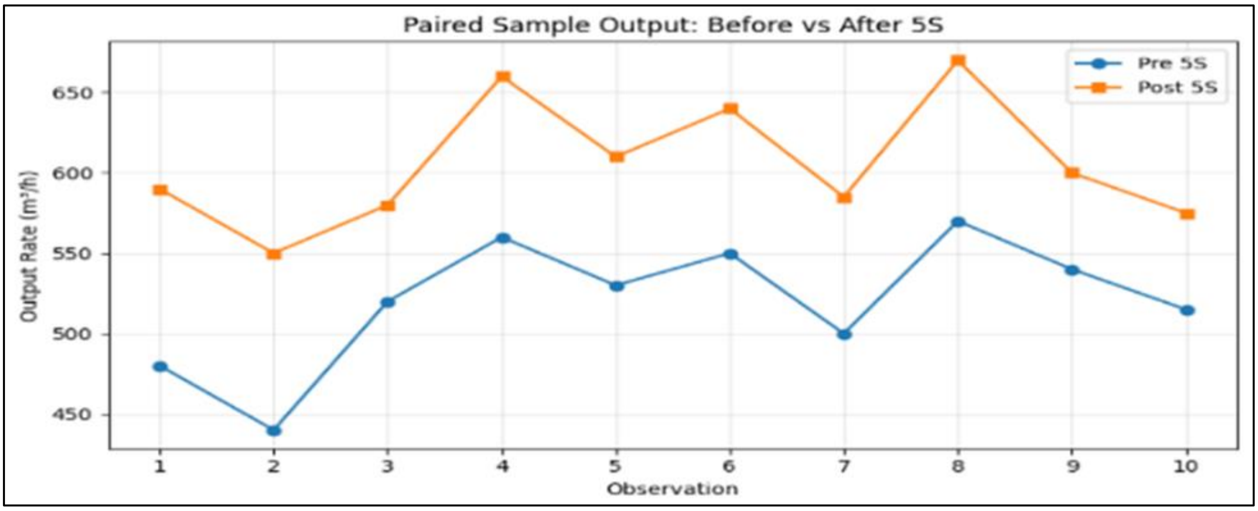

Figure 2 Paired Sample Output Before and After 5S

The paired difference plot shows the change in dredger output before and after 5S for each observation. In all 10 observations, before 5S output is higher than after 5S. The improvement is consistent across periods. This shows strong operational gains after implementation.

4.4. 4.4 Inferential Statistical Analysis

A paired-samples t-test was conducted to determine whether the observed improvement was statistically significant.

The analysis showed a statistically significant increase in dredger output after 5S implementation:

t(9) = 8.97, p = 0.001

95% Confidence Interval: [71.41, 99.57]

Standard deviation of differences: 19.68

The results indicate that the improvement in output is statistically significant at the 5% level.

To assess practical significance, the effect size was computed:

$$\text{Cohen's d} = \frac{85.49}{19.68} = 4.34 \text{ (approx.)}$$

This represents a very large effect size, suggesting that the intervention had a strong operational impact under the study conditions.

4.5. Interpretation of Findings

The improvement in dredger output following 5S implementation can be explained by reductions in non-value-adding activities within the operational workflow. Prior to implementation, inefficiencies such as poor tool arrangement, workplace disorganization, and delays in locating materials contributed to loss of productive time.

The Set in Order principle had the greatest operational influence by reducing search time and improving accessibility of tools and equipment. The Sort principle contributed by eliminating unnecessary materials from the workspace, while shine improved equipment readiness and reduced minor operational disruptions.

Collectively, these improvements enhanced effective operating time, which is the primary driver of dredger productivity.

4.6. Comparison with Existing Studies

The findings are consistent with lean management literature, which reports that 5S improves productivity by reducing waste, searching time, faster turnaround and set up time, improving visual control, and enhancing workflow efficiency (McDonald, 2023). Similar results have been reported in mining and construction environments, where 5S implementation has been linked to reduced downtime and improved equipment utilization (Nemati et al., 2019).

This study extends these findings to dredging operations in swamp environments, a context that is less represented in existing literature. The results suggest that lean workplace organization principles remain effective even under highly variable field conditions.

4.7. Summary of Key Findings

- 5S implementation led to a statistically significant increase in dredger output
- Mean improvement was 85.49m^3/h
- Effect size was very large (d ≈ 4.34)
- Set in Order was the most influential workplace factor
- Improvements are consistent with lean operations theory

5. Conclusion

This study examined the effect of 5S workplace organization on dredging performance in a swamp environment using a single-site pilot field before–after design. The findings indicate that the implementation of 5S was associated with an increase in dredger output from 520.65m^3/h to 606.14m^3/h, representing an average improvement of 85.49m^3/h. A paired-samples t-test confirmed that this improvement was statistically significant ($t(9) = 8.97$, $p = 0.001$), with a large effect size.

The results suggest that structured workplace organization can improve operational efficiency in dredging activities by reducing non-value-adding activities such as tool searching, workspace obstruction, and workflow interruptions. However, given the limited sample size, single-site design, and short observation period, the findings should be interpreted as preliminary and context-specific rather than broadly generalizable.

Overall, the study provides initial empirical evidence that 5S implementation can enhance operational performance in swamp dredging environments, while also highlighting the importance of structured workplace management in field-based engineering operations.

Limitations

The study has several limitations that should be acknowledged:

- The research was conducted at a single operational site, limiting external validity.
- Only ten matched observations were used, which restricts statistical robustness.
- Full control of dredging variability (soil conditions, weather, equipment wear, and crew differences) was not possible.
- The study did not include long-term monitoring to assess sustainability of 5S adherence.
- Fuel consumption and downtime metrics, though initially considered, were not included in the final analysis.

Recommendations

Based on the findings, the following recommendations are made:

Adoption of 5S in dredging operations

- Dredging firms should consider implementing structured workplace organization systems such as 5S to improve operational flow and reduce non-productive time.

Targeted workforce training

- Operators and support staff should undergo continuous training on workplace organization principles, particularly focusing on Set in Order and Sustain, which are critical for long-term effectiveness.

Structured implementation strategy

- 5S should be introduced through phased implementation, beginning with workplace assessment, followed by training, execution, and continuous monitoring.

Management reinforcement systems

- Supervisory mechanisms should be established to ensure adherence and prevent regression to disorganized practices.

Future Research Directions

Future studies should:

- Employ larger datasets with more observation points
- Use multi-site or comparative designs
- Incorporate fuel consumption, downtime, and cost metrics
- Apply time-series or interrupted time-series analysis
- Investigate long-term sustainability of 5S in dredging operations

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

There is no conflict of interest at all. it is purely academic work sponsored single handedly by the corresponding author

Statement of ethical approval

Permission to conduct the study and use operational data was obtained from the management of Astra Group Ltd. Participation of personnel in training and observation activities was conducted with their knowledge and consent. No personal or sensitive data were collected, and all reported results are presented in aggregated form.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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Appendix

Work Method Flow Chart

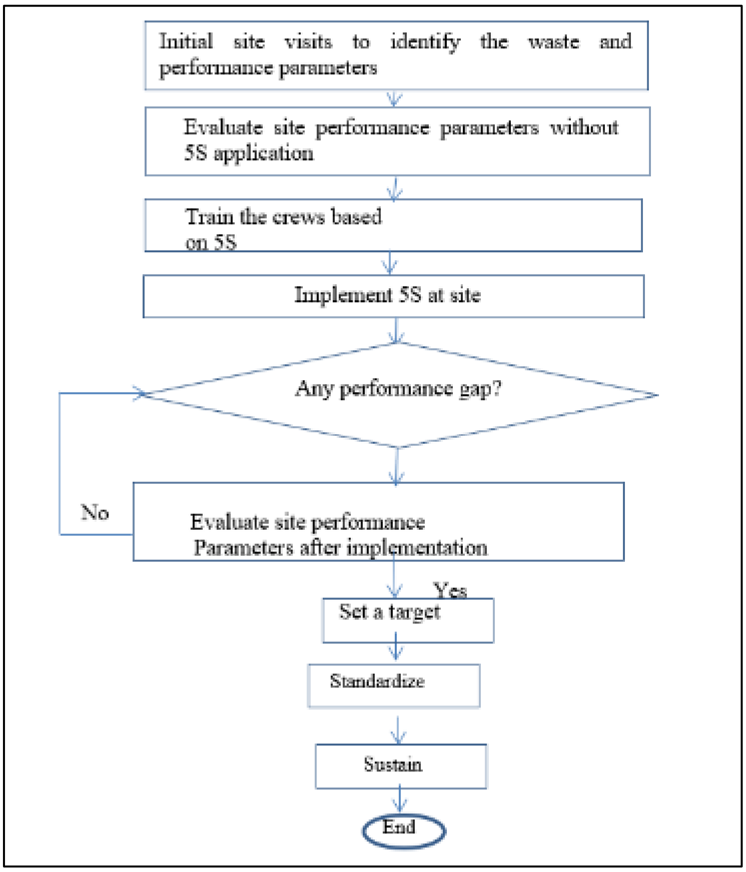

Figure 3 Work Flowchart

Training Schedule

Table 4 Training Schedule

Days	Topics	Time	Remarks
Day 1	Introduction Objectives Familiarizing with the crew through 5S eliciting questions What is 5S and what does it stands for? Benefits of 5S 5S Tools Methodology of 5S	10.00am-10.15am (Introduction) 10.15 - 30am (Tea time) 10.30-1.00pm(Training) 1.00-2pm (Break/Lunch) 2.00-3.30pm (Training) 3.30 - 4.00pm (Closure)	
Day 2	5S Work site scan diagnostic checklist 5S Implementation steps and goals	10.00am-10.15am (Introduction) 10.15 - 30am (Tea time) 10.30-1.00pm (Training) 1.00-2pm(Break/Lunch)	

	5S Before and After Implementation 5S Achievement 5S markings and synergies display on the dredger Crew involvement in 5S in a dredging system: Main Deck Control cabin Engine room Store	2.00-3.30pm (Training) 3.30- 4.00pm (Closure)	
Day 3	Field application of 5S in a dredging system: on board of the dredge	9.30-9.45am (Induction on board of dredger) 9.45-1.00pm (Implementation) 1.00pm-2pm (Break/Lunch) 2.00 – 4.30pm (Closure)	i) A list of materials required shall be sent ahead for the organization to procure and provide ii) The organization shall provide the logistics to and for site iii) Take away lunch and drinks package to go to site

Table 5 5S Levels of Achievement

5S Levels of Achievement					
Level V: Continuously Improve	Cleanliness problems are identified and mess prevention actions are in place.	Needed items can be retrieved within 30 seconds and require a minimum number of steps.	Potential problems are identified and counter measures are documented.	Reliable methods and standards for housekeeping, daily inspections and workspace arrangement are shared and are used throughout similar work areas.	Root causes are eliminated and improvement actions focus on developing preventive methods.
Level IV: Focus on Reliability	Work area has documented housekeeping responsibilities & schedules and the assignments are consistently followed.	Needed items in work area are minimized in number and are properly arranged for retrieval and use.	Inspection occurs during daily cleaning of work areas and equipment and supplies	Reliable methods and standards for housekeeping, daily inspections and workplace arrangement are documented and followed by all members of the work group.	Sources and frequency of problems are documented as part of routine work, root causes are identified, and corrective action plans are developed.
Level III: Make It Visual	Initial cleaning has been performed and sources of spills and messes are identified and corrected.	Needed items are outlined, dedicated locations are properly labeled and required quantities are determined.	Visual controls and identifiers are established and marked for the work area, equipment, files and supplies.	Work group has documented agreements on visual controls, labeling of items, and required quantities of needed items.	Work group is routinely checking area to maintain 5S agreements.
Level II: Focus on Basics	Needed and not-needed items are identified. Those not needed are removed from work area.	Needed items are safely stored and organized according to frequency of use.	Key work area items to be checked are identified and acceptable performance levels documented.	Work group has documented agreements for needed items, organization and work area controls.	Initial 5S level has been determined, and performance is documented and posted in work area.
Level I: Just Beginning	Needed and not-needed items are mixed throughout the work area.	Items are placed randomly throughout the workplace.	Key work area items checked are not identified and are unmarked.	Work area methods are not consistently followed and are undocumented.	Work area checks are randomly performed and there is no visual measurement of 5S.
Place yellow box where each area is on the 5S Levels of Achievement.	**Sorting**	**Simplifying**	**Systematic Cleaning**	**Standardizing**	**Sustaining**

Table 6 5S Rating Level

No of problems	Rating Level (RL)	Remark (s)
5 or more	Level 0(L0)	
3-4	Level 1(L1)	
2	Level 2(L2)	
1	Level 3(L3)	
0	Level 4(L4)	

Table 7 Frequency-Based Ranking of 5S Elements Deficiencies

Main Deck	No of problems	(RL)	Remark (s)
Sort	4	(L1)	Unneeded and removal of disused drums, wrecks, debris, wood logs etc.
Set in order	6	(L0)	Needed and reposition of fixtures, welding machine, filled oil and gear drums, fire extinguisher, sand box in their right places
Shine	4	(L1)	Dirt, oil, grease on the deck of two side pontoons, equipment: fixture, welding machine on deck; cleaning materials not readily accessible
Control Room			
Sort	3	(L1)	Disused water sachet and papers, damaged dredge captain's seat etc. identified and removed
Set in order	3	(L1)	Manuals, and placing on the right place; repair of damaged dredge captain's seat, leaking roof
Shine	2	L2	Water on the control room deck properly mopped
Store			
Sort	6	(L0)	Disused oil filters, cans, drums, water nylons, cartons, worn out PPEs etc.
Set in order	11	(L0)	Needed items were safety materials, tools and accessories: marine rope, slings, and buoys, personnel protection equipment: (coveralls, helmets, safety shoes, goggle, rain coat etc.), oil fitters, suction throat, spare parts, store records and documentations and set in right places
Shine	5	(L0)	Dirt keel, inner roof, and inner hull were properly washed; racks were dusted and mopped. The tools and some dusty spares and materials were cleaned and kept in proper places.
Engine Room			
Sort	5	(L0)	Unneeded items: disused gallons, fitters, nylons, tool box, cartoons etc.
Set in order	7	(L0)	The needed items such as the tools, tool box, fitters, oil containers, spare parts and maintenance records booklets and set in the right place
Shine	5	(L0)	Oil and grease smeared on the engine room deck and inner hull. They were properly washed and mopped.