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Åland University of Applied Sciences, Bachelor of Marine Technology

THE DIGITAL WORK PERMIT

From Paper to a Screen

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Abstract
<p>The study serves as a foundation for an upcoming project regarding the development of a digital Work Permits system. It was done so by evaluating existing procedures with executed Hot Work Permits and comparing the findings with a theoretical model of a digital Work Permit system. To accurately evaluate the Hot Work Permits and to get more nuanced answers of the questions a person with extensive experience of the existing Work Permit system was consulted and interviewed.</p> <p>The digital Work Permit system model was outlined with the purpose of being closely compatible with the existing TelScope platform developed by Telko AS Norway.</p> <p>Further studies are needed to examine how such a product would be introduced onboard ships and to fit variable onboard Work Permit procedures.</p>

Keywords
Work Permit, Hot Work, Permits, Digital

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Abstrakt
<p>Studien fungerar som en grund för ett kommande projekt om utveckling av ett digitalt arbetstillståndssystem. Det gjordes genom att utvärdera befintliga procedurer med tidigare utförda arbetstillstånd för heta arbeten. Resultatet jämfördes sedan med en teoretisk modell av ett digitalt arbetstillståndssystem. För att exakt utvärdera de heta arbetstillstånden och få en mer nyanserade svar på frågorna konsulterades och intervjuades en person med omfattande erfarenhet av det befintliga arbetstillståndssystemet.</p> <p>Det digitala arbetstillståndsmodellen utformades i syfte att vara nära kompatibel med den befintliga TelScope-plattformen som utvecklats av Telko AS Norge.</p>

Nyckelord
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Glossary of acronyms

DOC	Document
EOW	Engine Officer of the Watch
GNSS	Global Navigation Satellite System
GUI	Graphic User Interface
HWP	Hot Work Permit
ICS	International Chamber of Shipping
ILO	International Labor Organization
IMO	International Maritime Organization
ISM-CODE	International Safety Management Code
IAPH	International Association of Ports and Harbors
MSC	Maritime Safety Committee
OCIMF-Oil	Companies International Marine Forum
OOW	Officer of the Watch
PPE	Personal Protective Equipment.
PRA	Preparations and Risk Analysis
RA	Risk Assessment
SMS	Safety Management System
UHF	Ultra High Frequency
UTC	Universal Time Coordinated
WhatsApp	Mobile App for texting and calling.
WP	Work Permit

1 INTRODUCTION

Work Permits is a safety tool, and its purpose is to give the worker a layer of defense against accidents and to ensure the integrity of the ship. Regardless of how well intended the idea of Work Permits is there are many flaws to the system. Since the system of using Work Permits was introduced in June 2003, it has exclusively consisted of paperwork. The method is inefficient in today's standard where the permit must travel physically between the different stakeholders open for unintended shortcuts, assumptions, and complacency. It Leads the crew and the ship down a treacherous road where false confidence can lead to damage done to the ship or even loss of life.

In the last decade, the aviation and automobile industry have had significant advances in the use of technology. The maritime industry on the other hand still lingers behind at least 10 years or more in its digital advancements. There is currently a race for improving old and developing new technology. Yet little to no effort has been made to improve the system regarding Work Permits. We can assume there are many reasons why a digital platform for managing Work Permits has not yet been developed. Since there are no studies on this matter alone, we cannot know for certain what they are. There is no agreed international standard on how the layout for the documentation, monitoring and filing of Work Permits and it is the ship owner's sole responsibility to establish a working Work Permit system with the necessary documentation and procedures. I believe these are some of the factors that have made it difficult to develop a system that fits a larger number of shipping companies and type of ships. On top of this there must be a potential for profitability and then the task become even more complex and possibly not worth the effort.

The cruise ship industry where I stem from operates well over 300 ships and more is under construction. In the year of 2019, we handled a total of 2037 Work Permits within the Deck department alone on one of the ships I had previously worked on, undoubtedly there is a need.

I believe a digital platform for Work Permits would allow the process to be more time efficient and hopefully stakeholders will refrain from taking short cuts or circumventing essential procedures.

2 PURPOSE

The purpose of the study is to elaborate around and raise questions related to Work Permits, how procedures, document handling, management, reporting, and record keeping can be done more efficiently through a digital system. Besides the efficiency aspect the study shall consider what impact implementation of a digital Work Permit system will have on the SMS and possible soft values for the ship owner.

2.1 Question at issue

- How are time and recourses managed with the existing system for Hot Work Permits?
- Are recourses being utilized inefficiently or in a contradicting manner in relation to the SMS?
- How can a digital system assist or improve a stage in the Work Permit process that has been identified as inefficient or improperly managed?
- What changes are required within the SMS for a digital Work Permit system to be implemented?
- What other potential positive and negative effects are there when digitalizing the Work Permit process?

2.2 Delimitations

The Scope of this thesis will remain within the framework of the process chart and focus of how to digitalize the process. Adding content regarding how certain events are carried out in the completion of the Work Permit process or trying to refine such an event would divert attention from the issue in question. When describing the issues, it will be limited to parts of an already existing SMS regarding Work Permits. As every company has its own SMS, involving more than one SMS could result in contradicting procedures each other and it would be too much information to process.

3 BACKGROUND

Work Permits has become an essential part of the SMS and any work carried out onboard that presents a risk towards the crew or jeopardizes the integrity of the ship now requires a Work Permit. The Work Permit is the document that confirms that a risk assessment and accident prevention evaluation was conducted prior to beginning a high-level risk work. The Work Permit is aimed to allow involved personnel to carry out the specific task in a safe way. Besides the risk assessment the Work Permit defines authority and responsibility for each department, precautions, duration, validity, and nature of the work.

The Work Permit system is governed by the ISM-Code, *The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel* (ISM-Code, Part A, Chapter 7). IMO has in several resolutions and circulars given recommendations and guides such as MSC/Circ. 1084, 13 June 2003 “*Principles for hot work on board all types of ships.*” although those are not detailed. Instead they have recognized the efforts of organizations like ILO, IAPH, ICS, OCIMF among others which has developed recommended guidelines based on best industry practices.

Each company is responsible to establish their own Work Permit system and to source the necessary expertise either within their own organization or elsewhere. As a result, each Work Permit system is slightly different. Irrespective the objective is the same, to safeguard the crew and the ship from accidents and disasters. Unfortunately, even when a Work Permit is present accidents occur. Regardless if there are deficiencies with the Work Permit procedures or the person responsible fails to execute them correctly.

The time spent on reporting and documenting events onboard ships is continuously increasing due to strict requirements on navigational safety, environmental protection and to ensure compliance with laws and regulations. Despite the digital aids already available to officers and crew onboard, much of the manual paperwork remains adding to the increasing heavy administrative workload.

In 2018 Telko AS in Norway began developing their new platform TelScope. The platform offers a series of electronic record books and e-Navigation services. After the launch in 2020 the work has continued to improve and develop new features. One idea is to make the electronic record book more versatile by expanding and integrating it beyond its traditional area of use. The handling of Work Permits is theoretically a part of the daily operation that could be integrated with TelScope.

3.1 Material description

I have decided to use a Work Permit system commonly used in the cruise ship industry as a prerequisite for this study. The advantage being that I am already familiar with their system. Other information will be sourced through internet and printed literature to complement the above mentioned.

Design and logic for the digital system follows the principles used in the TelScope platform. The reference material from Telko is classified and I have not been given permission to publish it with the study.

Sensitive information in Appendix 1 and 2 such as Company, Ships Name, Names, signatures etc. has been masked, extracted, or deleted to protect certain interests.

4 METHOD

The work will be divided into 4 phases.

4.1 Phase 1 Evaluation of Hot works

I will evaluate several previously completed Hot Work Permits based on a commonly used Work Permit model from the cruise ship industry.

- What stakeholders were involved?
- Were there any persons involved outside the assigned stakeholders? If so, how did they impact the Work Permit process?
- Were the procedures followed correctly?
- Were there any delays in the process?

Together with the findings, interviews will be held with some stakeholders to complete the evaluation.

4.2 Phase 2 The Digital Work Permits System Requirements

Defining the requirements for the digital Work Permit system.

- Identify user and user needs.
- Describe the functional and operational requirements.
- Design a Flowchart for the digital Work Permit system.

4.3 Phase 3 System Design and Graphic User interface

Create a design of the new Digital Work Permit system with focus on the graphic user interface.

4.4 Phase 4 Comparison

I will review the digital Work Permit system by comparing steps in a hot work scenario from phase 1 against the tabletop exercise and presenting the positive and negative effects between the two. During the tabletop exercise TelScope Logbook and WhatsApp will be used to simulate the flow of information and notifications between the stakeholders.

5 EVALUATION OF HOT WORKS

5.1 General observations

From a stack of Work Permits for hot works, 5 was randomly selected as examples for review. Reviewing some of the Work Permits proved to be difficult due to indistinct handwriting and the fact that in some cases information was missing. The Chief Officer onboard where the hot works were performed was consulted to clarify where a complete review was not possible. When the hot works had been reviewed it was discovered that there were consistent faults in the documentation throughout the Work Permits.

Fault 1” Who issues a Work Permit?”

The person who issues a permit should always be the Responsible Officer as stated in:

- Hot Work Guide, 3.3 a *“The Responsible Officer will typically be as defined by procedure section 3.0. The Responsible Officer is responsible for issuing the Work Permit”*.
- General Guidelines, 4.2 Topics, Process *“The Work Permits shall be issued by the Responsible Officer upon verifying that the relevant Risk Assessment has been properly completed. The signature of the Responsible Officer validates the Work Permit itself.” In this and all the other cases according to the permit itself the Bosun has been the person issuing the Work Permits”*.

Fault 2” Preparations and Risk Analysis document Item 1 clear instruction missing?”

It is not defined in the Hot Work Guide nor in the General Guidelines what event should be notified on item 1 leaving it open for interpretation.

The Chief Officer interprets that it is the Risk Analysis Officer who is responsible for this document and he believes item 1 should be filled in when they start preparing the area or doing the risk analysis. The ship has an onboard procedure to further mitigate risk that prohibits certain Work Permits to be performed during arrival/departure and in situations where safety of navigation is not be jeopardized or critical stages in the engine room.

To control this the original documents are then handed over to the OOW/EOW after being signed and validated by the Responsible Officer. The OOW/EOW then gives the Work Supervisor a verbal permission by phone or radio before they can start.

5.2 The five Hot Works

5.2.1 Work Permit # 1

What Stakeholders Were Involved?

- Person who issues the permit, 1st Bosun.
- Responsible Officer, Staff Captain.
- Work Supervisor, 1st Bosun.
- Risk analysis Officer, Fire Fighter.
- Person Performing the task, Repairman.
- Fire Watch 1, Able Seaman.
- Fire Watch 2, Deck Repairman.
- Delegated representative of the Responsible Officer, Chief Officer.

Other Persons involved?

- OOW

Were the procedures followed correctly?

The Process of was mostly followed but there are a few discrepancies in the documentation.

- The start time for the Preparations and Risk Analysis is incorrect.
- The Work Permit was not issued by the Responsible Officer.

The Chief Officer confirmed that Risk Analysis Officer failed to document the time when they started the risk assessment.

Were there any delays in the process?

There were no significant delays in the process.

5.2.2 Work Permit # 2

What Stakeholders Were Involved?

- Person who issues the permit, 1st Bosun.
- Responsible Officer, Staff Captain.
- Work Supervisor, 1st Bosun.
- Risk analysis Officer, Senior Fire Fighter.
- Person Performing the task, Repairman.
- Fire Watch 1, Able Seaman.
- Delegated representative of the Responsible Officer, Chief Officer.

Other Persons involved?

- OOW

Were the procedures followed correctly?

- The start time for the Preparations and Risk Analysis is incorrect.
- The start time for the Work Permit is missing.
- The Work Permit was not issued by the Responsible Officer.

Were there any delays in the process?

There was a delay from the time the responsible officer signed and validated the Work Permit and the starting time. The reason for the delay was an arrival into port according to the Chief Officer

5.2.3 Work Permit # 3

What Stakeholders Were Involved?

- Person who issues the permit, 1st Bosun.
- Responsible Officer, Staff Captain.
- Work Supervisor, 1st Bosun.
- Risk analysis Officer, Senior Fire Fighter.
- Person Performing the task, Repairman.
- Fire Watch 1, Able Seaman.
- Delegated representative of the Responsible Officer, Chief Officer.

Other Persons involved?

- OOW

Were the procedures followed correctly?

- The start time for the Preparations and Risk Analysis is incorrect.
- The time documented in the Work Permit, Item 8 suggests that the Work Permit was signed and validated before the Preparation and Risk Analysis had been completed.

Hot Work Guide, 3.3 a “*The Responsible Officer will typically be as defined by procedure section 3.0. The Responsible Officer is responsible for issuing the Work Permit upon verifying the level of risk associated with a specific hot work by either verifying the proper completion of the check list by the Risk Analysis Officer or personally verifying that the involved area is safe. The signature of the Responsible Officer validates the Work Permit itself.*”.

Hot Work Guide, 3.3 b *“The Risk Analysis Officers can be any one as defined by the procedure in Ship SMS. section 3.0. The Risk Analysis Officer is the one that is in charge of the work preparation (through the relevant check list) prior to the issue of the relevant Work Permit.”.*

- The Work Permit was not issued by the Responsible Officer.

Were there any delays in the process?

There is a slight delay between validating and start time of the Work Permit.

5.2.4 Work Permit # 4

What Stakeholders Were Involved?

- Person who issues the permit, 1st Bosun.
- Responsible Officer, Staff Captain.
- Work Supervisor, 1st Bosun.
- Risk analysis Officer, Senior Fire Fighter.
- Person Performing the task, Repairman.
- Fire Watch 1, Able Seaman.
- Delegated representative of the Responsible Officer, Chief Officer.

Other Persons involved?

- OOW
- Deck Watch

Were the procedures followed correctly?

- The start time for the Preparations and Risk Analysis is incorrect.
- The Work Permit was not issued by the Responsible Officer.

Were there any delays in the process?

There is a delay between completion of the Preparations and Risk Analysis and the validation of the Work Permit.

According to the Chief Officer the Deck Watch was tasked to deliver the Preparation and Risk Analysis document to the Responsible Officer. Due to a meeting between onboard management the Deck Watch waited till meeting was over before delivering the document.

5.2.5 Work Permit # 5

What Stakeholders Were Involved?

- Person who issues the permit, 1st Bosun.
- Responsible Officer, Staff Captain.
- Work Supervisor, 1st Bosun.
- Risk analysis Officer, Senior Fire Fighter.
- Person Performing the task, Repairman.
- Fire Watch 1, Able Seaman.
- Delegated representative of the Responsible Officer, Chief Officer.

Other Persons involved?

- OOW

Were the procedures followed correctly?

- The start time for the Preparations and Risk Analysis is incorrect.
- The Work Permit was not issued by the Responsible Officer.

Were there any delays in the process?

There were no significant delays in the process.

5.3 Interview

I followed up the review of the documents with an interview of the Chief Officer. I wanted to hear his point of view on the findings to get more basis to better answer some of the questions at issue.

How do you feel times and recourses are managed onboard regarding Hot Works?

“Every job is different so it is difficult to compare one against the other but it is very rarely a fluent process and a lot time is lost when the work does not start or is prepared in time. For example, if the preparation is done late then the risk analysis officer might be occupied with other things which creates a delay in the chain of signatures needed to start the work.”

Is there anything else regarding the Hot Work Permit process you find inefficient or is done in a contradicting manner in relation to your SMS?

“The way documents must be passed between different people around the ship before that permission to start can be granted is not particularly efficient. I do not believe the process is done in a contradicting manner beside the point you made where the Bosun had issued the permit instead of the Staff Captain who is the Responsible Officer. But the reason for this deviation from the guidelines is to reduce some of the workload of the Staff Captain and make the process a little bit more efficient.”

5.4 Conclusion for the current hot work process

It is evident a lot of time is lost when a Hot Work Permit travels between stakeholders. In our case it took an average of 20 minutes for the PRA to be delivered to the Responsible Officer and 15 minutes from validation and signing of the Work Permit till when the work commenced.

The Chief Officer mentioned that Deck Watch had been tasked to deliver the documents and in combination with a management meeting the delay was unusually long compared to the others. The involvement of crew members who does not have a stake in the process could be a reason why so much time is lost or when one stakeholder is not available at the time for different reasons the process comes to a standstill.

In the execution of the Hot Work Permits there are some minor deviations from the guidelines and in the documentation. After evaluation of the 5 Hot Work Permits with assistance of the Chief Officer and the interview, certain parts of the guidelines seem incomplete or undefined. Parts are left open for interpretation where it could easily be defined by just a few sentences. For example, it lacks definition and explanation of who is responsible of the PRA document and how various parts are to be handled, resulting in some missing or wrongfully entered information.

The “owner” of the Work Permit document seems to have been delegated to the Bosun/Work Supervisor who issues the Work Permit instead of the Responsible Officer as defined by the written procedures. There are a lot of discrepancies in the documentation, especially the start timings of the PRA and WP. It is likely that this is because certain stakeholders and the OOW are not fully familiar with the documents and the procedures. If you disregard the above mentioned the Hot Work Permits are managed sufficiently looking at it from the view of compliance with the Safety Management System.

There is no process flowchart provided in the guidelines to illustrate the intended workflow which could further explain the various deviations in how the procedures are carried out. In this case it is aberrant because the industry use process flowcharts as a tool in many other events especially for safety and emergency procedures. In favor of the reader and to complement the conclusions made. I have created two process flowcharts explaining the Hot Work Permit process based on the review of the Hot Work Permits, my own experience and the information provided by the Chief Officer. The flowcharts aim to reflect the actual workflow rather than what is described in the guidelines, how stakeholders and other involves parties interact.

5.4.1 Preparation and Risk Analysis – Flowchart

The Flowchart in Figure 1 illustrate the process of the preparation and risk analysis for the Hot work Permit.

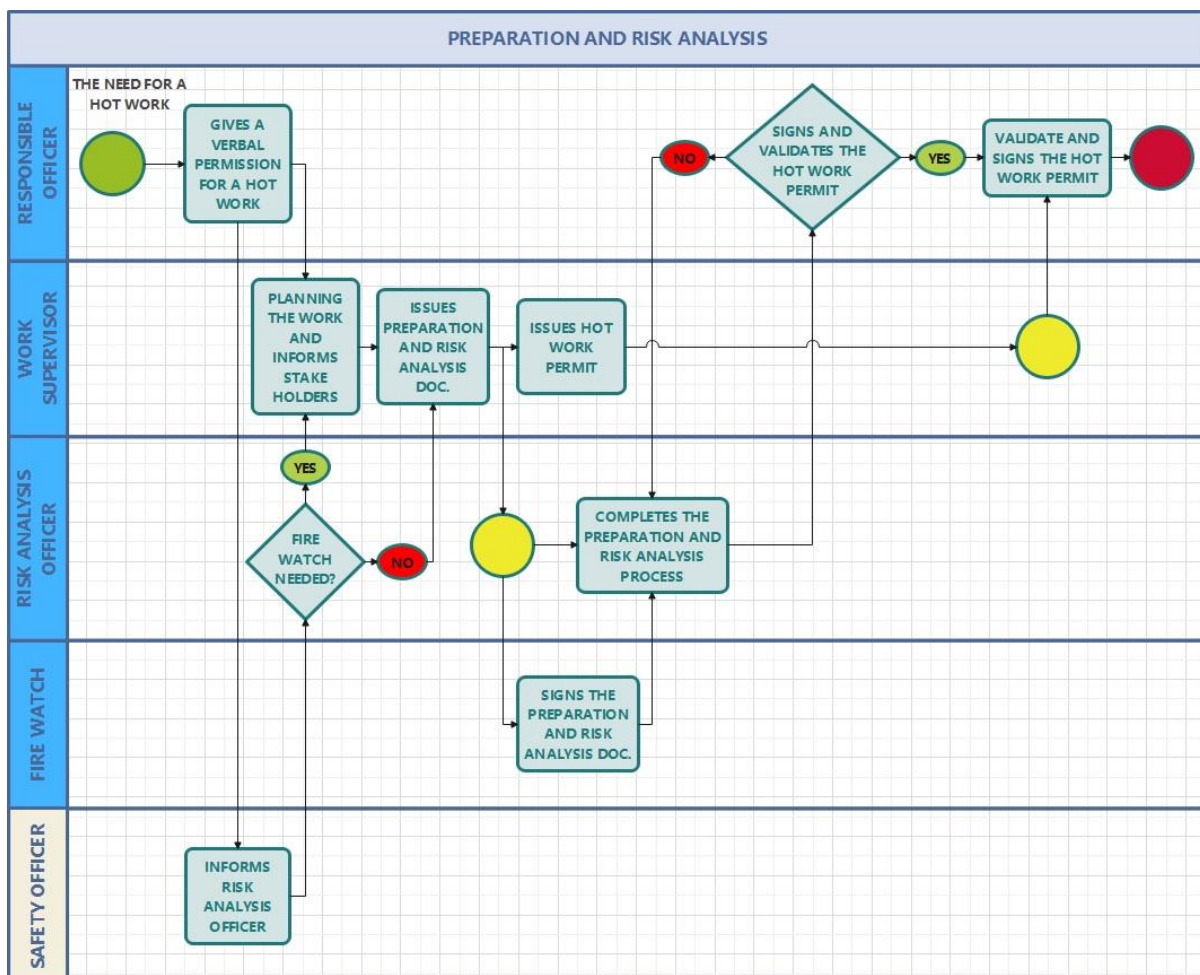


Figure #1: Preparation and Risk analysis Flowchart

When there is a need for a Hot Work the onboard management plans and decides on the details. The information is then passed down either by the Staff Captain or the Chief Officer to the Bosun. Worth mentioning is that The Bosun has also been the Work Supervisor in all reviewed

cases. The Bosun (Work Supervisor) will then plan the work and coordinate with the stakeholders. When all the necessary planning and preparations are done, he will issue and prepare the PRA and WP documents for the process to begin.

The Safety Officer informs one of the Fire Fighters and assigns him as the Risk Analysis Officer. There is always a Fire Watch for every Hot Work but as for how many the Risk Analysis Officer usually decides together with the Work Supervisor. The PRA checklist is then completed by the Risk Analysis Officer before it is delivered together with the WP for validation and approval by the Responsible Officer.

5.4.2 Hot Work Permit – Flowchart

The Flowchart in Figure 2 illustrate the process of the execution of the Hot work Permit.

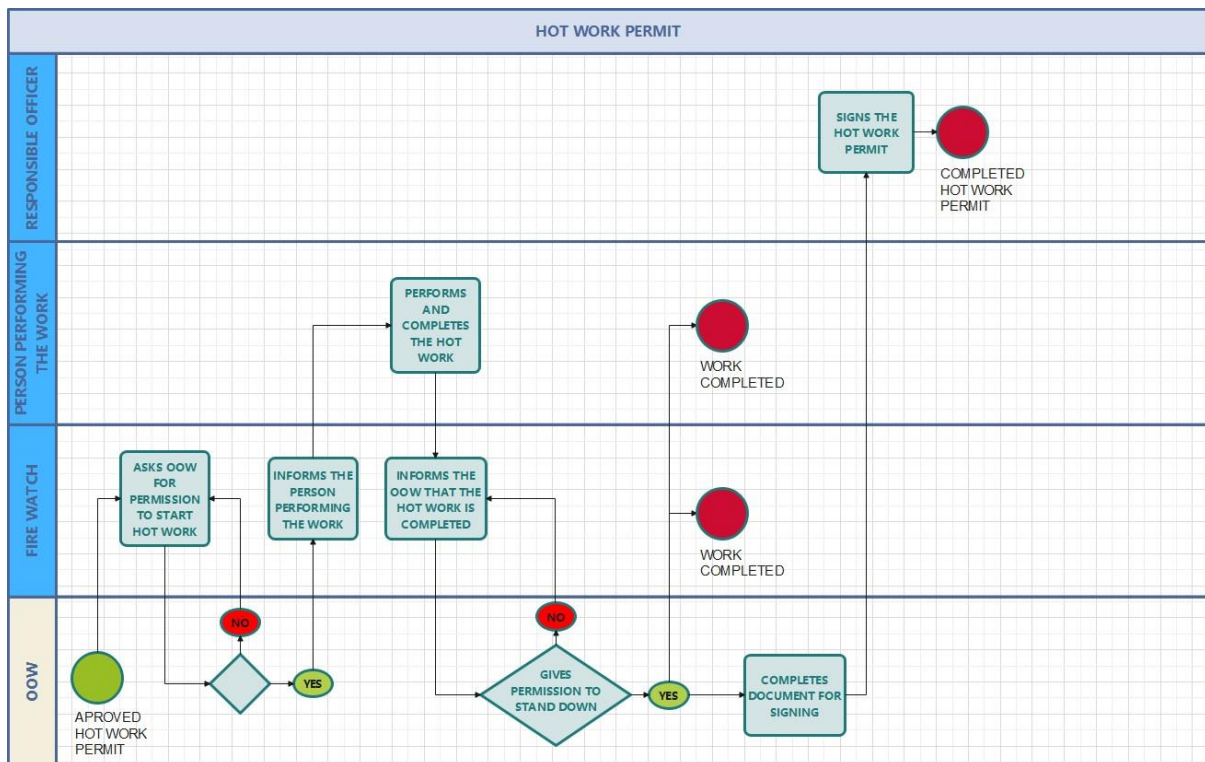


Figure #2: Hot Work Permit – Flowchart chart

After approval of the WP the original documents are handed over to the OOW, a copy is then brought back and posted in the work area. Before the work can begin one of the stakeholders, usually the Fire Watch asks the OOW for permission to start.

When the work is completed the Fire Watch informs the OOW who then gives them the permission to stand instead of the Responsible Officer.

6 THE DIGITAL WORK PERMIT SYSTEM REQUIREMENTS

6.1 User Needs

An important input to the development process is the user needs. The purpose of the user needs is to align all stakeholders involved in the development process. It can also be used for evaluation of the finished software.

The following user needs were defined for the digital Work Permit process.

General User Needs

- Push Notifications for start and stop and other events needed to track the process.
- Access to and completion of checklists
- View of permit status and progress.

Responsible Officer

- Digital review and approval of completed draft permit.

Work Supervisor

- Digital interface for generating draft permit including assignment of stakeholders.
- Digital signing of draft permit

Risk Analysis officer

- Access to Risk Assessment tool (Not part of this scope)
- Digital signing of Risk Assessment.

Person Performing the task

- Clear comprehensive final permit presentation.

OOW/EOW

- Push notifications for start request.
- Digital Start/Stop permissions.
- Situation dashboard for tracking of ongoing Work Permits.
- Automated logbook record of completed permit.
- Onboard Management
- Push notifications and location details and durations.

6.2 Functional and Operational Requirements

The idea with the project is to include the Work Permit System as a module with an existing system, therefore the part with functional and operational requirements are partly aligned with the Telko AS platform TelScope. TelScope Product description has been used as reference for design, basic system functions, abbreviations etc. The Digital System for Work Permit Management shall meet the following Functional and Operational requirement as minimum.

6.2.1 Work Permit Platform and User Workplace

- The Work Permits System software and database shall be installed on a server onboard the ship.
- The System shall be able to work off-line this means connection to Internet, Cloud or shore system is not required for the daily work.
- The User shall be able to work with the system via a Web-Client Interface on office workstations connected to the ships network.
- System shall be accessible from a mobile application on a tablet, mobile phone or a handheld device via Ships Wi-Fi.
- Off-Line mode shall be available for the Mobile APPs
- Several users shall be able to work on the same Work Permit simultaneously with online updates of records, with exemption where mobile device is used in offline mode.

Network and Cyber security are not part of the scope at this stage.

6.2.2 Work Permit Main Functions and Sub modules

6.2.2.1 Function for creating a draft Work Permit that includes

- Work Permit type
- Work Permit id/ref number (to be generated by the server)
- Start Time, Position and created by
- Short description of the work
- Work Location
- Assignment of stakeholders
- Work Permit limitation (time interval when the work can be carried out)
- Risk Assessment Limitation (time when the risk assessment is not valid any longer)

6.2.2.2 Function for notifications to stakeholders when/for

- New Assignment
- Task to be performed or signed
- Request for approval of Work Permit
- Permissions
- Work Permit will be terminated due to exceeding time
- Work Permit will be terminated due to that Risk Assessment is not valid
- Operation stopped or cancelled.

6.2.2.3 Risk assessment Module

- Not part of this Scope

6.2.2.4 Function for approval of Work Permit

- Push notification to Responsible Officer
- Approval and digital signing with 6-digit pin-code

6.2.2.5 Checklist

- Tool for creating and editing Checklist

6.2.2.6 Connection to logbook for automation of the following records

- Cancellation of work
- Work Completed

6.2.2.7 Dashboard for view of ongoing Work Permits and its status that should show the following information as minimum

- Work Permit Id/ref
- Work Permit Type
- Work Location
- Status

6.2.2.8 Function for print of

- Work Permit
- Checklist
- Completed Work Permits

6.2.3 System Access

- The access to the system should be controlled and tracked so that each entry in the Work Permit system is linked to an identified user onboard.
- As a minimum, access to the application shall require a unique personal login identification and password for each user.
- The following credentials shall be defined for each user as minimum
 - Username
 - Fore Name
 - Surname
 - Position
 - Password (Used for log into the system)
 - Pin Code 6-digit (used for personal verification or approval of records in the system)
 - A Role that provide the needed access in the Work Permit System
- To ensure the security of the system Role Based Access Control shall be used.
- The Role Based Access Control provides the following different rights for users of the Work Permit System.
 - Draft Permit – user have the right to create a draft permit
 - Approve Permit – user have the right to approve the Work Permit
 - Read – user have limited access and can only view Work Permits
 - Write – user can contribute and complete actions, make notes related to the work
 - Permissions – the user have the right to give permissions when the Work Permit is carried out
 - Risk Assessment – the user has the permission to complete Risk Assessment for the Work Permit.
 - Stop Operation – user can stop the operation
 - Cancel Permit – User can cancel the Work Permit

6.2.4 Time reference

- Date, time, and positions shall be obtained from connected GNSS sensor
- All events shall be logged in UTC together with the offset to ship time, for example UTC 09:15 (+01:00h)

6.2.5 Records and Entries

- Records and entries should be protected by measures aimed at preventing and detecting attempts at unauthorized deletion, destruction, or amendment
- If a wrong entry has been made, it should be corrected by single strike linked to the responsible user.
- It should not be possible, to delete or in any other way change the recorded data besides what is allowed as Strike Through of data
- The Work Permit system should provide a status field showing the different stages of the data entries and the approval process,
- To ensure that activities are carried out in a timely manner, the system should provide a notification to the stakeholder.

6.3 Digital Work Permit Flowchart

Figure 3.1-3.4 illustrates the digital Work Permit Process where.

- Column A, provides a short description to the section
- Column B, the process map
- Column C, Notifications to Stakeholders
- Column D, States and Record send to System


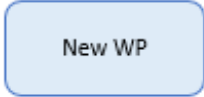
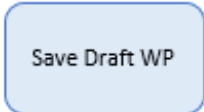

Description	Process Map	Notifications	Records and Status
Need for Hot Work			
Create New Work Permit <ul style="list-style-type: none"> • Select Work Permit type • Date and Time (from GNSS) • Ships Position (From GNSS) Who: Work Supervisor			DRAFT WP
<ul style="list-style-type: none"> • Save Draft Work Permit • Created By • Work Permit ID generated by server. Who: Work Supervisor			DRAFT WP

Figure #3.1: Digital Work Permit Flowchart

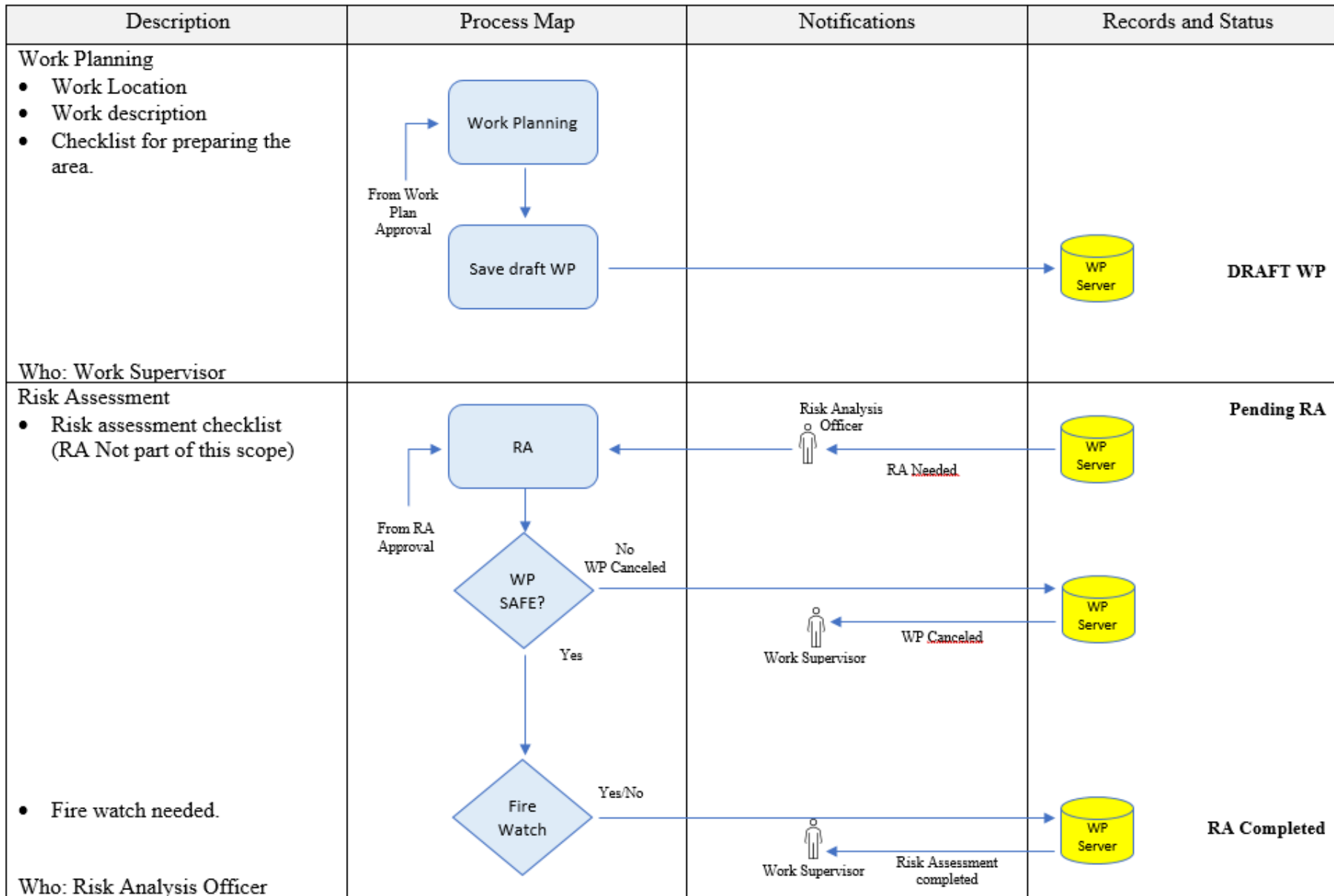


Figure #3.2: Digital Work Permit Flowchart

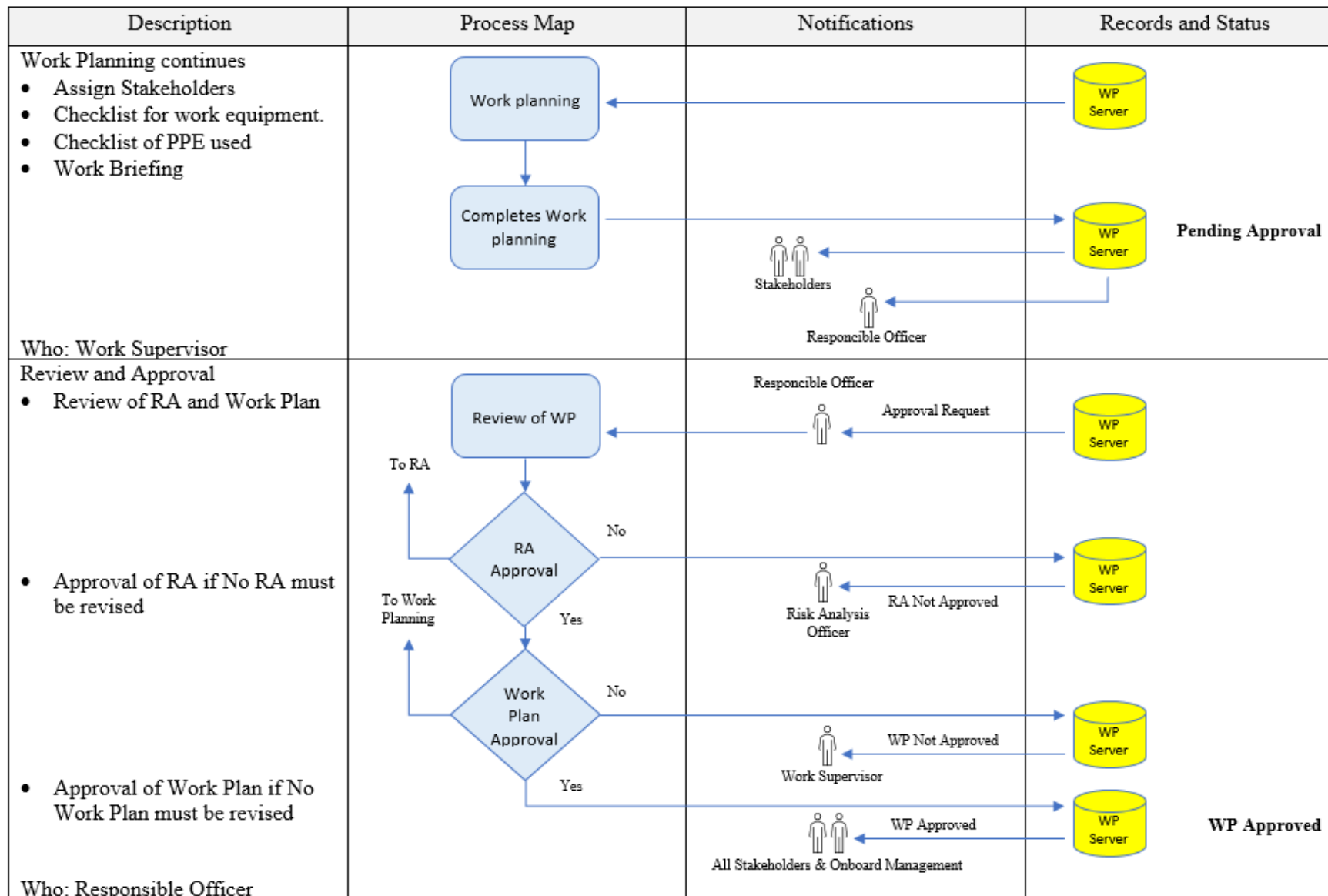


Figure #3.3: Digital Work Permit Flowchart

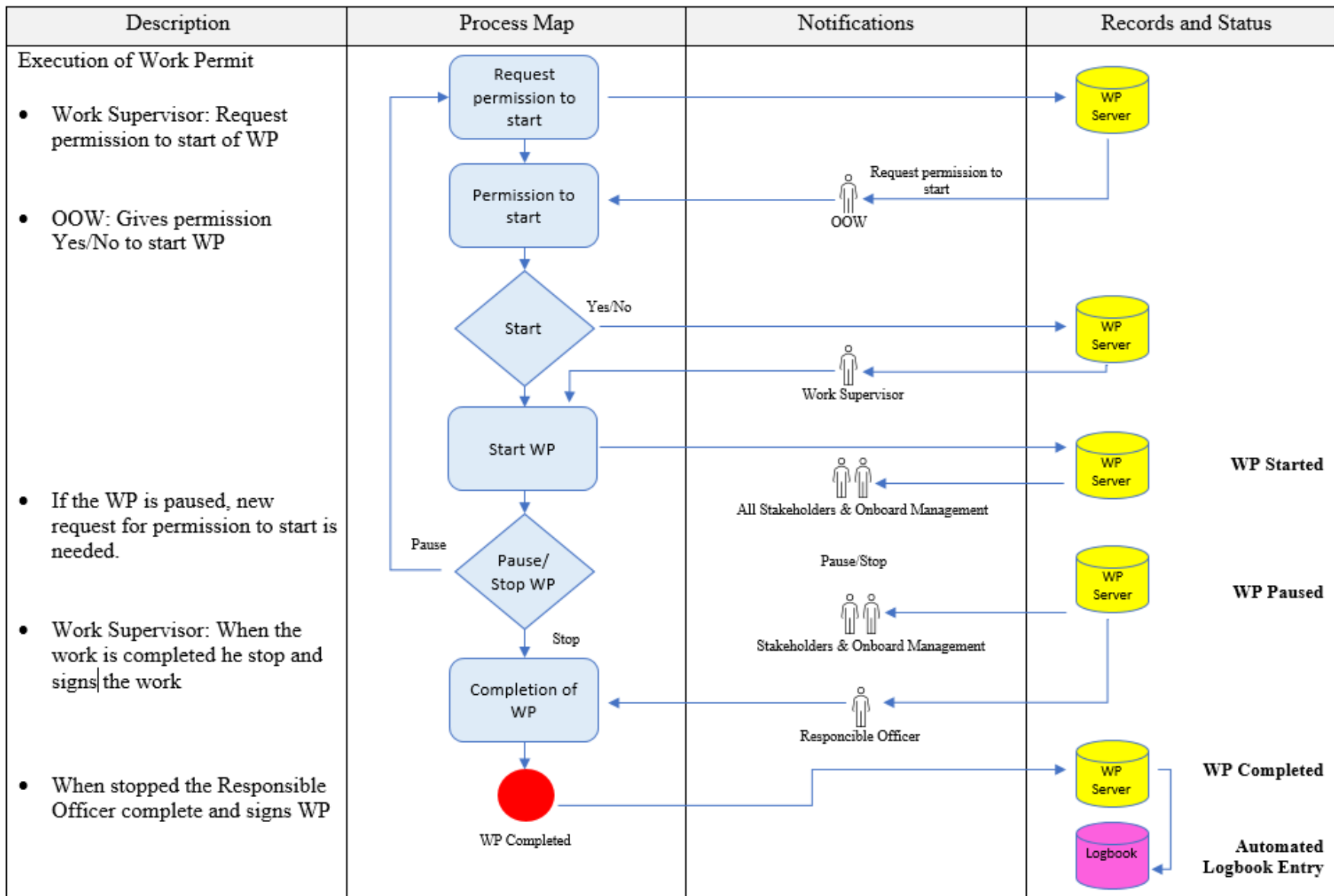


Figure #3.4: Digital Work Permit Flowchart

7 SYSTEM DESIGN AND GRAPHIC USER INTERFACE

INTERFACE

The scope of the System Design and Graphic User Interface has been limited to what is needed to explain the concept and ideas around the Digital Work Permit Process.

7.1 Basic system Configuration

The Digital Work Permit System will include the following main parts

- Work Permit Server and Database connected to the ships network.
- Application for the user (Front-end) that either can be accessed via a Web-Client that runs on a computer workstation on the ships network or as a Mobile application via the Wireless Network.

The Figure 4 below illustrates a basic setup on a ship.

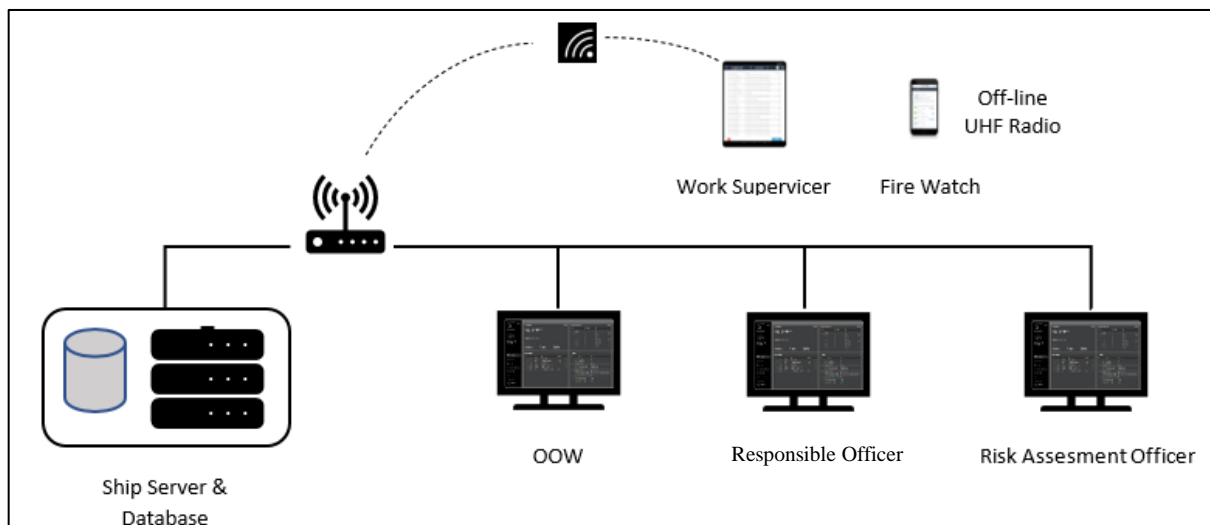


Figure #4: Basic System Configuration

7.2 Work Permit Server and Database

The Work Permit Server and Database host different modules such as:

- User Management
- Role Management
- Work Permit Module

- Checklist Module
- Ship Dashboard
- Logbook Module
- Record data storage

7.3 Work Permit Graphic User Interface

The Work Permit Graphic User Interface (GUI) accessible via the Web-Client or the Mobile App shall have the following tools allowing the Stakeholders to write, read, sign and work with the Work Permit during the whole process. .

- **Dashboard** – overview and status of all ongoing Work Permits
- **Work Permit Editor** – tool for creating and editing Work Permit templates and checklist.
- **Add New Work Permit** – tool for creating new Work Permit
- **Work Permit Operation Windows** – tool for managing the work Permit Record during process. All activities performed by the stakeholders from start to completing the WP is done inside this module. Se 7.3
- **Notification center** – Tool for sharing changes of Work Permit status to stakeholders, and alert to designated person carry out certain task in the Work Permit process.

Design of the GUI will not be part of this scope.

7.4 User & Role Management

The user and role management system are the key to control access rights and privileges for users of the Work Permit System. In user management the user is set up with his credentials, one of them are the different roles he can fulfill. Several roles can be assigned to a user.

In Role Management user rights for each role are defined. This is done in a matrix structure with the activities on the row axis and the user rights on the column axis

Find below roles for the user that are included in the digital process.

Table #1, List of Roles, and user rights

<i>Responsible Officer</i>	<i>Read</i>	<i>Write</i>	<i>Sign</i>	<i>Approve</i>
Create Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Risk Assessment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Permission Start/Stop	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Cancel Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

<i>Work Supervisor</i>	<i>Read</i>	<i>Write</i>	<i>Sign</i>	<i>Approve</i>
Create Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Risk Assessment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Permission Start/Stop	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Cancel Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

<i>Risk Assessment Office</i>	<i>Read</i>	<i>Write</i>	<i>Sign</i>	<i>Approve</i>
Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Risk Assessment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Permission Start/Stop	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Cancel Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

<i>Officer of the Watch</i>	<i>Read</i>	<i>Write</i>	<i>Sign</i>	<i>Approve</i>
Work Permit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Risk Assessment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Permission Start/Stop	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Cancel Work Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

<i>Fire Watch</i>	<i>Read</i>	<i>Write</i>	<i>Sign</i>	<i>Approve</i>
Work Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Risk Assessment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Permission Start/Stop	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Cancel Work Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

7.5 The Work Permit Record

In the analogue system the two forms PRA and WP are the carriers of information, decisions, and records during a Work Permit process. In the digital system this will be replaced by digital templates, electronic checklist, data inputs, notifications, and data records.

Figure 5 illustrates the information flow where the Work Permit Record is the place holder for data, tasks/actions, time, status and the source for visualization and notifications.

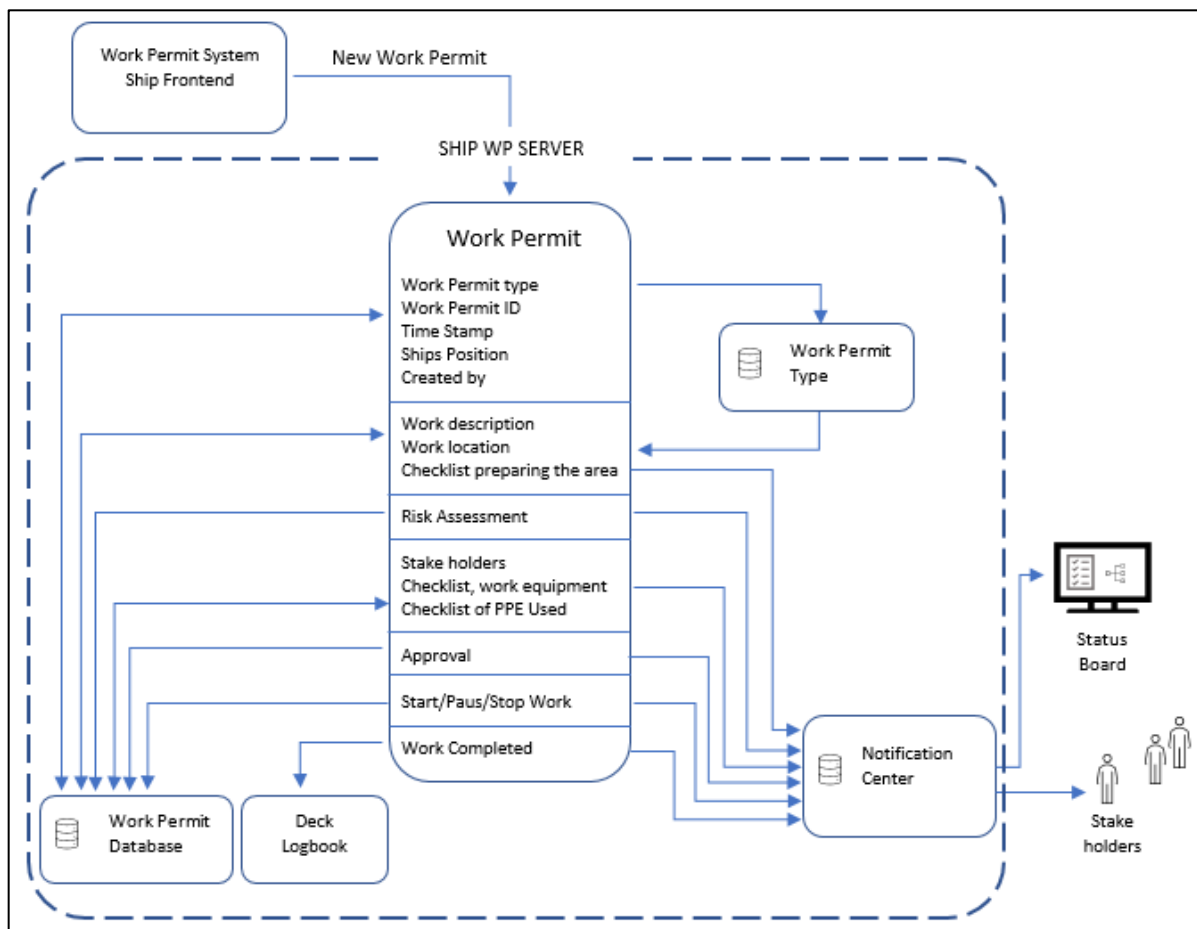


Figure 5: Work Permit Record Information Flow

Description of the Work Permit Record

- Work Permit Record is generated in the Web Client or Mobile App by Creating new Work Permit.
- The Work Permit can be opened by stakeholders based on the role and access rights at any time.
- Input, actions, signing/approval are sent to the Work Permit Data Base.
- Information is sent via the Notification Centre to stakeholders when a task is completed, or Work Permit Status is changed.
- By selecting Work Permit Type, the record will be prefile with data and the appropriate checklist will be opened depending on the work type.
- The User fill in mandatory information such as Work description, Work Location (Deck, Fire Zone, room/area) and save the draft permit
- Risk assessment section (not part of this scope)

- Work Planning section for assignment of stakeholder's, preparation of checklists - planning is completed and signed with users 6-digit Pin Code
- Approval Section – for Validation and approval of RA and Workplan – Signing by Pin-Code
- Execution section for permission/information of Start/Paus/Stop/Termination and Completion of work
- When the Work Permit is Completed and Signed a record will be generated automatically in Ships Electronic Logbook

7.6 Tabletop Exercise

7.6.1 Preparation

The Tabletop Exercise was prepared as follows

1. Four Computers was set up connected to Internet allowing the users play different stakeholders in the test of the digital Work Permit process.
2. Four different users / stakeholder was created that carried out the following different roles

Short Name	Role
• NIC	Responsible officer
• CLI	Work Supervisor
• ABE	Risk Analys Officer
• ARY	Officer of the Watch

3. TelScope Checklist module was used to prepare a checklist reflecting Digital Work Permit Process. The checklist does not contain all functions included in the digital Work Permit flowchart. See Figure 6.
4. iPhone with "What's App" was used to simulate system notification centre. The notifications represent when steps in the digital HWP has been completed and seeks the attention of another stakeholder to take the process further.

No	Status	Time	Description
Create New Work Permit			
2	✓	⌚	Work Description
3	✓	⌚	Work Location
4	✓	⌚	Checklist for Preparing the Area
Risk Assessment			
6	✓	⌚	Risk Assessment Checklist
7	✓	⌚	Work Safe or unsafe -> CANCEL
8	✓	⌚	Fire Watch needed
Work Planning			
10	✓	⌚	Assign Stake Holders
11	✓	⌚	Checklist for Work Equipment
12	✓	⌚	Checklist of PPE used
13	✓	⌚	Work Briefing
Approval			
15	✓	⌚	Review of Risk Assessment and Work Plan
16	✓	⌚	Approval of Risk Assessment
17	✓	⌚	Approval of Work Plan


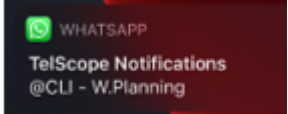

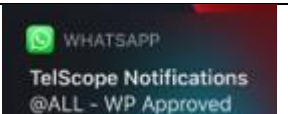
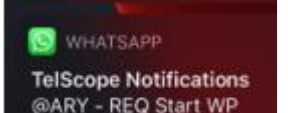
Figure 6: Checklist used.

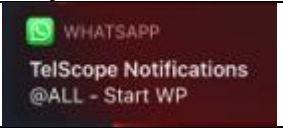
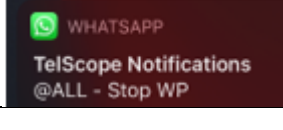
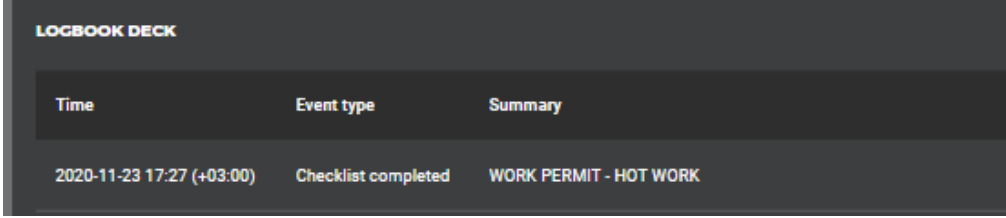
5. A scenario was created to be compared with Permit #4 in Phase 1. Bear in mind that exercise only intends to reflect the time it takes to share information between stakeholders and other involved parties. It does not reflect a realistic scenario for the time required to complete a certain checklist or reviewing it.

7.6.2 Exercise

Table below shows the logged activities and notifications during the exercise

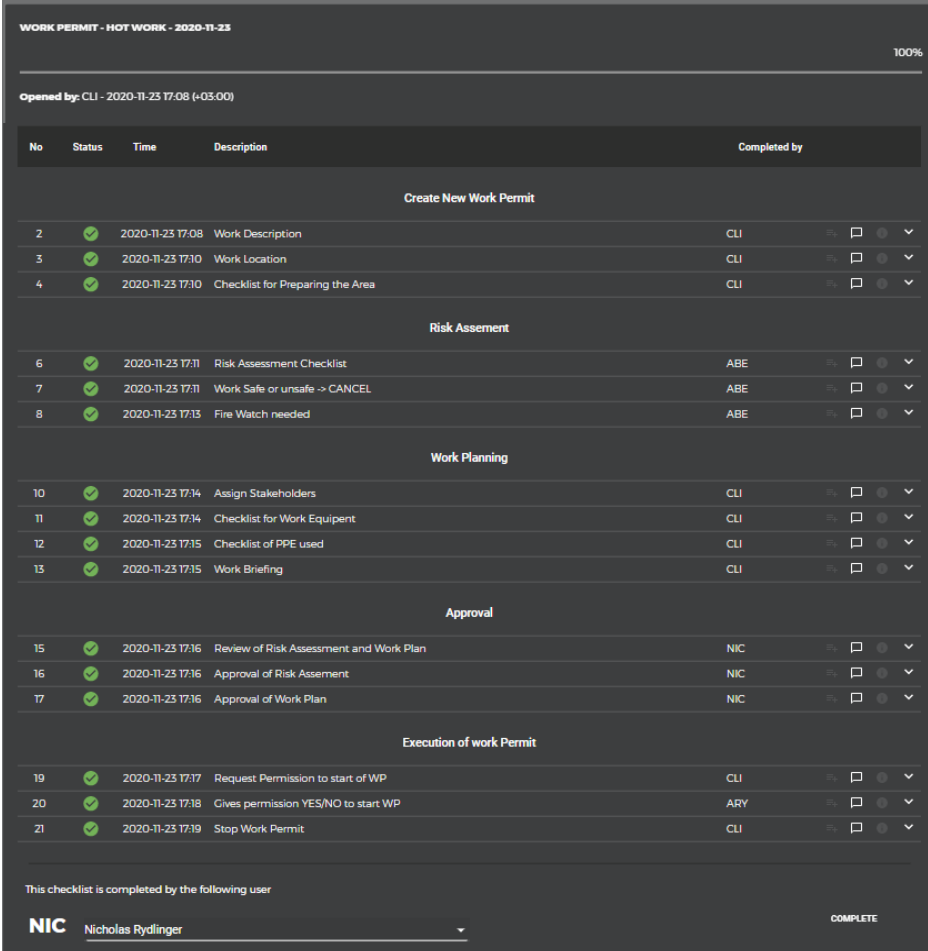
Table #2 Exercise Log

Time	Activity	Notifications	Note
17:08	CLI: Opens New Hot Work Permit		Starting time not documented
17:10	CLI: complete Work Description, Work Location and Checklist for Preparing the Area		
17:10	Notification sent to @ABE, to start the Risk Assessment		
17:11	ABE: Start the RA		
17:13	ABE: Risk Assessment was completed		
17:13	Notification sent to CLI to complete the WP planning		
17:14	CLI: Continue Work Planning		
17:15	CLI Completes the work planning		In Permit #4, Phase 1 the 08:25 PRA completed
17:15	Notification sent to NIC for Review of Risk Assessment and Work Plan		
17:16	NIC: start review of Risk Assessment and Work Plan		
17:16	NIC: Approves the WP		09:08 the Responsible Officer Signs and Validates the WP. A possible delay of 43 minutes.
17:16	Notification sent to ALL		
17:17	CLI: Send Request Permission to start WP		09:19 Start of WP. Possible delay of 11 minutes.
17:17	Notification sent to OOW		
17:18	ARY: Permission given to start Work Permit		

<i>Time</i>	<i>Activity</i>	<i>Notifications</i>	<i>Note</i>
17:18	Notification to ALL Start WP		
17:19	CLI: Work completed, Stop Work Permit		
17:19	Notification sent to ALL		
17:27	NIC: Complete and Signs the WP		
17:27	Record was sent to Electronic Logbook		

All completed activities was recorded in the checklist used during the exercise with time and completed by, shown in Figure 7

What is missing now but shall be part of the final system is a complete audit log that can include, time when notifications were sent out, read, and confirmed by stakeholders.



No	Status	Time	Description	Completed by
Create New Work Permit				
2	✓	2020-11-23 17:08	Work Description	CLI
3	✓	2020-11-23 17:10	Work Location	CLI
4	✓	2020-11-23 17:10	Checklist for Preparing the Area	CLI
Risk Assessment				
6	✓	2020-11-23 17:11	Risk Assessment Checklist	ABE
7	✓	2020-11-23 17:11	Work Safe or unsafe -> CANCEL	ABE
8	✓	2020-11-23 17:13	Fire Watch needed	ABE
Work Planning				
10	✓	2020-11-23 17:14	Assign Stakeholders	CLI
11	✓	2020-11-23 17:14	Checklist for Work Equipment	CLI
12	✓	2020-11-23 17:15	Checklist of PPE used	CLI
13	✓	2020-11-23 17:15	Work Briefing	CLI
Approval				
15	✓	2020-11-23 17:16	Review of Risk Assessment and Work Plan	NIC
16	✓	2020-11-23 17:16	Approval of Risk Assessment	NIC
17	✓	2020-11-23 17:16	Approval of Work Plan	NIC
Execution of work Permit				
19	✓	2020-11-23 17:17	Request Permission to start of WP	CLI
20	✓	2020-11-23 17:18	Gives permission YES/NO to start WP	ARY
21	✓	2020-11-23 17:19	Stop Work Permit	CLI

This checklist is completed by the following user

NIC Nicholas Rydlinger

COMPLETE

Figure 7: Stages in the digital HWP process.

8 RESULTS

The results of the study can best be summarized by answer the questions at issue, therefore I have listed the questions bellow together with the respective answers.

How are time and recourses managed with the existing system for Hot Work Permits?

There is a significant loss of time in the process when documents are delivered between the stakeholders and the wait for someone to make themselves available. Meanwhile the stakeholders who are waiting for a final approval of the Hot Work Permit stands idle. This makes the existing system particularly inefficient and the waste of man hours are substantial considering the large amount of Work Permits are handled each year.

Are resources being utilized inefficiently or in a contradicting manner in relation to the SMS?

The discission to delegate the responsibility of issuing the WP from the Responsible Officer (Staff Captain) to the Work Supervisor (Bosun) contradicts the written procedures. The reason for this was explained by the Chief Officer to reduce administrative workload of the Staff Captain. This has ultimately resulted in the Responsible Officer losing some of his stake in the Hot Work Permit, distancing himself from the process on the expense of the other stakeholders.

There are consistent errors in the documentation of the starting times in Item 1 in the PRA and the WP. This is likely due to a combination between the Risk Analysis Officer and the OOW not being completely familiar with the procedures or they have been misunderstood by both parties.

How can a digital system assist or improve a stage in the Work Permit process that has been identified as inefficient or improperly managed?

The upside of a digital Work Permit process is extensive and to really highlight the potential benefits of a digital process, some of the findings in the review of the hot Work Permits will be compared against the same or a similar event performed in the tabletop exercise.

In the tabletop exercise the digital Work Permit simulation had a clear advantage over the reviewed case of Permit #4 in Phase 1. In the digital Work Permit simulation, the information

is instantly shared between stakeholders. If a stakeholder is not available for any reason, they will get a notification on their device instead of someone having to wait for them.

A digital workflow with checklists will reduce or eliminate the risk of information being wrongfully documented during the process and assuring that the right stakeholders performs the task assigned to him.

What changes are required within the SMS for a digital Work Permit system to be implemented?

The existing guidelines regarding Hot Work Permits in the SMS would have to be revised or perhaps completely re-written for it to match with a digital Work Permit system. What the SMS for a digital Work Permit system would like is hard to define without the finished product.

Although some key parts that would likely be included are:

- User and Role Management
- How record keeping is handled in the system.
- A process flowchart illustrating the entire process together with written procedures for each step.
- Checklists available for printing if there are unforeseen issues with the platform.

Some parts of the existing guidelines for Hot Work Permits that could be of benefit when revising or writing the new guidelines. For example, parts in the existing system explaining the different stakeholder's responsibility could be used to define the new User and Role Management.

What other potential positive and negative effects are there when digitalizing the Work Permit process?

Positive effects

- Reduction of administrative workload such as filing and record keeping of Work Permits.
- Facilitates for easier use and creates better clarity in the process.
- Better overview of what permits are active and ongoing.
- Less involvement of outside parties in the process.
- Gathering and sharing of data for future analyzing and development.
- Reducing the use of paper, could be seen from an environmentally friendly standpoint.

Negative effects

- Expensive transition process and hardware needed for the new system.
- The lack of standardization and the difference in SMS procedures adopted by shipping operators poses a challenge.

9 DISCUSSION

The findings and answers reached in the study were distinct and the potential benefits identified were adequate for this study to evolve further. Although during the study there was one question raised that perhaps are more important than the others for the continuation of the work, *what changes are required within the SMS for a digital Work Permit system to be implemented?* The question itself is particularly hard to answer because there is no agreed international standard for Work Permit procedures. Launching a digital Work Permit system on the market today and for it to be commercially compliant would require it to fit a wide variety of SMS procedures and process workflows.

I see three possible solutions to the problem:

1. A future agreement on one international accepted standard for Work Permits. This would make it an easy task to develop a software to fit procedures and process workflows. This is highly unlikely in the near future as development of IMO standards historically takes many years.
2. Aligning the development and the process flow of the digital Work Permit system with Best Industry Practices for Work Permits including some minor possibilities for customization and a tool for generating checklists etc. The shipping company would have to revise their SMS so it aligns with the digital Work Permit system process work flow.
3. Developing a software so flexible that it would be customizable to every SMS and process workflow. It is an option, but it would drive the cost for both development and implementation. Also, such a high level of customization could cause problems with future upgrades.

My opinion is that alternative two will be the best way forward.

SOURCE AND LITERATURE LIST

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APPENDICES

- Appendix 1 Hot Work Permits
- Appendix 2 Hot Work Guide
- Appendix 3 General Guidelines
- Appendix 4 PRA Checklist
- Appendix 5 WP Checklist