Mini-Traineeship Internship at Damen Shipyards

Planning of the design check phase, model tests for an Offshore Patrol Vessel, Walk to Work and improving the evaluation process within Offshore & Transport.

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DAMEN SHIPYARDS GORINCHEM
Maarten van Poppelen

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UT supervisor	Kees Venner

Preface

Figure 1: Posting my application

In December 2016 together with 14 students I participated in the Damen Business Course: a three-day event which was filled with cases, presentations and tours around the yards. The goal was to give us a glimpse of what Damen Shipyards looks like, their way of working and the opportunities they offer. I really liked the impression I got, especially the atmosphere which felt very friendly and open. The amount of freedom and responsibility you get at Damen feels in several ways similar to the University of Twente. For these reasons I decided to apply for an internship at Damen. This resulted in the internship I've conducted the past months. One of the main goals has been to get to know Damen as a company, the different departments and projects and the way of working.

Within Damen my overall supervisor has been Huib Slings, whom I'd like to thank for the opportunity I've been offered and the support and feedback during these months. The first month Rodney Stuijt acted as my daily supervisor where René Hooijman was this for my second part of my internship. I would like to thank both of you a lot for the time and energy invested in me, showing me around and for the assignments. I would also like to thank Carola Servaas for the arrangement of the internship and feedback, Jelle Visser for the support and collaboration on the O&T evaluations, Deniz de Koningh and Scott Terry for the support and information with the model tests for the OPV1900, Mark Allpress for the work on the P140 and Niels Kooiman for the collaboration on the O&T evaluations. And of course all the other colleagues with whom I've worked together who have answered all my questions and explained me everything!

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1. Summary

From 4 September till 15 December 2017 I've conducted my internship at Damen Shipyards Gorinchem. The internship was a mini-traineeship where I experienced different departments and phases of designing a vessel. The main goals were to get to know Damen as a company, the different departments and projects and the way of working. Damen is known for their innovative approach of building standardized ships, series production and the possibility to deliver ships off the shelf. The internship took place within the department 'Offshore & Transport'. This department is a part of the Damen Commercial New Build Division.

For a 4.000 tons displacement vessel (DN4000) an adapted version of the design spiral (Evans, 1959) has been made, resulting in a total of 169 documents to be delivered in the design check phase.

For another vessel, the OPV1900, model tests have been carried out at CTO in Gdansk, Poland. Bare hull, appended hull and self propulsion tests have been executed and are in quite good comparison with the predictions made using the statistical Holtrop and Mennen method.

For the Walk to Work vessel the contract signing was delayed, resulting in only a restricted action list to be given free for vessel #2. For the first vessel an evaluation took place at Damen Engineering Gdansk in Poland. This was combined with the kick off meeting for vessel #2. For #2 the planning has been checked and adjusted and lead times were discussed with procurement.

Finally, within the current document system is not that easy to find and search for specific information within evaluations or to find specific evaluations at all. This results in some mistakes being made again. In SharePoint a database has been build for Offshore & Transport to have all evaluations in one place and improve searchability.

2. Abbreviations

APM	Assistant Project Manager
APME	Assistant Project Manager Engineering
CFD	Computational Fluid Dynamics
COG	Centre of Gravity
CTO	Centrum Techniki Okrętowej (in Gdansk, Poland)
DEGd	Damen Engineering Gdansk
DNV-GL	Det Norske Veritas - Germanischer Lloyd (classification society)
D&P	Design and Proposal
DSBe	Damen Shipyards Bergum
DSGo	Damen Shipyards Gorinchem
DWT	Deadweight
ERP	Enterprise Resource Planning
IFS	Industrial Financial System (ERP System of Damen)
ISO	International Organization for Standardization
L_{pp}	Length between perpendiculars
O&T	Offshore and Transport
OPV	Offshore Patrol Vessel
PM	Project Manager
PME	Project Manager Engineering
PMO	Project Management Office
SP	SharePoint
W2W#1 / #2	Walk to Work #1 / #2

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5. Introduction

From 4 September till 15 December 2017 I've conducted my internship at Damen Shipyards Gorinchem. The internship was a mini-traineeship where I experienced different departments and phases of designing a vessel. The main goals were to get to know Damen as a company, the different departments and projects and the way of working.

Before the work that has been carried out is presented, information about Damen can be found in the first chapter. Here is presented what the Damen Commercial New Build Division looks like and what the schematic flow of working is.

In the second chapter 'Planning design check phase' the design spiral by J. Harvey Evans is presented. For a vessel called the DN4000 an adapted version of this design spiral has been made.

For another vessel, the OPV1900, model tests have been carried out at CTO in Gdansk, Poland. Bare hull, appended hull and self propulsion tests have been executed and are in quite good comparison with the predictions made using the statistical Holtrop and Mennen method.

The third chapter is all about the Walk to Work, a vessel designed to perform maintenance and repair jobs for a maximum of 30 days at sea at offshore windfarms. As the contract signing was delayed only a restricted action list had been given free for vessel #2. For the first vessel an evaluation took place at Damen Engineering Gdansk in Poland. This was combined with the kick off meeting for vessel #2. For #2 the planning has been checked and adjusted and lead times were discussed with procurement.

The final chapter is about improving the evaluation process at the Offshore & Transport department. Within the current document system is not that easy to find and search for specific information within evaluations or to find specific evaluations at all. This results in some mistakes being made again. In SharePoint a database has been build to have all evaluations in one place and improve searchability.

6. About Damen Shipyards

Damen Shipyards was founded in 1927 by Jan and Marinus Damen in Hardinxveld. In 1969 Kommer Damen, son of Jan Damen, took over and is still running the company. Damen is known for their innovative approach of building standardized ships, series production and the possibility to deliver ships off the shelf.

The turnover in 2017 was 2.0 billion euros. Damen Shipyards Group consist of 52 companies worldwide of which 24 are located in the Netherlands and 28 in other countries. In total Damen Shipyards employs more than 10.000 people worldwide. They delivered over 160 vessels in 2017 and have delivered over 6.000 in total. In Table 1 the number of newbuild vessels per market in 2017 can be found. Besides newbuild, repair and conversion, maintenance and refit projects are also part of Damen's business resulting in more than 1500 project annually (2018).

Market	Number (#)
Tugs / Workboats	64
Offshore Vessels	5
High Speed Craft & Ferries	40
Pontoons & Barges	12
Dredging & Specials	23
Defence & Security	16
Yachts	5
Total	**165**

Table 1: Number of vessels delivered in 2017 per market (2018)

My internship took place within the department 'Offshore & Transport'. This department is a part of the Damen Commercial New Build Division. To get an idea how the Commercial New Build division looks like within Damen, see Figure 2.

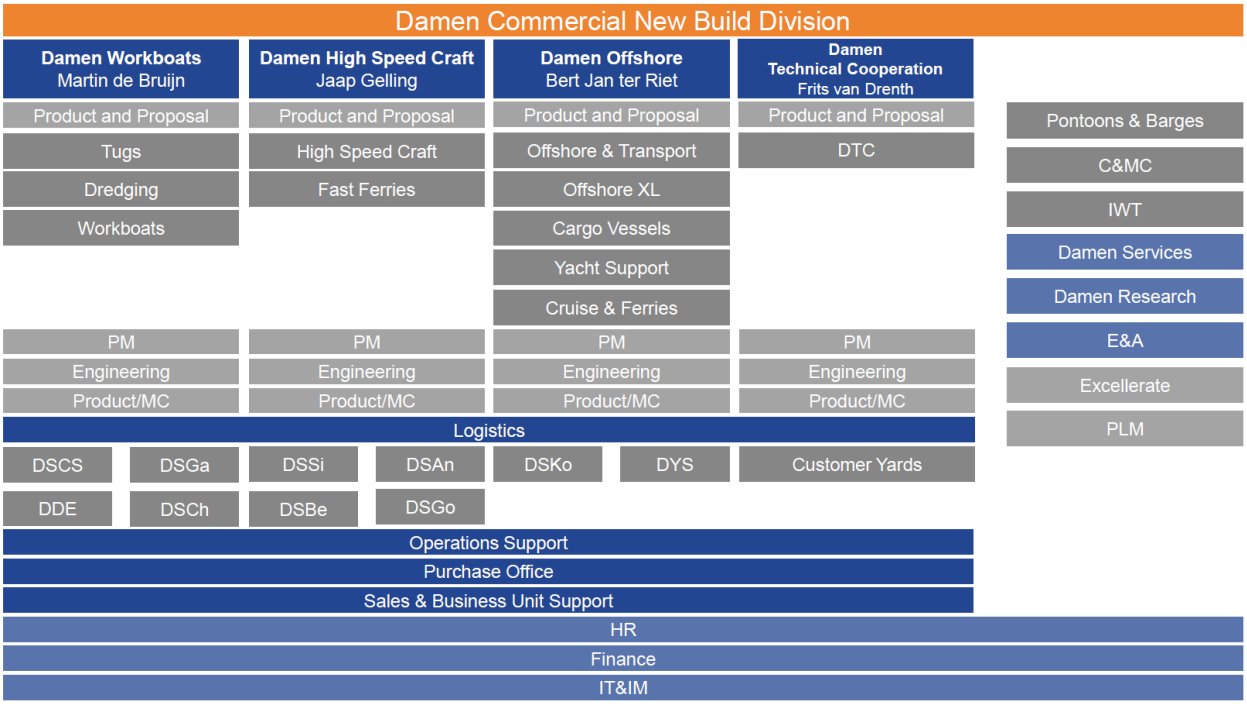

Figure 2: Organogram Damen Commercial New Build Division

The whole process of selling a vessel until services and warranty is captured in Figure 3. In principle this flow diagram is followed for all new build vessels.

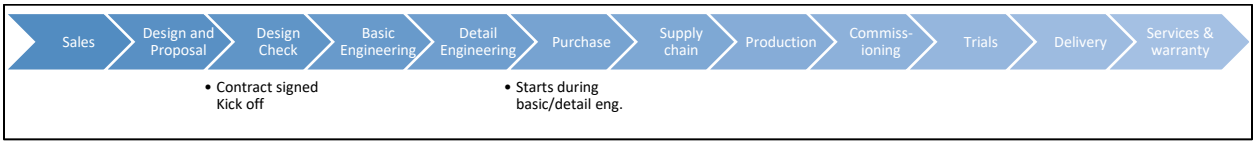

Figure 3: Schematic flow of activities for building a vessel at Damen.

7. Planning design check phase

The first assignment was to set up the design spiral for a vessel named 'DN4000'. This is a 4,000 tons displacement vessel for the Vietnam government.

7.1. Design spiral

During the design check phase (see also Figure 3) the engineering department is responsible for checking the design which has been made by the design and proposal engineers. For example the rules are checked and first estimates for speed, range, deadweight, etc. are made. The output from the design check phase is a fully checked design after which basic engineering can start. There are lot of dependencies when designing a ship and a lot of compromises have to be made. This will result in several iterations with every step going further into detail until an agreeable solution is reached. Within Offshore and Transport the vessels which are designed and build differ a lot from each other. This makes it harder to develop one standardized method of designing these vessels. Quite recently they started working with a variation of the design spiral as described by (Evans, 1959) which is shown in Figure 4.

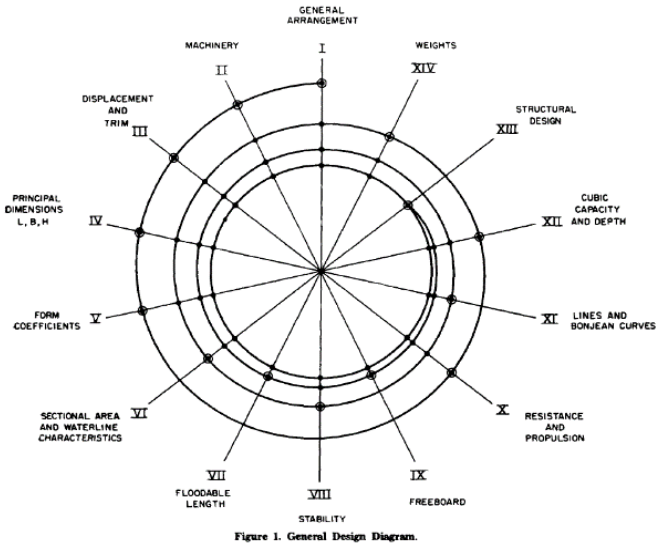

Figure 4: Design spiral by J. Harvey Evans (1959)

To create the design spiral, J. Harvey Evans divided the spiral in 14 subjects ranging from General Arrangement to Weights and into 4 iterations. From a previous vessel designed by Damen, the OPV1900, the design spiral consisted of 4 iterations, 13 subjects and almost 200 documents.

7.2. Design 'spiral' for the DN4000

In Figure 5 the result for the DN4000 can be found. The columns indicate the different iterations. In comparison with the previous vessel, the OPV1900, and the original design spiral by J. Harvey Evans an iteration 0 has been added. When looking at the rows, 13 different subjects can be seen, which are:

0. Planning/Management
1. Rules
2. Hull
3. Speed & Power
4. Weight & COG
5. Range & DWT
6. Stability & seakeeping
7. Safety
8. Deck arrangements

9. Construction
10. Diagrams & Tech. arr. (= Technical Arrangements)
11. Electrical
12. Accommodation & Comfort

When looking at a specific row (corresponding to the iterations) and column (corresponding to the subjects) the documents that have to be delivered can be found. This results in a total of 169 documents for the DN4000.

Iteration 0 has been added for several reasons. Due to reasons with the contract between both parties the building has been delayed by 6 months. A small start had already been made with the design check phase and this was continued by a few people to make effective use of personnel. The second reason is that the client had some equipment of their own and wanted Damen to use this. Early researching the equipment, obtaining material- and datasheets will result in less surprises in a later stage.

Another addition is row 0: Planning/Management. With the previous design spiral this was not incorporated in the schedule. As a (project) manager you want to make sure you are always one step ahead of the engineering team with your planning and to make the optimal use of all employees and their strengths. By incorporating this into the design spiral, this does not only make it more visual, but it is also less likely that something will be forgotten or started too late in the process. In the last iteration finishing the design is included (report and presentation) and also the next phase is started: planning the basic engineering phase.

As every ship is different, in comparison with the OPV1900 the subject Military has been removed. For the small arms, ammunition stores are required. They are here placed under 10. Diagrams & Tech. arr.

7.3. Conclusions and recommendations

Starting with the specifications drafted by D&P I determined what topics needed to be focused on during the design check phase. After reading the specifications, I read all documents from the OPV1900 which have been delivered in the design check phase. From there on I build the design spiral for the DN4000. While drafting the design spiral I've discussed the work with Rodney several times, which really helped improving the work.

As a first assignment I think this was very helpful to get a first total view of what its needed to design a vessel like this. As my knowledge about shipbuilding was limited, this proved to be a challenge. The most difficult part was to find out what information every document contained, on what other documents it depended and what information was required to draft that document.

An improvement that can be made is to give a brief description of every document, state the input which is required (this can be other documents, but also a list of parameters/variables/etc.) and finally state the output and other documents depending on the information in the document.

Currently in the design spiral there are documents with the same name in multiple iterations. The work done on these documents is not the same for every iteration. This could also be added to the description, which would result in a better overview and clearer boundaries.

	DN4000	Iteration 0	Iteration 1	Iteration 2	Iteration 3	Iteration 4
0	Planning/ Management	Design check Scope, Spiral & Planning Comparison DN2000 vs DN4000		3109135 General arrangement	3109135 General arrangement	3109135 General arrangement Design check presentation Design check Report Basic engineering planning
1	Rules	3092256 Remarks on specification 3109125 Reference liner 3109131 Requirements ammunition store 3109132 Requirements Fixed Internal FiFi Systems 3199288 Solas - Safe Return to Port Impact 3094017 Definition of Class notation 3094015 Compliance report Class & Flag 3094018 SPS code impact Main vertical zones	3109126 GP-FB-EN-GT-NT calculation 3109127 Requirements evacuation or 80 persons SPS ship 3109128 Requirements evacuation for 183 Survivors	3109130 Requirements Wheelhouse Arrangement and Bridge Viribility		3094015 Compliance report Class & Flag 3109126 GP-FB-EN-GT-NT calculation 3109125 Reference liner
2	Hull	3109134 Ship comparison 3094019 Main particulars determination 3109149 Lines plan		3109149 Lines plan 3109151 Hydrostatics 3109152 Hydrostatic model	3109149 Lines plan 3109152 Hydrostatic model	3109152 Hydrostatic model
3	Speed & Power	3113773 Power - Speed prediction (MEMO) 3108085 Propulsion arrangement System integration engine	3108085 Propulsion arrangement	3108085 Propulsion arrangement	mcma CFD Resistance Analysis 3108085 Propulsion arrangement mcma Power - Speed prediction	3108085 Propulsion arrangement
4	Weight & COG		3109156 Lightship weight calculation	3109156 Lightship weight calculation	3109156 Lightship weight calculation	3109156 Lightship weight calculation
5	Range & DWT	3109159 Tank Arrangement	3085565 Calculation range and consumption	3108141 Calculation fresh water 3109159 Tank arrangement 3109158 Calculation deadweight		3109158 Calculation deadweight 3085565 Calculation range and consumption 3108141 Calculation fresh water 3109159 Tank arrangement
6	Stability & seakeeping	Pilot Hull form prepared	3109160 Drafts & Trims 3109164 Stability requirements	3109174 Min. GM curves	3109167 Watertight integrity 3109168 V-line 3109165 Probabilistic damage stability definition of zonal boundaries	3109161 Intact Stability 3109162 Damage Stability
7	Safety		3109192 Arrangement life saving equipment	3109188 Escape route plan	Fire integrity plan	3109188 Escape route plan
8	Deck arrangements	3104018 Space check specification w GA 3109285 Plan of functions pace	3109210 Arrangement helicopter deck 3109211 Arrangement hangar 3109186 Arrangement slipway and RHIB recovery	3109183 Arrangement main deck outside, aft 3109184 Arrangement Fore castle deck outside, fore 3109185 Arrangement Accommodation deck outside Arrangement bolau bridge deck outside Arrangement bridge deck outside	3109285 Plan of functions pace	3109210 Arrangement helicopter deck 3109211 Arrangement hangar 3109183 Arrangement main deck outside, aft 3109184 Arrangement Fore castle deck outside, fore 3109185 Arrangement Accommodation deck outside Arrangement bolau bridge deck outside Arrangement bridge deck outside
9	Construction	3109170 Basic construction choices	3109170 Basic construction choices 3109177 Principle Free Height Accommodation	3109173 Midship section	3109173 Midship section	3109172 Section plan
10	Diagrams & Tech. arr.		3108143 Principle Bilge system diagram 3108147 Principle Ballast system diagram 3108152 Principle Internal fifi system diagram 3108157 Principle Fuel oil transfer system diagram 3108159 Principle Fuel oil supply system diagram 3108160 Principle Sea cooling water system diagram 3108161 Principle Fresh water cooling system diagram	3108143 Principle Bilge system diagram 3108147 Principle Ballast system diagram 3108152 Principle Internal fifi system diagram 3108157 Principle Fuel oil transfer system diagram 3108159 Principle Fuel oil supply system diagram 3108160 Principle Sea cooling water system diagram 3108161 Principle Fresh water cooling system diagram 3108215 Principle External fire fighting system diagram Water treatment room 3108163 Calculation bilge and fire fighting pump 3108164 Calculation exhaust and air intake 3108165 Calculation cross-over 3108162 Heat balance 3108216 Arrangement engine room 3108217 Arrangement auxiliary engine room 3108223 Arrangement evcat pump room 3108218 Arrangement steering gear room 3108221 Arrangement emergency generator room 3108220 Arrangement bauthruster room Ammunition store arrangement	3108143 Principle Bilge system diagram 3108147 Principle Ballast system diagram 3108152 Principle Internal fifi system diagram 3108157 Principle Fuel oil transfer system diagram 3108159 Principle Fuel oil supply system diagram 3108160 Principle Sea cooling water system diagram 3108161 Principle Fresh water cooling system diagram 3108215 Principle External fire fighting system diagram Makers list 3111396 Hydraulic block diagram Arrangement diving equipment	3108143 Principle Bilge system diagram 3108147 Principle Ballast system diagram 3108152 Principle Internal fifi system diagram 3108157 Principle Fuel oil transfer system diagram 3108159 Principle Fuel oil supply system diagram 3108160 Principle Sea cooling water system diagram 3108161 Principle Fresh water cooling system diagram 3108215 Principle External fire fighting system diagram Makers list 3108216 Arrangement engine room 3108217 Arrangement auxiliary engine room 3108223 Arrangement evcat pump room 3108218 Arrangement steering gear room 3108221 Arrangement emergency generator room 3108220 Arrangement bauthruster room Ammunition store arrangement Water treatment room
11	Electrical	3093706 Electric One Line diagram	3085566 Load balance 3108222 Hazardous zone plan 3093706 Electric One Line diagram	3085566 Load balance	3085566 Load balance ECR arrangement	3085566 Load balance Cable tray and gauge neck arrangement
12	Accommodation & Comfort		3109286 Area check	mcma Noise level prediction 3109178 HVAC design check	Survivor arrangement Arrangement accommodation Bridge-deck Arrangement accommodation A-deck Arrangement accommodation B-deck Arrangement accommodation Main-deck Arrangement accommodation Tween-deck Arrangement accommodation Tanktop	Survivor arrangement mcma Noise level prediction 3109178 HVAC design check Accommodation colour & interior- line matrix

Figure 5: Design 'spiral' for the DN4000 for the design check phase

8. Model tests – OPV1900

For the OPV1900, which is an abbreviation for Offshore Patrol Vessel 1900 (see Figure 6), model tests had to be executed. The first reason was to verify the calculations that had been made and the second reason was that it was an obligation, as it was part of the contract with the client.
Damen performs a lot of model tests at MARIN (Maritime Research Institute Nederland) in Wageningen, however these tests were performed at CTO (Centrum Techniki Okrętowej) in Gdansk, Poland. This had mostly to do with availability as there were no slots free at the towing tank at MARIN. From October 25 till October 27 together with Deniz de Koningh (project manager at Damen) and Scott Terry (development engineer at Damen) we were in Gdansk to visit CTO and watch a part of the execution of the model tests.

Figure 6: Offshore Patrol Vessel 1900 (OPV1900)

8.1. Centrum Techniki Okrętowej (CTO)

CTO exists since 1972 and has currently around 140 employees. They do a lot of research on a variety of hydrodynamic subjects and have a lot of facilities (2018). An overview can be found in Figure 7. They have the following facilities:

- Aerodynamic tunnels
- Cavitation tunnels
- Devices for testing offshore facilities
- Towing platforms for model basins
- Stations for testing flow phenomena

Within model testing section they focus on the following topics:

- Prediction of nautical properties of ships, vessels and other floating objects:
  - Resistance
  - Self-propulsion
  - Maneuverability
- Optimization of the ship hull
- Design of:
  - Drive and rudder systems
  - Dynamic positioning systems
  - Anchorage systems

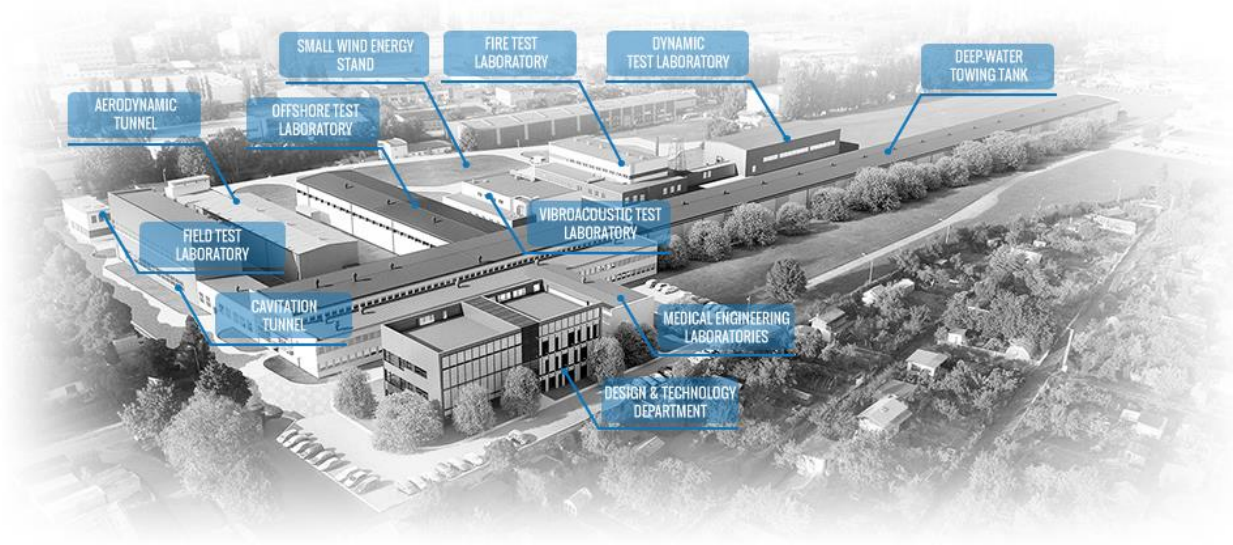

Figure 7: Overview of CTO, Gdansk, Poland

8.2. Testing at CTO

CTO has been testing for more than a week to complete the following tests for the OPV1900:

- Bare hull tests
- Appended hull tests, including bilge keels, stabilizer fins and struts
- Self propulsion tests

The tests have been performed at the following speeds: 6.0, 9.0, 12.0, 15.0, 18.0, 20.0, 21.0, 22.0, 23.0, 24.0 and 26.0 kn. These values are full scale values. The scale factor was approximately 15, which results in model speeds between 0.8 and 3.5 m/s. Tests above 20 kn had to be done twice to get enough data for statistics due to the length of the towing tank. In Figure 8 a picture of the scale model of the OPV1900 can be found. The length (L_{pp}) of the vessel (full scale) is around 80 meters, which results in a model with a length of almost 6 meters. All the tests have been performed at two draft levels: 3.70 meter and 4.00 meter, whereby draft fore equal is to draft aft.

Figure 8: Scale model of the OPV1900 including all appendages

The goal of the model tests was to verify the vessels speed with the current hull design, appendages, engines and propellers. In Figure 9 the results for the bare hull tests can be found. The speed which the vessel has to reach is 22.00 kn as defined in the contract with the client. Due to confidentiality the results for the appended hull and self propulsion tests are not included in this report.

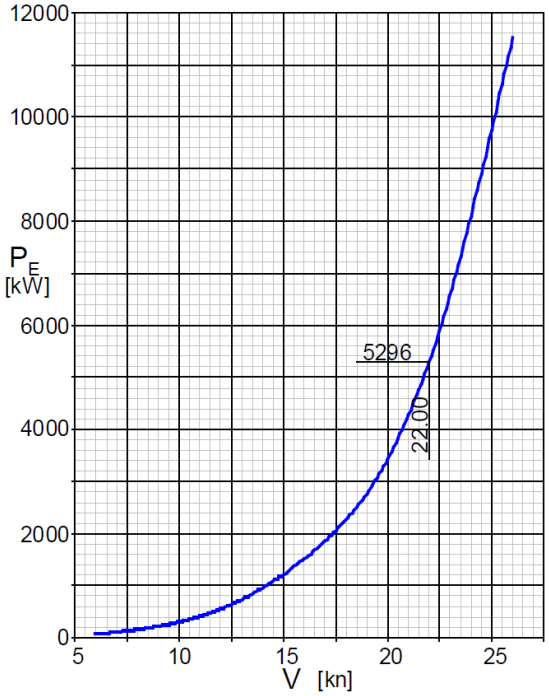

Figure 9: Results for bare hull tests - draft 4.00m

8.3. Holtrop and Mennen method

Besides model testing and CFD calculations there is another method to estimate a vessels resistance: by statistics. In 1978 J. Holtrop and G.G.J. Mennen presented their paper 'A statistical power prediction method' (Holtrop, 1978). They performed a regression analysis on model test data and full scale data to obtain a model to determine the required propulsive power. This is especially beneficial during the start of the design phase to get a quick resistance and power estimate.

In 1982 they updated their initial model, which resulted in the following formula for the total resistance of a vessel (Holtrop, 1982):

$$R_{total} = R_F(1 + k_1) + R_{app} + R_w + R_B + R_{TR} + R_A \quad (1)$$

With:

R_F	Frictional resistance according to the ITTC-1957 formula
$1 + k_1$	Form factor of the hull
R_{app}	Appendage resistance
R_w	Wave resistance
R_B	Additional pressure resistance of bulbous bow near the water surface
R_{TR}	Additional pressure resistance due to transom immersion
R_A	Model-ship correlation resistance

In 1984 J. Holtrop updated the model again with now a total of 334 models. The range of possible vessels for which a total resistance could be estimated was increased and a method to determine the influence of propeller cavitation was added.

In Figure 10 the estimations according to the Holtrop method for the OPV1900 can be found. As can be seen in Figure 10 the difference between the Holtrop method and the model tests are very minimal. Above 18 kn Holtrop slightly underestimates the total resistance.

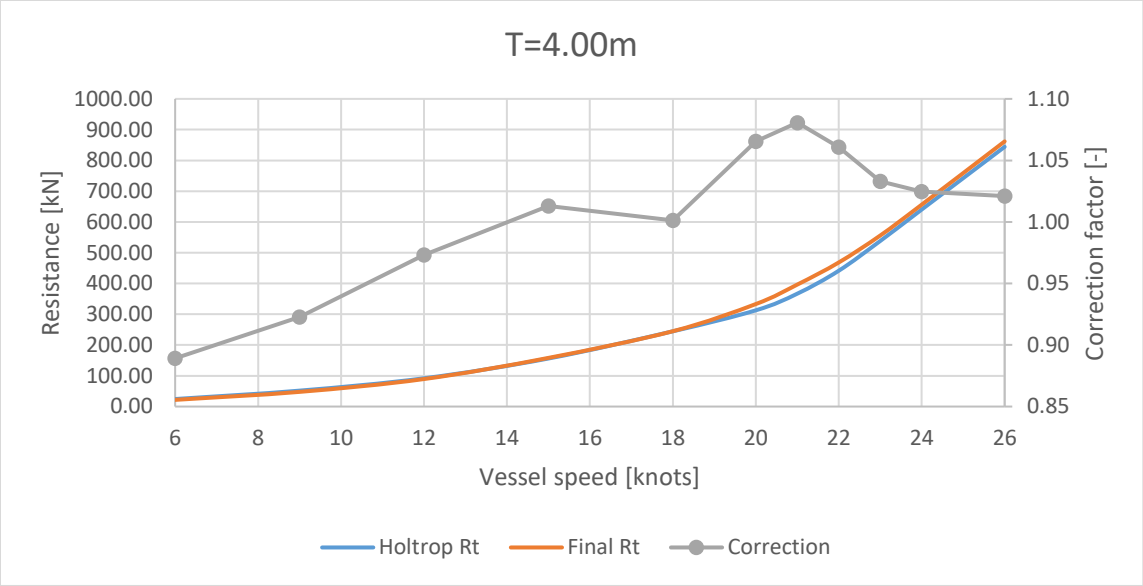

Figure 10: Total resistance for the OPV1900 by the Holtrop method

8.4. Conclusion

CTO has been very friendly, given as an interesting tour around the facility and executed the model tests nicely. They supported us with a lot of additional information. From the graph above it can be seen that the Holtrop method estimated the total resistance pretty well, which offers a fast possibility at the start of a design phase to get a quick estimate. Damen has also performed CFD calculations, which are not included in this report. Damen has quite some experience building these kind of vessels. The CFD results where very similar to the model tests, which means that for future project CFD calculations only might be sufficient to get a trustworthy estimate for the total resistance.

9. Walk to work – Bibby Wavemaster

One of my goals was to experience what project management looks like within Damen. This wish has been accommodated for by connecting me with René Hooijman. René has been the project manager of the 'Walk to Work'; Bibby Wavemaster 1 (see Figure 11). This vessel is designed to perform maintenance and repair jobs for a maximum of 30 days at sea at offshore windfarms. For the last part of my internship René acted as my daily supervisor.

The idea was that we would be working on the Walk to Work #2. The contract was going to be signed next week and then we could take off. The signing of the final contract has been delayed several times, which resulted in a signed agreement after my internship had ended. When there is no contract, the action list, which lists all activities and budgeted hours, is not released within Damen, which means no work can be done on the project. After a few weeks there was an agreement on a restricted action list, which meant that some tasks could be carried out. This means there were a few things we could pick up and next to that there were still some activities involving the Bibby Wavemaster 1.

Figure 11: Walk to work: Bibby Wavemaster 1

For the Bibby Wavemaster 1 several round up meetings took place. A few companies had performed extra work, which resulted in discussions about what was in and outside the scope of the initial contract. This has all been handled nicely, for me it was interesting to observe how both parties came to an agreement.

9.1. Differences planning

Approximately a year ago a planning had been made for building the next Walk to Work, this planning has been updated, resulting in Figure 12. Due to the contract delays the planning has been adjusted and updated once more by the shipyard in Romania. My task was to compare both plannings and check for differences. In Figure 13 the second planning can be found. As most of the engineering had already been completed, the W2W#2 is fairly similar to the W2W#1, the focus was on the latter topics:

- Modification and outfitting of sections
- Arrival main equipment
- Assembling and final outfitting
- Commissioning and Launching

The results with differences in days can be found below. P1 refers to the first planning (Figure 12) and P2 to the second planning (Figure 13).

Modification and outfitting of sections

	P1		P2		Difference P1 <> P2 in days	
	Start	End	Start	End	Start	End
Batch 1	08-01-18	09-03-18	10-01-18	27-04-18	2	49
Batch 2	12-02-18	06-04-18	19-02-18	04-06-18	7	59
Batch 3	22-01-18	23-03-18	25-01-18	11-05-18	3	49
Batch 4	12-02-18	06-04-18	12-02-18	25-05-18	0	49
Batch 5	26-03-18	25-05-18	02-04-18	20-06-18	7	26
Batch 6	26-02-18	20-04-18	05-03-18	15-06-18	7	56
Batch 7	26-02-18	20-04-18	12-03-18	29-06-18	14	70
Painting sections and blocks	12-03-18	01-06-18	05-03-18	10-08-18	-7	70

Arrival main equipment

	P1	P2	Difference P1 <> P2 in days
Items from B/S needed in the building stage (plugs, echo, portholes	11-12-17	05-01-18	25
Big equipment from Aux Room	02-04-18	02-04-18	0
Sanitary units	13-04-18	13-04-18	0
Big equipment from BWT Room	01-05-18	13-04-18	-18
Big equipment from Tecnical Space (C-deck)	04-06-18	04-06-18	0
Big Equipment from E.R	18-06-18	04-06-18	-14
Big equipment from Propulsion Room & Switchboard	18-06-18	04-06-18	-14
Gangway tower	19-11-18	05-10-18	-45

Assembling and final outfitting

For P1 this has been divided in 8 parts, for P2 this has been merged into one part: Assembling & outfitting and painting.

	P1		P2		Difference P1 <> P2 in days	
	Start	End	Start	End	Start	End
Assembling & outfitting and painting	02-04-18	28-12-18	02-04-18	23-11-18	0	-35

Commissioning

Note: P1: Preparation for delivery (3 weeks), P2: Rest points (4 weeks).

	P1		P2		Difference P1 <> P2 in days	
	Start	End	Start	End	Start	End
Commissioning systems and equipment	17-12-18	29-04-19	17-12-18	22-04-19	0	-7
Sea trials	01-04-19	05-04-19	26-03-19	29-03-19	-6	-7
Delivery (ex yard)	05-05-19		30-04-19		-5	

Launching

	P1	P2	Difference P1 <> P2 in days
Launching	03-12-18	23-11-18	-10

9.2. Conclusions

When comparing planning P2 with P1 the following things stand out:

- There is much more time (26-70 days, depending on the batch) for modification and outfitting of the sections.
- Except for items from B/S needed in the building stage, most of the equipment has to be delivered earlier, with the gangway tower 1.5 months earlier (-45 days).
- The assembling and final outfitting has to be completed 35 days earlier.
- The commissioning and launching is scheduled roughly one week earlier.

More time for modifying and outfitting the batches results in no problems. The delivery of the equipment is a different story as almost all equipment has to be delivered earlier. To check whether this is possible, a list of all big equipment was available from the W2W#1 (which is comparable with the W2W#2) and was filled in by purchase with lead times. The biggest problem would be the gangway tower, which has the longest lead time and with the current planning would not be on time. One solution is to assemble the batch where the gangway tower is placed as late as possible. Checking with the yard said it would not be their preferred building order, however it would be possible. The second solution would be purchase negotiating with the supplier about shorter lead times.

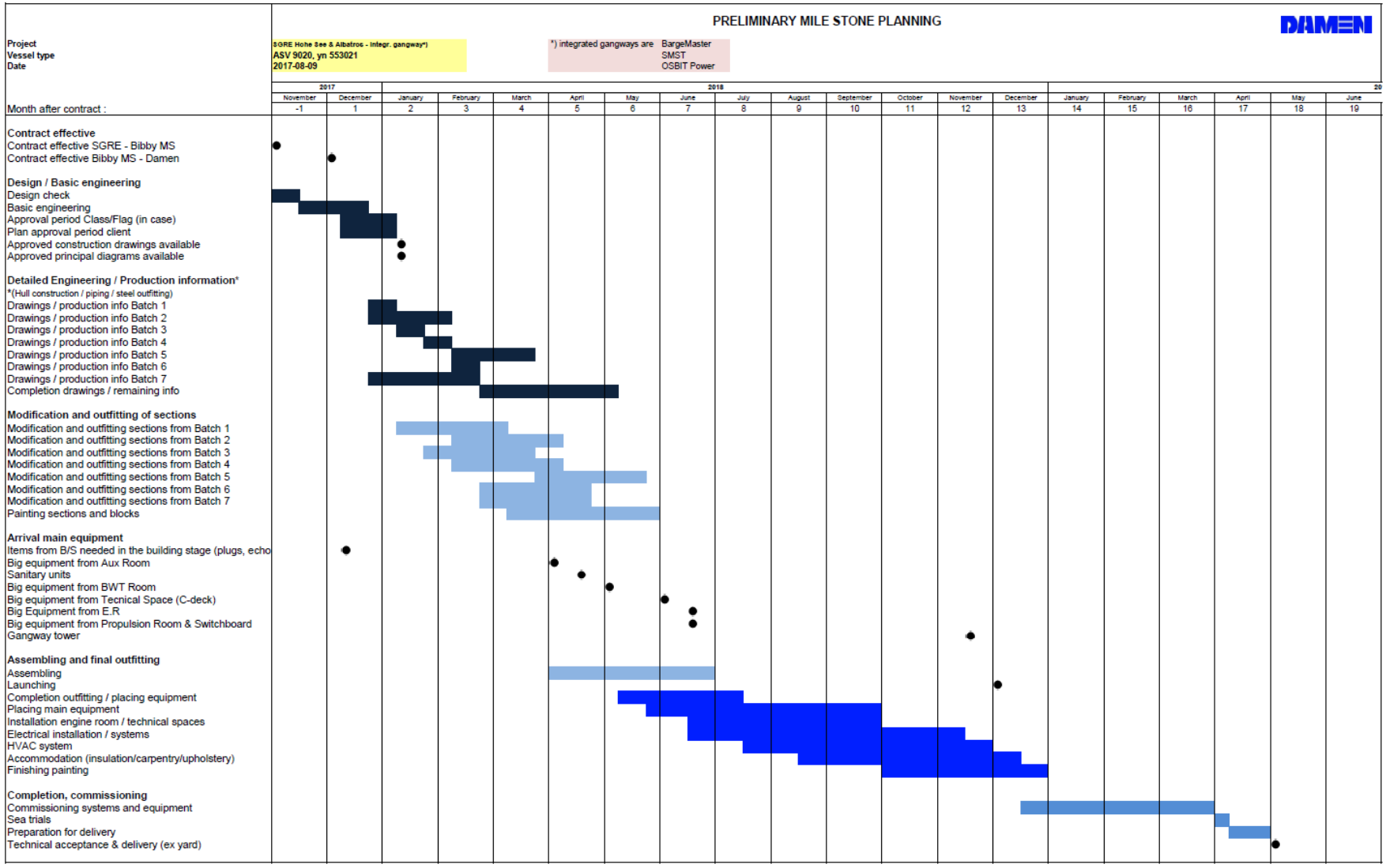

Figure 12: First planning for the Walk to Work #2

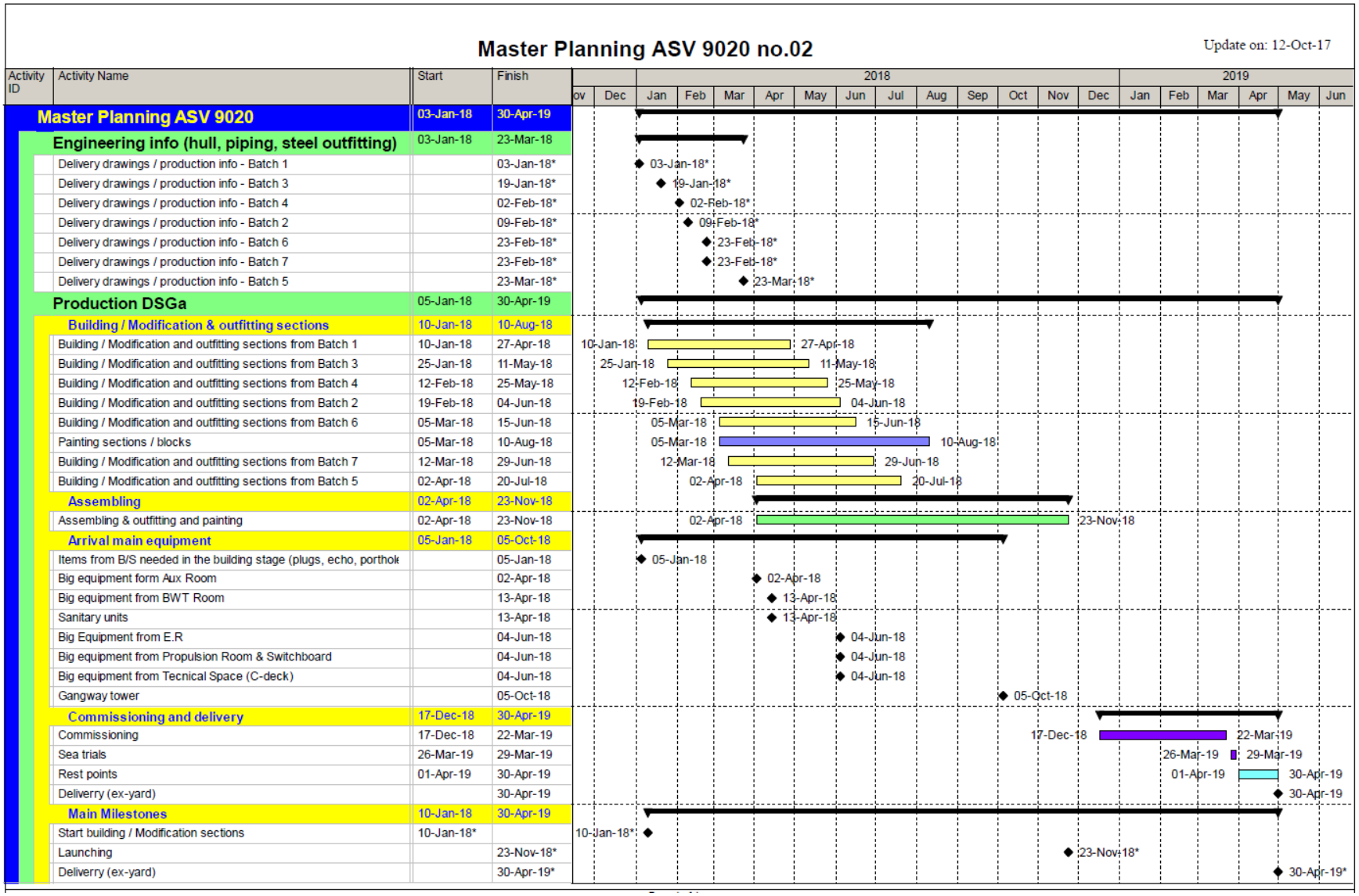

Figure 13: Second, updated planning for the Walk to Work #2

9.3. Visit Bibby Wavemaster 1 in Norwich (England)

On October 17th we left for Norwich, England to visit the Bibby Wavemaster 1 as the vessel would be in port for one day to resupply. The vessel was already in operation, but there were a few things which needed to be measured and fixed. The most important thing was that the vessel had been sold with DNV-GL comfort classification, where COMF-V stand for noise and vibration and COMF-C for indoor climate. The vessel was not fully compliant with this norm yet; during tests and trials several noise measurements have been performed and in several cabins the allowable amount was exceeded (Figure 18).

This had to do with two different problems. The first one, was noise from the corridor to the cabins (the crews sleeping rooms) was not being damped sufficiently. The second one, was that too much noise and vibrations reached the front cabins coming from the bow thrusters when they were active. To measure the amount of damping a noise generator was placed in the corridor (Figure 15, Figure 16) and a microphone was inside the cabins. When taking a closer look at the doors it was concluded that rubber strips were forgotten between the door and the wall by the supplier. After these were added (Figure 17) and additional insulating had been placed above the ceiling the problem for these cabins was solved. As we could only do a few doors, the insulation material was brought onboard for the next trip and would be placed between the doors by the crew.

The noise and vibration problems in the front cabins is relatively harder to solve. A first solution would be to increase the amount of air being injected around the bow thruster blades to damp vibrations going through the hull and affecting noise levels in the front cabins. Research needed to be done on the compressors, pipe diameters and ring configuration. Discussions about this solution were still ongoing when my internship ended. Another, less favorable solution would be to overhaul the front cabins and insert floating floors and ceilings. This is going to take more time and will be more expensive. However as the client might want to have life boats installed, wherefore additional davits are required, this could be done in one go, which will save downtime costs.

During the day an inspector from DNV-GL was present to check the comfort class notation. At the end of the day several points could be signed off and it was agreed that the crew would place the remaining rubber strips between the doors. For me it was a fantastic experience to see the vessels with my own eyes and walk over it, which is completely different from seeing it on pictures and drawings.

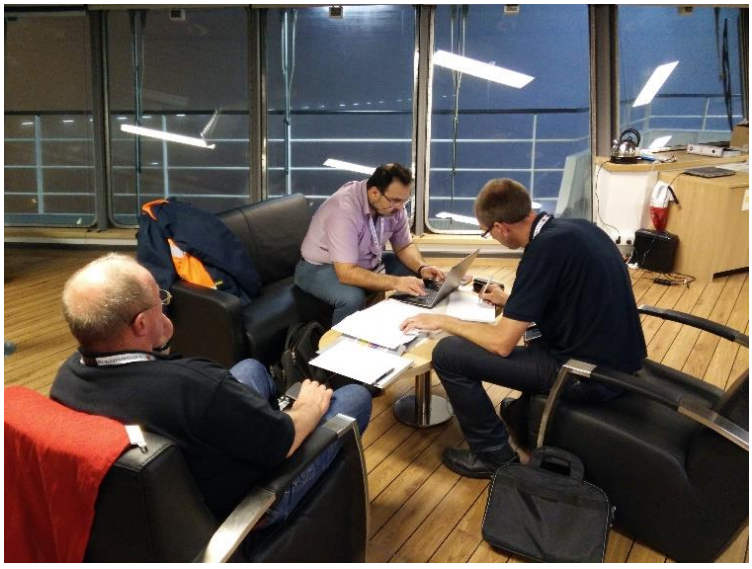

Figure 14: Documents are being signed by DNV-GL and Damen

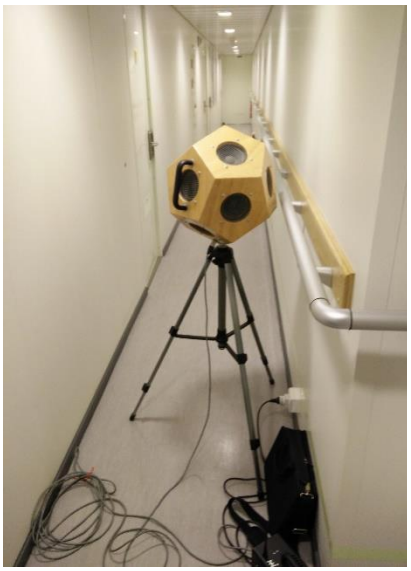

Figure 15: Noise generator

Figure 16: Noise generator

Figure 17: Adding rubber strips to the doors

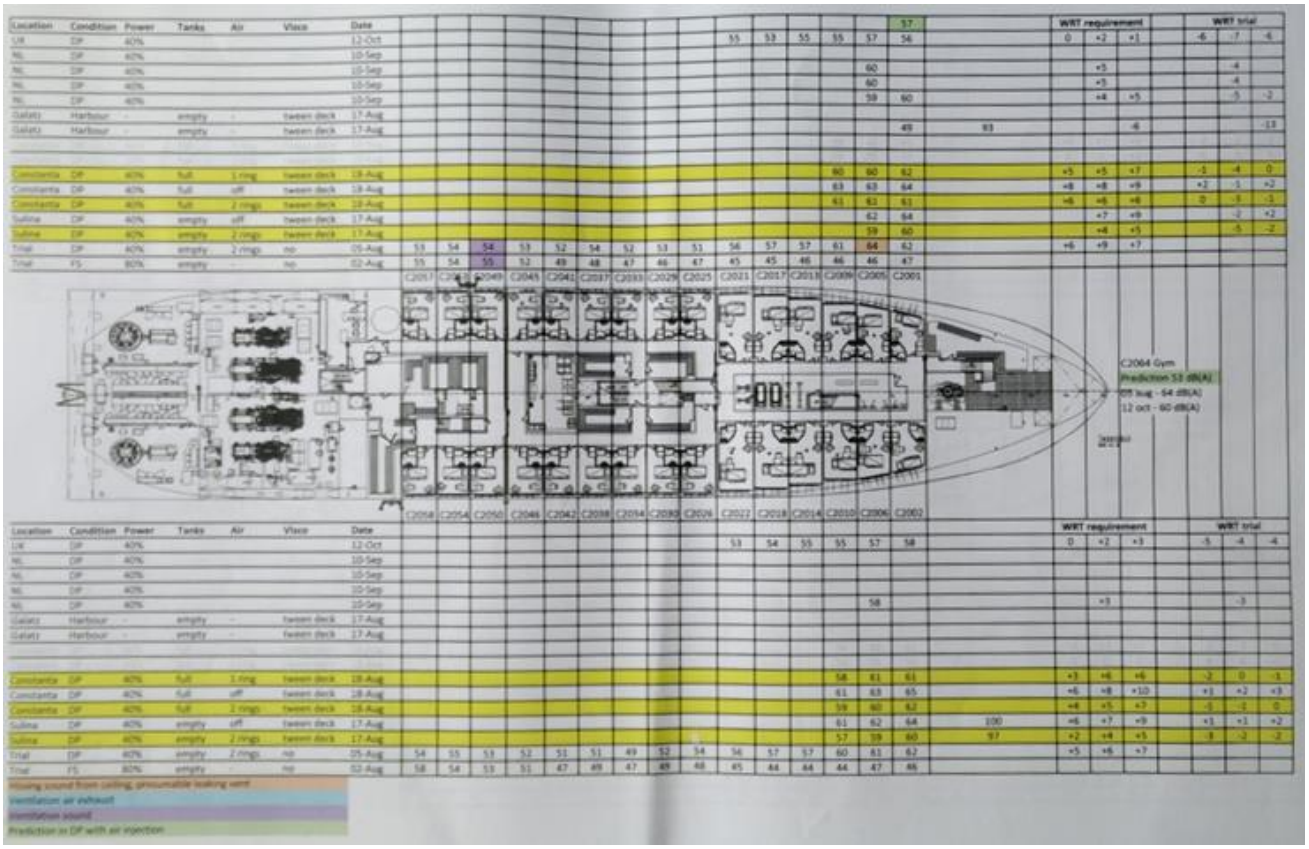

Figure 18: Noise measurements of the Bibby Wavemaster 1

9.4. Visit Gdansk (Poland) for evaluation Bibby Wavemaster 1

13 and 14 November a visit to the engineering office in Gdansk, Poland was scheduled. The main reason for the visit was to evaluate the design process for the W2W#1 and discuss future work for the W2W#2.

Evaluation

From the evaluation of the W2W#1 the most important topics were:

- Handover from information between the different companies
- Series versus one-off approach

Design & Proposal, Engineering and Project Management took in the end place at three different locations: DSGo, DSBe, DEGd. From the evaluation it followed that different engineering standards were used at the different companies. During handovers too much information was lost and a lot of engineering had been done again. The final vessel deviated quite a lot from the initial standard as was handed over by DSBe. This was also due to the client who changed their preferences several times. Preferably it is prevented that handovers between Damen companies are needed, if this is not possible for reasons, is advised to budget extra hours.

The whole W2W project started off with the idea of a series production of 8-10 vessels. Because of the current markets this ended up being not feasible. The engineering started with developing a standard with additional options which could be toggled on/off. As the requirements from the client changed, parallel to the standard vessel, a one-off W2W was designed as well. This made it in the end more difficult for engineering. The series approach resulted in more than required from the client because options could not be switched off. It is advised to first finish the standard vessel, before working on changes/customer specific. Preferably the first vessel within a series is one-off as this is easier for planning and engineering. Considering the amount of vessels O&T builds (and the specific requirements from the client), a series with standard + options (as within tugs) is most of the time not feasible.

Preliminary kick off W2W#2

As the final contract would be signed soon for the W2W#2, a preliminary kick off meeting was held, which was a good continuation of the evaluation the previous day. A lot of details have been discussed between engineering and D&P. Some items or (parts of) equipment could be downsized, as it turned out that these were over dimensioned. The message was to only change these parts if it would be cheaper in the end to replace these. Some of the most important conclusions from the meeting were:

- The elevator and gangway were not integrated, there are newer options available where this is combined, this will be a huge advantage.
- The crane will be changed from heave compensated to 3D compensated.
- The craft will be changed. This might result in changing the Davits as well.
- The compressors for the air injection around the blades of the bow thrusters have to be increased in size.
- The azimuth propulsion thrusters can be downsized (currently 2150 kW), only execute if cheaper.

10. Improving the O&T evaluation process

10.1. Motivation

The last assignment I have worked on is to improve the evaluation process within O&T. Currently after a project (a vessel or series of vessels) is finished, a project evaluation is carried out which includes evaluating the whole project: planning, engineering, procurement, production, building yard, subcontractors, commissioning, client and finance. A lot of these lessons learned are written down, however when a new project is started the experience is that these lessons learned are a lot of times not incorporated in the new project. The same mistakes occur, which results in a waste of time and money. Evaluations are saved in IFS, this is mandatory due to companywide ISO certification. In IFS accessibility and searchability is not very high which leads to unseen and unused evaluations.

10.2. Approach

Jelle Visser is the owner of this project and Niels Kooiman and I were responsible for the execution. Niels already made a small start when I joined the project. As I would have only 4 weeks we made a schedule to demarcate the project to make sure it was possible for me to deliver something in the end and not have to stop halfway because my internship would come to an end. We divided the project into two parts, the first part consists of the following goals:

- Make the current project evaluations easy accessible.
- Make the current project evaluation smarter (by adding some data) so to make a more focused search possible.
    - Present to the department before December 15th.
- Set stage gate(s) for the project evaluation in specification of a new awarded project. (connection stage gates).
    - Set the outline of the project.
    - When do you need which information?
    - Is it wise to have one or more stage gates?
    - Define the stage gate(s).

The first part is focused on accessibility and searchability and using the previous evaluations in the current projects. The second part is about diving deeper into the evaluation process itself to check which loops there exists, how it is done in other departments and improving the evaluation itself. The following points have been set for the second part:

- Review and improve the current project evaluation set up.
    - Make it smarter, more focused, fixed deliverables and more easy to search through.
- Which evaluation loops exists?
- Which information do you really need and when do you need this in the project?
- What is and how is it done in other departments?

The expectation was that the first part would be possible to complete within 4 weeks.

10.3. Execution and results

To increase the accessibility and searchability a library on SharePoint has been made. SharePoint is a highly configurable document and storage system from Microsoft which is being used throughout Damen. After several discussions, interviewing colleagues and iterations the 20 headers (columns) below have been created. The criteria for these headers is that they should not only be informative, but also be useful to perform a more focused search to find specific previous evaluations which are of interest. To increase the searchability further every column has been standardized as far as possible. This means that most fields contain a drop-down menu to prevent people from entering different descriptions for the same item. Via a direct link on the left side of the page people can send feedback or ask for anything which needs to be added. An email will be sent to Niels. The 20 headers are the following:

1. IFS doc
2. Ship type
3. Short summary of the vessel
4. Yard number
5. Client
6. Country of Client
7. Building yard
8. Basic engineering
9. Detail engineering
10. Co-maker (Elec)
11. Co-maker (HVAC)
12. Co-maker (Interior)
13. Co-maker (Nav/Naut)
14. Propulsion type
15. Engine make
16. Date of contract
17. Achieved delivery date
18. Flag
19. Class
20. Class notations

After the SharePoint was set up a list of all projects which have been executed by O&T was obtained. It was decided to add all evaluations starting from 2010. The evaluations which were not saved in IFS yet, but on the ‘G: directory’ (previous data storage system), have been added to IFS and together with the ones that were already stored in IFS added to the library. The result is shown in Figure 20.

This has been presented to the project managers within O&T on December 11th and an email with explanation has been send to the entire department. This means the first and second bullet point of the first part have been accomplished. The third and last one is about setting the stage gates. In Figure 19 a schematic overview of the phases for building a vessel at Damen is shown. This is the same as Figure 3, but is repeated here for convenience.

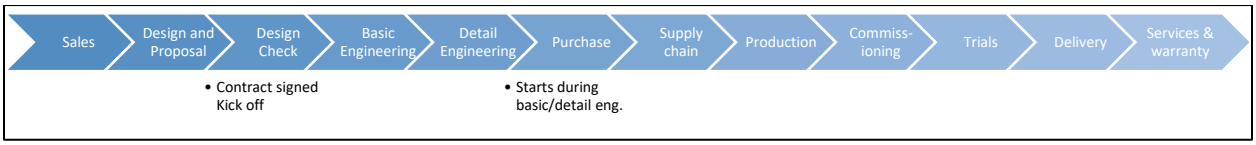

Figure 19: Schematic flow of activities for building a vessel at Damen.

The first stage gate is during the kick off of a new project with the project team as it is a part of the agenda. Secondly, before a project is started a risk analysis is carried out. The evaluations from previous projects can now easily be used as input and preparation for this risk assessment. This leads to the second stage gate. Jelle will be further responsible for the stage gates as he is working on the project timeline and is responsible for the integration of it.

Everyone in the company has been granted access to this SharePoint, however only PM, APM, PME and APME ((assistant) project manager (engineering)) from O&T are able to edit and add evaluations (contributor) whilst Niels is the only with the access to modify the library itself (owner).

Figure 20: Screenshot of the O&T evaluation library

10.4. Conclusion and recommendations

The first part has been finished within 4 weeks and I received positive comments from colleagues. They said it will be really helpful, which I'm happy about. The next part is to take improve the evaluation process itself. One could start easily with improving the forms: not everyone uses the same format and not all information for all columns is included in the evaluations. A future possibility is to develop a template on SharePoint eliminating a separate file which has to be saved somewhere as well. An advantage is that it would be possible to sort on a specific co-maker and read all parts in different evaluations about this co-maker instead of having to go through all the evaluations.

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Appendix A: Reflection on own functioning within Damen

First of all I would like to mention that I had a fantastic time within Damen and really enjoyed everything, the atmosphere, colleagues, assignments, trips and other opportunities that have been offered to me. I am very grateful for all of this.

Although I'm studying Engineering Fluid Dynamics my knowledge about the maritime sector and hydrodynamics is limited as my study is more focused on CFD related topics. This was sometimes quite a challenge and meant I had to learn a lot, but as I like to keep on learning I found this no problem at all. All colleagues were very helpful in explaining me everything and you can find a lot of information on the internet.

One thing I will take with me is talking about and managing expectations. Especially when starting an internship (or thesis/job) it is really important to talk about what both parties expect from each other. During the internship it noticed that some things were different than I expected (it definitely didn't turn out bad), but I noticed that we hadn't discussed these things beforehand.

Something which was not really present was a common theme during my internship. I think that this is something that could be improved for future internships of this kind. For me it made things more difficult to connect everything with each other and also resulted in more uncertainty than needed.

I noticed that I was less busy during my internship compared to my time studying. Partly this was because I moved to another city and wasn't taking part in committees besides my studies. On the other hand it was due to the contract for the W2W#2 being delayed, which forced me to look further within Damen for additional assignments to fill up my time. As there was less pressure than I was used to, this was a new experience for me from which I learned quite some things.

Feedback I received from both Huib and Carola was that I can put too much pressure on certain things. These things were not a priority for them, but were for me (or at least felt that way). As my internship would be only 14 weeks, I wanted to make sure to get as much out of it as possible. Pushing on these items comes partly from my experiences within the solarteam and secondly from my tendency to reduce uncertainties and turn these items more certain. This can be unpleasant for others and I am more aware of this now.