The Dutch shipbuilding decline and science: Why *MARIN* survived.

1970-1989

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Master History
Specialization Applied History
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18321 words

Master's Thesis
10 June 2025

Abstract

Maritime Research Institute Netherlands (MARIN) is an internationally renowned maritime institute that finds itself at the cutting edge of maritime expertise. From the 1960s to the 1980s Shipbuilding would shift away from Europe to countries in Asia with lower wages. In the Netherlands this led to a shrinkage in the shipbuilding sector of about 60%. At the same time the 1970s and 1980s would be a bad time for shipbuilding in general as the 1973 oil crisis would be followed by the 1980s oil glut.

This raises the question of why *MARIN* survived all this turmoil? This question was answered by gathering data from *MARIN's* annual reports and other sources like newspapers to establish three key facts: Firstly in how much trouble *MARIN* really was, secondly how reliant *MARIN* was on income from Dutch sources and lastly what core competence the institute built up to face the new market.

The coming hardships where not apparent to *MARIN's* executives in 1968 when they decided to build a large and expensive new testing facility in Ede called the vacuum tank. The vacuum tank, while certainly pushing *MARIN's* technical and scientific pedigree of *Ship powering* forwards, did provide the revenue was hoped for.

Unable to generate the profits needed to pay back its loans *MARIN* started making heavy losses. These losses where however not due to the Dutch shipbuilding collapse, but instead due to a general malaise in the shipbuilding sector combined with strong foreign competition. *MARIN's* core competence in *Ship powering* and *Ocean engineering* allowed it to tap into relatively healthy segments of the Dutch shipbuilding market when it needed to. After a looming bankruptcy the Dutch government provided emergency relief and set up the *CRONSP* to provide a long term solution.

This would result in *MARIN* merging with the *NMI* and receiving an annual subsidy. *MARIN's* situation was still not sustainable in the long term, but this annual subsidy combined with government loans ensured *MARIN's* survival for now. The subsidies *MARIN* would have needed to reach sustainability were significantly less than some of its fellow *GTI's* were receiving. This means that while *MARIN* relied on government funding for survival, this amount was less than expected for a public institute of its size.
KEYWORDS: *shilpbuilding, MARIN, NSP, Grote Technische Instituten*

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Introduction

The *Maritime Research Institute Netherlands (MARIN)* is an internationally renowned maritime institute that finds itself at the cutting edge of maritime expertise. It provides maritime engineering solutions for mostly commercial, but also governmental partners.[1] It is therefore highly dependent on its position within the shipbuilding market for commissions and cooperation. It is not unique in this model as a number of maritime research institutes, like Japan's *NMRI* and NATO's *CMRE* provide similar services.

MARIN finds its origin in 1932, when the *Nederlandsch Scheepsbouwkundig Proefstation (NSP)* was founded. The *NSP* quickly gained international recognition for the *Wageningen B-type* screws it developed in the years following its founding.[2] This screw series became an international standard and is still used as a base for new custom propellor designs. In 1980 the *NSP* would absorb the *Nederlands Maritiem Instituut (NMI)* and became *MARIN* we know today.

In the 1960s Japanese firms aggressively challenged the global shipbuilding industry with high production and low pricing.[3] In the 1970s South Korean companies would join them. This pushed almost all European shipbuilders into uncompetitive positions within the market, leading to massive losses. The government offered financial aid, but this was not enough to turn the tide; Many dockyards closed and more than half of all jobs in shipbuilding were lost by the mid 1980s.[4]

So why did the *NSP/MARIN* survive this decline of its home market? The literature provides no answer. In fact its coverage of the *NSP* mostly cuts off shortly after its founding. The sole mention of the NSP in the 9170s and 1980s is that of the opening of a new state of the art testing facility in 1972.[5] Wider historical works about the Dutch shipbuilding decline posses an often monotone focus on the actions of the companies and the government. No

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[1] Jan Dirk van Manen and R. J. H. Kruisinga, *International jubilee meeting on the occasion of the 40th anniversary of the Netherlands Ship Model Basin : August 30 - September 1, 1972*. (Netherlands Ship Model Basin, 1973), 9.

[2] Larrie D. Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000* (The MIT Press, 2020), 242.
J. S. Carlton, *Marine Propellers and Propulsion*. Second edition (Butterworth-Heinemann, 2007), 103.

[3] C. de Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*. (Den Boer/De Ruiter, 1993), 16.

[4] Sjaak van der Velden, "The Dutch shipbuilding industry, 1950-2012," in *Shipbuilding and Ship Repair Workers around the World: Case Studies 1950-2010,* ed. Raquel Varela, Marcel van der Linden, and Hugh Murphy. (Amsterdam University Press, 2017), 242.

[5] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.

historian has yet asked why *MARIN* survived this decimation of its home market, thus leaving the perspective of a Maritime Research Institute on these events unstudied. This point of view could add to the existing historiography in a multitude of different ways. Firstly it adds a now lacking piece of context, providing a more wholistic view. This case could show one of the knock on effects of the Dutch shipbuilding decline, thereby highlighting its significance to the greater Dutch maritime sector. The findings could also apply to a broader perspective: *MARIN's* situation could illuminate the broader relation between the Dutch government its industry and its scientific institutions during this period. This could also shine a light on the reasoning for the continued support and existence of this type of scientific institute. This paper aims to fill these gaps by finding out why *MARIN* survived the Dutch shipbuilding decline of the 1970s and 1980s.

Research question

To fill the gap found in the literature the research question will be as follows: Why did *MARIN* survive the Dutch shipbuilding decline of the 1970s and 1980s? The answer will be constructed by answering a number of sub-questions. First and foremost it must be established in how much danger *MARIN* actually was, since the literature does not provide any insight on this matter. The first sub-question will therefore be: How did the financial situation of *MARIN* change during the Dutch shipbuilding decline of the 1970s and 1980s?

The objective here is to see if the crisis affected *MARIN*. The answer to this question changes the nuance of the subsequent sub-questions and even the main question. If *MARIN* was financially healthy throughout then this thesis really becomes about how *MARIN* was insulated from all the various ongoing crises and changes within the shipbuilding industry. Otherwise the focus will be on what *MARIN* achieved to either be valuable enough to be rescued or to climb out of the hole on its own. It is most likely that the answer will be a combination of both.

The next most important sub-question to answer is: How reliant was *MARIN* on income from Dutch sources during the 1970s and 1980s? If the answer is only a negligible amount then the only changes in its market must be global shipbuilding changes. These could be increased competition from Asian maritime institutes or the tanker market crash of 1974, which would lessen demand ships and thus also for ship testing. This sub-question therefore may allow us to more accurately identify what events caused trouble for *MARIN*. Another indication to look out for is if *MARIN*'s reliance on the Dutch market shifted over time. This could be a great example of *MARIN* adapting to the changing market.

The final sub-question will be: What core competence did *MARIN* build up and

maintain during the 1970s and 1980s? Essentially what's being asked here is what use was *MARIN* to the shipbuilding market. If *MARIN* was, like it was before, a market leader in certain processes like screw design then surely *MARIN* should've been able to stay afloat from that? The only reason why not is if the market did not value its advantage enough. Either by cheaper close competition or the market segment being irrelevant. The great answer to changing market preferences is to diversify. Therefore this sub-question will attempt to identify all ways in which *MARIN* was useful to commercial shipbuilders and the Dutch government. These core competencies likely changed throughout the discussed period due to technological advances and market shifts. This could either show *MARIN* being forced to try out new things, or its commercial partners asking for new capabilities.

Main theoretical concepts

The two main theoretical concepts are marine research institutes and core competence. This paper does not dive deep into theory, but these terms are important to define to answer the questions asked.

Maritime research institutes, or MRI's for short, have no grand classification. Instead they are Public research institutes, or PRI's, that work with and for the maritime sector. PRI's are mostly government funded organisations which exist to first acquire advanced technology and then make it available for a target industry.[6] *MARIN's* reliance on commercial income is on the higher side for a PRI. The way that MRI's generally diffuse their knowledge is to help test and improve designs for vessels before they are built. This is unlike most other sectors, like semiconductors and medicine, where they exist to directly transfer their advanced knowledge to partner or spinoff companies.[7] Every company could have their own model ship testing basin, but it is way cheaper to have one at a central location that everyone can commission. Meaning that a larger centralised institute is preferred to a smaller institute with many spinoffs.

The term core competence was scientifically coined in 1990 by C.K Prahalad and Gary Hamel in their paper *The Core Competence of the Corporation*.[8] The concept properly defined in this landmark paper. A core competence is a long term combination of experience, technology and skills that can be utilised in designing products to gain a

[6] Roberto Mazzoleni and Richard R. Nelson, "Public Research Institutions and Economic Catch-Up," *Research Policy* 36, no. 10 (December 2007): 1513-1515, https://doi.org/10.1016/j.respol.2007.06.007.
[7] Ibid, 1516.
[8] C.K. Prahalad and Gary Hamel, "The Core Competence of the Corporation," *Harvard Business Review* 63, no. 3(May-June 1990): 90.

competitive advantage. The core of core competencies is therefore a shift away from short term profit to long term technological knowhow and expertise. This competence in specific but broadly appliable technologies can then be used to develop several products with competitive advantages. The approach that Prahalad and Hamel recommend is to first identify which budding core competencies the company possesses, then they can be nurtured and grown. Then the company can try to apply the mastered technology to as many different products as possible in order to gain the most out of it.[9] To paraphrase: the core competencies are the core ideas on which a companies products are built.

But how is this concept useful? *MARIN* has a large reliance on the commercial sector. It performs contract research and testing for commercial partners in order to generate revenue. This means that it is leveraging its knowledge and expertise to fulfil market demand. *MARIN* is of course not the only research institute performing these services for commercial partners which means it finds itself in a competitive market. In this market it is therefore effectively selling its knowledge and expertise. A better understanding of the physics involved, or a better ability to simulate them would mean a better market position. The differentiator, or the core competence, in this situation could therefore be a deeper understanding and more advanced facilities that allow *MARIN* to provide better applied knowledge.

MARIN is however a Dutch institute and the reasons for its market success could also just be its integration within the local market. A Dutch shipbuilder building a ship for a Dutch shipowner could prefer working with a Dutch research institute. *MARIN* would be the closest institute and it would also avoid any potential language barriers. This locational advantage based on its integration with the Dutch market could be an alternative to a core competency based advantage. If *MARIN* possesses no great core competence, then this locational advantage could be key to its market position. This would however mean that *MARIN* is very susceptible to downturns in the Dutch market. Since it is here where this advantage is felt. A *MARIN* that bases its competitiveness more on a core competence whoever, is more resilient to this local decline as its advantage is universal. The presence and strength of *MARIN's* core competence is therefore intimately intertwined with *MARIN's* reliance on the Dutch shipbuilding market. This means the concept provides a good angle, not just to gauge *MARIN's* general position in the market and its fluctuations, but also how it survived the Dutch shipbuilding decline.

[9] Ibid, 81-82.

Literature report

A maritime research institute in the Netherlands is not a given

With its near hundred year history and prominent position in the market *MARIN* may seem like an untouchable institution. But the existence of a maritime research institution in the Netherlands should not be taken for granted, because there is a long period of time where there wasn't one. In the 1960s and 1970s *MARIN* was known as the *Nederlandsch Scheepsbouwkundig Proefstation (NSP).* It opened in 1934 and its main attraction was its model ship testing capabilities.[10] It was however not the first facility in the Netherlands to have such capabilities. Bruno Tideman had built the first model ship testing basin shortly after the invention of the technique in England. This testing site gathered some international importance in the late 19th century.[11] However Tideman died in 1888 and the testing site was closed by the end of the century.

In 1916 an attempt would be made to create a new model ship testing basin, but only a renewed effort from 1927 onwards would result in the opening of a true replacement in 1934.[12] There is therefore a period of more than 30 years during which the Netherlands possessed no large scale model ship testing basin at all. The *NSP* was a true maritime research institute and therefore had more capabilities than Tideman's model ship testing basin, but the fact that for over 30 years there existed no independent testing facility at all shows that a maritime research institute in the Netherlands can not be taken for granted.

But why was Tideman's facility allowed to close without a replacement and why did it take so long for one to come about? Davids & Schippers attempt to provide an answer.[13] Firstly they argue that shipbuilding in the Netherlands in the early twentieth century was just not very scientifically oriented.[14] The craft was simply handed down from father to son. Most technologies were invented in foreign countries and then spread to the Netherlands. The department of shipbuilding at *Delft Polytechnic*, now *Technische Universiteit Delft (TU Delft)*, had no more than two graduates per year up until 1920.[15] The size of this department before 1920 and its subsequent growth indicate the initial undervaluing of science within Dutch shipbuilding and the eventually shifting tides.

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[10] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.
[11] Mila Davids and Hans Schippers, "Innovations in Dutch Shipbuilding in the First Half of the Twentieth Century," *Business History* 50, no. 2 (March 2008): 213, https://doi.org/10.1080/00076790701868643.
[12] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.
[13] Davids, "Innovations in Dutch Shipbuilding in the First Half of the Twentieth Century," 205.
[14] Ibid, 221.
[15] Ibid, 213.

The second factor was foreign competition. Whenever model testing was needed it was done at foreign testing centres.[16] It was simply cheaper for Dutch firms and institutions to perform their research elsewhere than to create a Dutch testing basin. All of the failed plans basically got the same response from the industry and state: it is too expensive. This does not mean that the establishment of a new Dutch ship model testing basin would not have been profitable in the long run, but simply that the upfront cost was considered too much. The presence or absence of these two factors can provide an insight into the danger that the *NSP* may have been in.

The NSP was forced to specialise

When the newly founded *NSP* opened its doors in 1934 it didn't exactly find itself in a very comfortable position. The negotiations to establish the institute were long and full of compromises which resulted in a basin that was far smaller than the original plan.[17] This meant that larger tests still had to be performed abroad. The *NSP* was therefore immediately forced to specialise. It did so successfully. *NSP* researchers performed systematic experimentation on screw propellors that had aerofoil sections, or ducts. This resulted in the *Wageningen B-series propeller*, which became and industry standard from the 1940s onwards.[18] Crucially the propellors where not just efficient but also relatively easy to manufacture.[19]

This expertise continued to develop into the 1970s and 1980s. The wave basin, a state of the art 240 meter long vacuum tank, opened in 1972. One author, Larrie D. Ferreiro, called this the culmination of its propellor research.[20] This well developed expertise made the *NSP* more competitive in the showering powering market segment. In the face of market troubles this specialisation could either work in favour or against the *NSP*. A specific niche could fare comparatively better or worse than the rest of the market in a downturn. This could leave the *NSP* relatively unaffected or particularly hard hit. A broader market spread is safer, since it is more insulated against market fluctuations which affects specific niches, but by devoting more resources to one market segment the *NSP* is able to be competitive in that one segment. This is effectively a trade-off between risk and competitiveness. The *NSP* becomes more competitive in one market segment, while taking the risk of relying more on it.

[16] Ibid, 221
[17] Ibid, 214
[18] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242; Carlton, *Marine Propellers and Propulsion*, 103.
[19] Carlton, *Marine Propellers and Propulsion,* 113-115.
[20] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.

Besides this the construction of the wave basin can provide additional context for the *NSP's* financial situation. A major scientific apparatus like the wave basin is not planned, designed and built in a year. The Dutch shipbuilding crisis had already been apparent since the end of 1964, so this very expensive decision was made in the midst of it.[21] Was this a desperate *NSP* trying to bolster its expertise in order to retain relevancy, or was this a well oiled machine simply taking the next step? No historian has as of yet attempted to answer this question.

The Dutch shipbuilding decline

The 1950s had been a prosperous period for the Dutch shipbuilding industry.[22] New global competition would however enter the market, and by 1956 Japan had already surpassed the Netherlands by tonnage built.[23] This became a grave concern in the 1960s as Japan began aggressively lowering costs and conquering markets leading to major losses for Dutch shipbuilding firms.[24] South Korea would later do the same thing in the 1970s. By the 1960s seven shipbuilding companies combined made more than half of all sales of all shipbuilders in the Netherlands.[25] These were affectionately known as the "seven sisters" and comprised of: *Van der Giessen-de Noord NV, Nederlandsche dok- en scheepsbouw maatschappij, Rotterdamsche droogdok Maatschappij, machinefabriek en scheepswerven van P. Smit Jr, Koninklijke maatschappij "de Schelde," Verolme verenigde Scheepswerven en dok-* and *Werfmaatschappij Wilton-Fijenoord.*[26]

In December of 1964 these companies united to send the Dutch parliament a report showing how bad the position that Dutch shipbuilding was finding itself in really was. *De Voogd* argues that the fact that these usually bickering rivals united to deliver this report gave it a lot of gravitas. [27] Since things must have gotten really worrisome, or they must have seen large opportunity, for them to agree on anything. He also argues that the unity represented in the distress call made by the seven sisters may have been the reason that the government would later try so hard to get the companies to merge.[28] The personalities within the companies were however still bitter bickering rivals. *De Voogd* argues that these underlying differences had a large negative impact on the ability of the newly merged

[21] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 16.
[22] Ibid, 12.
[23] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 228.
[24] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 16.
[25] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 226.
[26] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 13.
[27] Ibid, 16.
[28] Ibid, 17-18.

companies to restructure. The *NSP* did also undergo a merger as result of the crisis. In 1980 it merged with the *NMI* to become *MARIN* we know today. Similar personality clashes might have influenced the success of the newly forged institute, but this is not covered in the literature.

The government responded by setting up a commission called *Commissie Nederlandse scheepsbouw 1965 (Commission 1965)* to investigate.[29] Its results were published in 1966, and are mostly referred to as the *Keyzer rapport*, named after the chairman of the commission.[30] It found three main reasons for the lack of competitiveness of Dutch shipbuilding in the international market: Foreign governments financially supported their shipbuilding sectors. This was mostly done in the form of cheap loans to shipbuilders.[31] The Dutch shipbuilding market was unable to attract enough labour. And lastly the Dutch shipbuilding sector was lagging behind in industrialisation. To much work was still done by hand in poorly organised shifts on a small scale. Based upon this report the Dutch government would start giving out cheap credit and other subsidies to Dutch shipbuilders.[32] One of the requirements for receiving these subsidies would be the restructuring and merging of the firms. This policy most notably resulted in the formation of the *Rijn-Schelde-Verolme Machinefabrieken en Scheepswerven NV (RSV)*. This company was formed in 1971 after a complex series of mergers between six of the seven sisters. [33] The exact manner and the timeline of the mergers can be seen in figure 1 below.

The Dutch Government's policies would turn out to be largely unhelpful in turning the tide. The financial support helped out some well run companies in a pinch, but failed to turn most shipbuilders profitable.[34] Many firms were encouraged to merge in order to receive these subsidies. Some were even forced to, in order to receive the money they required.[35] Many argue that, at least in the case of the *RSV*, these mergers brought negative effects. *De Voogd* argues that the formation of the *RSV* left too many clashing personalities in management roles, resulting in inefficiency and infighting.[36] Many shipbuilder tried to diversify into different manufacturing industries; Most failed, but a few that did, like the

[29] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 228.
[30] Ibid, 228-229.
[31] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 18-19.
[32] Ibid, 18-19;
Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 229.
[33] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 245.
[34] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 78.
[35] Ibid, 41.
[36] Ibid, 90-91.

smaller *Industriële Handels Combinatie (IHC)*, survived relatively well.[37]

The killing blow for the many already staggering Dutch shipbuilders came in 1974 when the 1973 oil crisis caused a crash in the tanker market.[38] Demand for oil tankers had risen in the years just prior. This caused prices to balloon and many shipbuilders to project profits for the first time in years. Most shipyards had already started construction when contracts were suddenly cancelled. This left the shipbuilders to either eat the losses or to finish the boats at their own cost. The *RSV* chose the second option, which packed out disastrously.[39]

The government heightened its financial support for the shipbuilding sector as the crisis worsened and bankruptcies loomed. Most notably for the *RSV*. But in the end most companies were just overall unsustainable. They either merged into bigger firms or, like the seventh sister *Giessen-de Noord*, survived on their own in some form.[40] Almost all of them however did so by firing a significant portion of their workforce and closing a lot of their dockyards. *Damen Shipyards Group Damen* is the big exception here as it required no government aid at all and expanded rapidly. It saw a 1970s full of new opportunities and expansion, as it was able to keep costs low due to rigid standardisation.[41] *Damen* often bought up many of the best and surviving pieces of failing shipbuilders. An example of this can be seen in figure 1. Even with *Damen* helping preserve jobs the numbers were staggering. A total of 60% of all people working in the shipbuilding industry lost their jobs. [42] Many firms became a shadow of their former selves or disappeared outright.

[37] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 93;
Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 239.
[38] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 57,79.
[39] Ibid, 80.
[40] Ibid, 99.
[41] Joke Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken* (Boekschap, 2015), 44.
[42] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 242.

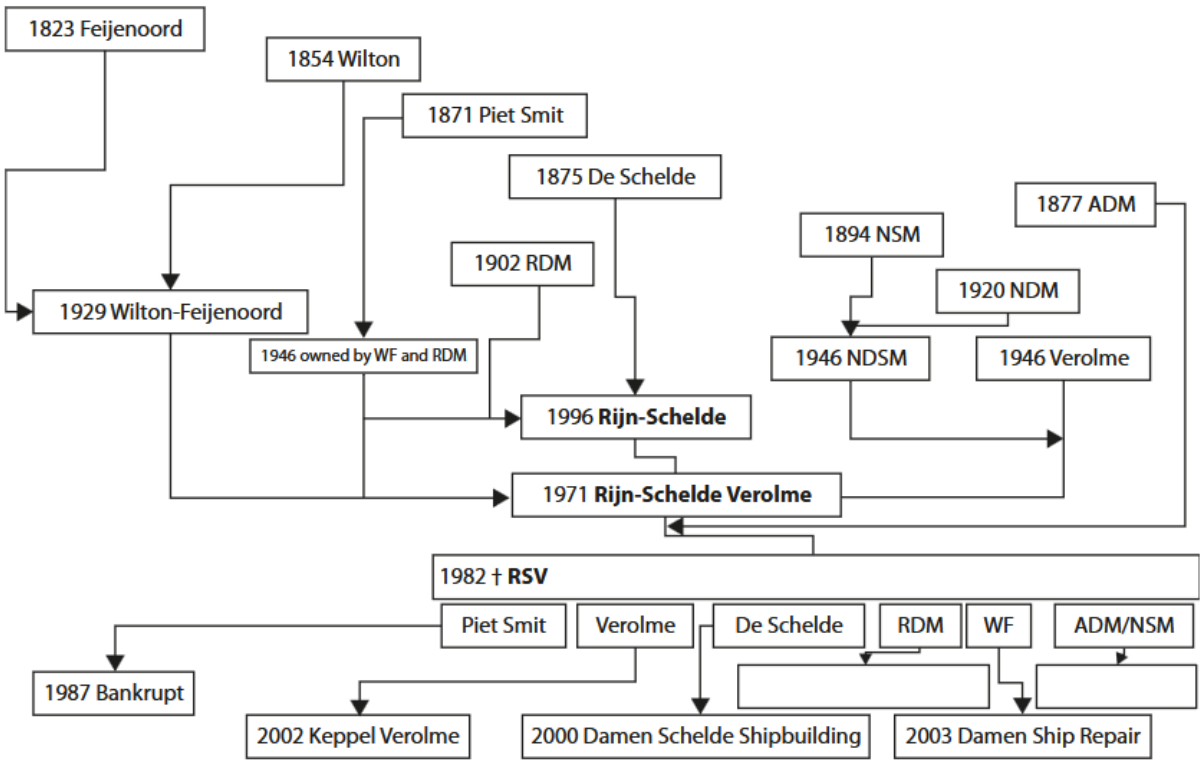

Figure 1: *The History of RSV* by Sjaak van der Velden. Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 245. This graph shows the mergers that created *RSV* and into what firms survived it. Six of the seven sisters are notably included. *RS* is mislabelled as being created in 1996 while it should be 1966.

The dependency of the NSP on Dutch shipbuilding

The *NSP* was heavily intertwined with the Dutch shipbuilding industry from the moment it was founded. Davids & Schippers argue that the establishment of the *NSP* was in fact only possible due to co-operation between the academic world, shipping lines and shipowners.[43] This is reflected in the funding the *NSP* received for the construction of its test basin. Half of it came from the government and the other half came from a group of the biggest Dutch shipping lines.[44]

The relationship between the *NSP* and the Dutch shipbuilding sector in the 1970s and 1980s is not explored in the literature. This is likely a result of the *NSP* rarely being covered at all, but could also be due to no significant change happening. It is likely that the commercial sector was the most important source of income for the *NSP*, but there is no

[43] Davids, "Innovations in Dutch Shipbuilding in the First Half of the Twentieth Century," 220-221.
[44] Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken*, 111.

distinction made between different markets.[45] It may be argued that the rise of the Asian market may have just shifted where the customer were. But new maritime research institutes popped up and aggressively expanded right along their commercial shipbuilding counterparts.[46] It is therefore not certain that the Dutch market was important to the *NSP*.

Did the NSP fit into the surviving Dutch market?

As companies began closing shipyards in the 1970s and 1980s only the profitable ones remained open. These largely worked with three different market segments: Ship repair, offshore and navy. This meant that the Dutch shipbuilding market effectively shifted to these sectors. The *NSP* would have to shift with the market to retain what business remained. This shift has not yet been researched. Each segment and the *NSP*'s position pertaining to it will de discussed now.

The repair sector had been steadily gaining importance within the Dutch shipbuilding industry for at least a decade by the time the decline started. The profitability of repair work laid at the core of the postwar recovery of the sector. [47] Dockyards would profit about evenly from shipbuilding and ship repair until the 1960s. In the 1970s shipbuilding would start heavily outpacing ship repair.[48] When the *RSV* and other large shipbuilders eventually collapsed a number of dockyards would survive under new management, albeit with reduced capacity after a firm round of layoffs. A majority of these surviving dockyards primarily conducted ship repairs.[49] So as the Dutch shipbuilding industry expands in the 1960s the ship repair segment grows less, but it survives the decline and the bankruptcies that result from it better. Repair, maintenance and modification often go hand in hand, but the changes and therefore the knowledge required to make them are rarely as wide reaching as the construction of a whole new vessel. The *NSP* could therefore have had a relatively weak position towards the ship repair segment.

The offshore industry was an upcoming market in the 1960s and 1970s as new technology allowed drilling much further into the sea than ever before. Dutch shipbuilders capitalised on this quite profitable demand. The aforementioned *IHC* was a dredger company that successfully diversified into the offshore market to survive the decline

[45] Manen, *International jubilee meeting on the occasion of the 40th anniversary of the Netherlands Ship Model Basin : August 30 - September 1, 1972*, 9.
[46] Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken*, 130.
[47] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 223.
[48] Ibid, 224.
[49] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 98.

relatively well.[50] It is still considered a market leader in this specialisations.[51] The *RSV* also possessed an offshore division with rather large potential that needed to be "rescued" from the sinking company.[52] *MARIN* itself boasts that the offshore sector has always been important to them, which lines up with the rapid technological advancement happening in the sector at the time.[53] If this claim is confirmed, then relative success of the Dutch offshore would have almost certainly aided the *NSP's* survival.

The Dutch shipbuilding sector may have been on a decline, but the budget of the Dutch navy was not. The cold war was at its height during the 1960s and 1970s, and even after the Dutch navy was still ordering plenty of ships.[54] This meant that the shipyards working for the navy were the third profitable sector. In his paper *The Pillars of Dutch Naval Shipbuilding* Alan Lemmers tries to lay out the three main "pillars" that Dutch naval success is built upon.[55] They are: the navy itself, the industry and the research sector. This is made up of *MARIN* and the *Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek (TNO)*. The navy would order ships from Dutch shipyards, for which *MARIN* and the *TNO* would perform research and testing. The Dutch navy was therefore, at least partially, dependent on *MARIN* for its technological advancements. Lemmers also stresses the long-term nature of these relationships, with some going back as far as more than a hundred years.[56] This system would persevere through the bankruptcy of several of the involved shipyards. It is however more debatable whether the navy could do without the *NSP* and later *MARIN*, since the only other organisation in its pillar, the *TNO*, is a general scientific technical institute, lacking a maritime focus. The loss of *MARIN's* valued expertise would clearly be large setback for the Dutch navy. This means that *MARIN* would not only have been heavily involved in this market segment, but the preservation of it and its expertise could have been a government priority.

Could the same factors that took down the Dutch shipbuilding industry also take down the NSP?

While the declining Dutch shipbuilding industry likely had an effect on the *NSP*, it also did not happen in a vacuum. The same factors that affected the industry as a whole could also

[50] Ibid, 93;
Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 239.
[51] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 224.
[52] Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken*, 51.
[53] Ibid, 37.
[54] Alan Lemmers, "The Pillars of Dutch Naval Shipbuilding after 1945," *The Northern Mariner / Le Marin Du Nord* 25, no. 3 (31 July 2015): 272-273, https://doi.org/10.25071/2561-5467.241.
[55] Ibid, 286-287.
[56] Ibid, 270.

have had direct effects on the *NSP*. The most obvious here are the three factors mentioned in the *Keyzer rapport*.[57] They are: a lack of labour, lagging industrialisation and governmental financial support. It is unlikely that the *NSP* would find a lack of engineers and scientist within the very educated Dutch labour market. The building of the state of the art wave basin in 1972 points towards the *NSP* being at the cutting edge rather than lagging behind industrially.[58] It is however likely that financial support from the government was a competitive advantage from Asian maritime research institutes. There are claims in interviews by former *MARIN* personnel that the *NSP*'s Asian competitors benefitted from an extraordinary 90% of subsidies.[59] But once again no further historical research has been performed.

Whatever subsidies these institutes got, they possessed good enough equipment and knowledge to perform most of the usual modelling work by the 1970s.[60] This shows that the rise of Asia also happened within the research sector of the shipbuilding industry. This may have hampered *MARIN's* attempts to expand into the region. Another event that almost certainly had some level of impact upon the *NSP* is the aforementioned tanker collapse of 1974.[61] With new tanker orders grinding to a halt any work in modelling their hydrodynamic shapes and screws also would've ceased to come in. If the *NSP* relied on this revenue stream it most certainly was a tough blow.

Innovative aspects and contributions to historiography

For the twenty years after the *Keyzer* rapport and the results of the policies that followed it most have focused on the *RSV*. It is understandable that most historians would study the *RSV;* Since it was by the biggest shipbuilding company in the Netherlands and thusly it employed the most people and received the most government aid. The angle most historians take is to try and understand if the measures taken by the government and other actors were the right ones to try to create the best outcome possible. This does however mean that a lot of smaller companies and actors are left understudied. This results in a bias towards the *RSV* and the government policy towards it within the historiography.

One major axis of research into the *RSV* downfall is the effect of unions. In 1950s Dutch wages were among the lowest in Europe.[62] In the 1960s the Dutch shipbuilding

[57] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 228-229.
[58] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.
[59] Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken*, 130.
[60] Ibid.
[61] De Voogd, *De neergang van de scheepsbouw en andere industriële bedrijfstakken*, 57,79.
[62] Ibid, 227.

industry unionized well and often struck for higher wages.[63] The striking is what is called offensive striking because the goal was to obtain better conditions. When the crisis became apparent the tune changed and the strikes became all about retaining jobs and benefits. This is called defensive striking. The conventional point of view is that the unions delayed the inevitable collapse for as long as possible in order to ensure the most benefit for their members.[64]

Bo Stråth argues that there is one aspect lacking from this point of view. With *RSV* floundering the government included union representatives in several committees from 1976 onwards.[65] Committees, like these, with union, commercial and governmental representation are referred to as so tripartite pacts. This resulted in a complex agreement in which the settlements where split per dockyard. *Stråth* argues that this form of settlement made it effectively impossible to organize large scale strikes against the measures. [66] Thusly by taking part in tripartite pacts the unions made further resistance impossible. It is unclear whether these possible strikes may have had a significant effect on the outcome for shipbuilders.

The involvement of maritime research institutions in the Dutch maritime decline could be another aspect to study and generate debate, just like unions do. The research institute is, like the unions, another third party heavily involved with the industry. This relationship, and the way it develops as the crisis deepens, could highlight another facet of the Dutch governments policy and its degree of success. This closer look of the ecosystem of the public research institute, funded by both commercial activities and subsidies, could shine a broader light on the Dutch governments scientific policy of the time period. How does a maritime research institute like *MARIN* justify its existence to both the industry and the government? The *NSP* is however never mentioned in the relevant literature. The sole topic in which the *NSP* gets brought up discussing the relevant time period is in the development of maritime science.[67] Even though it appears quite frequently in interviews about Dutch shipbuilding in the time period. This is a clear gap in the existing literature that this paper aims to fill.

It is also noteworthy that material from *MARIN's* archive used in this thesis does not yet appear in current discussions about *MARIN*. The main reason for this is that it has quite

[63] Van der Velden, "The Dutch shipbuilding industry, 1950-2012," 231.
[64] Ibid, 240.
[65] Bo Stråth, *The Politics of De-Industrialisation: The Concentration of the West European Shipbuilding Industry* (Croom Helm, 1987), 164.
[66] Ibid, 181-182.
[67] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.

recently been set up and is, as of writing, still in a process of being organized and digitized for the general public. This source will therefore make its grand scientific debut in this thesis.

Research methods & primary sources

MARIN's financial situation during the decline of Dutch shipbuilding in the 1970s and 1980s.

The first criterion to understand how *MARIN* survived the 1970s and 1980s is to explore whether it was in trouble at all. The most relevant sources to answer this question are *MARIN's* annual reports. These legally mandated documents have to provide truthful financial information. The annual reports also contain a summary of the financial outlook of the institute at the time of writing. This writing is more subjective and could be used by the authors, mostly the chairmen, to paint a better or worse picture to influence external decisions. In this light it was chosen to mostly rely on quantitative research, but then generate more qualitative analysis to contribute to the research overall. Since this paper analyses a period of twenty years all financial data will be inflation adjusted. The exact inflation figures used can be found in appendix one.[68] In the case of a partially government funded institute, like *MARIN*, the primary party to influence would be the government. A situation could be portrayed more negatively to underline the need for additional subsidies, while a more positive outlook could persuade the same government an institute in a very bad financial position could be saved. One complicating factor is that, during most of the 1970s, *MARIN* released two separate annual reports. One in Dutch with all legally mandated relevant financial information and one in English detailing the institute's latest scientific achievements. The English reports could be targeted towards commercial partners, showing of the institutes scientific prowess in order win over potential customers. Only the Dutch annual reports are relevant for ascertaining *MARIN's* financial health, since they contain the aforementioned legally mandated financial numbers and the annual financial outlook.

The legally mandated financial numbers consist of two balances, these are the balance sheet and the income statement. The income statement opposes the company's income and expenses for the year in order to calculate the company's income. The balance sheet opposes the company's total assets with its debt and equity. Debt or liability is subtracted from the company's total assets to calculate the company's equity. From this mass of information relevant numbers need to be selected to be analysed. Two of the most

[68] "Inflatie in Nederland per jaar," Hoeveel inflatie, accessed June 10th 2025, https://hoeveelinflatie.nl/nl/.

relevant financial numbers for a commercial company are its equity ratio and its earnings before interest, taxes depreciation and amortisation (EBITDA). [69]EBITDA shows how much the company makes directly, while equity ratio shows how much of the company's worth is actually owned by the shareholders. *MARIN* is however not a usual company: it is a non-profit that receives subsidies from the government. This impacts both equity ratio and EBITDA as measurements.

EBITDA leaves out depreciation, amortization, interest and taxes. This is great for determining how much a company earns from just its operations. Since *MARIN* shouldn't make any profit it should spend any money left over at the end of each year. Its earnings should thus be negligeable. This means that *MARIN's* EBITDA should just be interest, taxes, depreciation and amortization added up. It can therefore not distinguish a great year from a normal year since both should be around the four costs added up. The same goes for *MARIN's* straight up earnings. This number can however still clearly show when it had bad years, since it is not offset by the four costs. Therefore *MARIN's* earnings shall be analysed instead of its EBITDA. There is however one additional complication: *MARIN* receives direct subsidies from the government. This shall be taken into account when analysing *MARIN's* earnings to show both its performance as a subsidised institute and its viability without direct government support, to analyse its dependence on the Dutch government.

MARIN's equity ratio is affected less by its earnings, since these should aim to be near zero, but this ratio is otherwise still useful and will be utilised. Another ratio that will be looked at is *MARIN's* turnover ratio in order to ascertain how efficient *MARIN* utilised its assets over time. *MARIN's* largest single cost during this period is personnel. But not only is personnel a major cost, but it is also more flexible than most of *MARIN's* other costs. Maintenance and interest, for example, are set for the long term. While personnel can more easily be hired, fired or given different hours. This means that the numbers of people employed by *MARIN* and the hours they work serve as a good indicator of *MARIN's* prosperity.

***MARIN's* reliance on income from Dutch sources during the 1970s and 1980s**

In this chapter it will be determined if *MARIN's* struggles, or lack thereof can be attributed to a reliance or lack thereof on income from Dutch sources. This question will once again use quantitative methods to achieve a qualitative answer. The level of income that can be

[69] K. Montevirgen, "EBITDA," *Encyclopedia Britannica*, October 14, 2024, https://www.britannica.com/money/ebitda-earnings-before-interest-taxes-depreciation-amortization; J. Gopalakrishnan, "Starting your stock analysis? Here are the best financial ratios to watch," *Encyclopedia Britannica*, September 17, 2022, https://www.britannica.com/money/financial-ratios.

attributed to Dutch sources illustrates the level of importance of this market region. While any sudden shifts or steady changes in this amount could show a need to rely on international clientele, or a retreat to the home nation. This could signify either the importance of the Dutch shipbuilding crisis and its events like the collapse of the *RSV*, or the importance of events of global proportions like the 1973 oil crisis, its corresponding tanker crash and the 1980s oil glut.

Since *MARIN* is a government funded market oriented nonprofit it received income in two different ways. These are the income from its commercial operations and the subsidies it receives from the Dutch government. Most *MARIN* annual reports contain a section detailing the regions the institute served during the relevant year. Interestingly this information is present in both the Dutch and English version. Perhaps it is present in the English reports to show off *MARIN's* international character to potential customers. The subsidies *MARIN* received are also listed in each years *MARIN* annual report. These have to be extracted from the financial numbers, which are only present in the Dutch versions, so for these datapoints only these reports are relevant. This would provide accurate numbers, but without context these would not mean anything. *MARIN* is a PRI and the great majority of PRI's receive more than half their income from subsidies.[70] It is therefore expected that *MARIN* would receive some amount of government funding.

What really indicates *MARIN's* dependency on the Dutch government is just how much it got funded in comparison to other PRI's. A PRI operating effectively on an income that is subsidized for 10% in a market and context where 50% is the norm, would technically also be dependent on its government, but would be much less of a burden. To evaluate the dependency of a PRI it must therefore be compared with fellow institutes. But there have historically been many different institutes, operating in many different markets segments or sectors under many different conditions during differing time periods. The closest peers to *MARIN* must therefore be found in order to make a valid comparison.

Financial data from which to ascertain the subsidy level of *MARIN's* foreign competitors were unfortunately unavailable. The only relevant source here is a claim that *MARIN* faced some competition that was subsidized for a truly absurd 90%.[71] This claim is however verbal and could not be verified. This paper thus lacks these very valuable

[70] Patarapong Intarakumnerd and Akira Goto, "Role of Public Research Institutes in National Innovation Systems in Industrialized Countries: The Cases of Fraunhofer, NIST, CSIRO, AIST, and ITRI," *Research Policy* 47, no. 7 (September 2018): 1317, https://doi.org/10.1016/j.respol.2018.04.011.

[71] Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken*, 130.

international comparisons. A more international picture covering *MARIN's* competitors in this market and therefore the market as a whole could be an avenue for future research. The peers that *MARIN* will be compared to in this chapter are found rather closer to its home. *MARIN* is one of five institutes in the Netherlands that are collective referred to as the *Grote technische instituten (GTI's)*.[72] This term translates to the large technological institutes. They are grouped together since they are by far the largest independent PRI's in Netherlands. This means that these comparisons are being made across industries and fields of science, but all the *GTI's* receive some form of funding from the Dutch government, so they make for the closest possible comparisons.

These Dutch government, like most, publishes official accurate budgets for each year. The annual subsidies for each *GTI* will be extracted form these budgets. These numbers could be directly compared to the subsidies *MARIN* received each year. *MARIN* did however receive funds in multiple different manners. From direct cash injections, to base subsidies to state guarantees. The state guarantees in particular become eventually waived loans, that add interest, which got waived for some of the years, and repayment costs. This makes the amount the government spent in total on keeping *MARIN* afloat during the 1970s and 1980s impossible to accurately calculate. As discussed later the provided amount is also not the amount necessary to sustain *MARIN* in the long term, so a comparison to the subsidies *MARIN* received would also be unfair. Instead the reverse will be done, *MARIN's* deficit without subsidies will be inversed to create a subsidy target. This target represents the subsidies *MARIN* would need to operate in a sustainable manner during this period. This figure still includes interest on the state guarantees in some years, but this number most accurately represents the money *MARIN* required to operate as it did during the 1970s and 1980s.

The manner in which *MARIN's* annual reports present the geographical split of their revenue differs greatly over the years. In the first years, from 168 till 1972, this data is presented in bar charts. The annual reports form 1973 and 1974 would use stacked area charts. All the charts so far where in millions of guilders of revenue, but this would change in 1975 as its annual report would feature a bar chart in percentages. This report also outright listed the number, making this the most easily readable year yet. The following two years reports would be the opposite. They featured bar charts in percentage listed per type of

[72] Mila Davids, Harry Lintsen, Arjan van Rooij, and Eric Berkers, *Innovatie En Kennisinfrastructuur : Vele Wegen Naar Vernieuwing*. *Bedrijfsleven in Nederland in de Twintigste Eeuw* (Boom, 2013), 212; Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1986*. Wageningen 1986, 10.

client. The individual measuring of seven categories adds a so far unheard of amount of measuring uncertainty into the numbers belonging to those years. In 1978 *MARIN* would hire new external accountants.[73] The hired firm would significantly change the format of the annual reports going forwards. The Dutch annual report got stripped to the bone, and the English annual report was axed entirely. As part of these changes the reports stopped breaking down *MARIN's* revenue by region. It would take until 1984 for a useable geographic breakdown of *MARIN's* orders to return. The annual report would present these figures for a singular department going back to 1981, but with no way to determine if these figures were representative they were of no use. One unexpected occurrence is that a singular newspaper article from 1979 mentions the percentage of *MARIN's* orders attributed to international customers in the previous year.[74] This provides a figure for 1978, but also frustratingly shows that these numbers were tabulated, but not preserved.

The 1984 annual report would feature a table with a full numerical breakdown of *MARIN's* revenue by region in total amount and in percentages. This would be the standard going forwards. Luckily the 1984 annual report also featured last years numbers for comparison providing numbers for that year as well. These new numbers do however come with one caveat, they include the sizeable subsidies that *MARIN* received at the time. Form the annual reports it is unclear towards which region the subsidies are counted, but it is assumed that they are counted towards the figures for the Dutch market. This same issue is not present in the pre-1978 data.

This data gathering process unfortunately leaves a hole in the middle of the period, but this still allows an overall shift in the market to be measured. Some annual reports measured the data in amount of revenue, while others measured it in percentage of revenue and some annual reports contained both. To standardise the dataset all numbers are first calculated as a percentage, this percentage is then multiplied by *MARIN's* income from commercial operations to create a standardised number for total amount of revenue. This process serves to universalise any possible bias the multiplication by *MARIN's* income from commercial operations may impose. The resulting numbers do not significantly differ from the numbers provided in the annual reports. In the cases of the figures from 1983 onwards the numbers have also been calculated with the subsidies that *MARIN* received form the government in the relevant years subtracted from the revenue.

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[73] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1978*, Wageningen 1978 23.

[74] "Meer orders voor NSP uit het buitenland," *NRC handelsblad*, Januari 12, 1979, https://resolver.kb.nl/resolve?urn=KBNRC01:000026327:mpeg21:a0107.

The Dutch governments annual budgets are well digitised and easily accessible online. Three out of the four other *GTI's* where chosen for the comparison. This choice was made based on the availability of sources. The budgets were published per ministry, and the relevant *GTI's* appeared in the budgets of three. These are *Economishce Zaken (EZ)*, *Onderwijs en wetenschap (OW)* and *Verkeer en waterstaat (VW).* These translate to economic affairs, education & technology and traffic & water management. These budgets are however not immutable and perfect. They sometimes list costs as "memorie," meaning a different unreferenced document actually contains the relevant numbers. They are also frequently subject to adjustments from years later, making it hard to obtain final numbers. The first issue ensures that the figures gathered form this data are only a lower bound, which has to be kept in mind for the comparison. With that caveat in place the second issue is also irrelevant, since it is very unlikely that a research institute in this period and economic situation would not fully utilise its allocated funds.

***MARIN's* core competence during the 1970s and 1980s**

The last major component to understand why *MARIN* survived are the way it evolved its offerings on the market. *MARIN* would have adjusted the services it provided along with shifting market and government demands in order to attain the relevancy needed to survive. In the commercial market this would have meant offering competitive prices on in demand services. *MARIN* also needed to remain relevant to the Dutch government in order to attract and keep receiving its needed subsidies. In order to attain a deeper understanding of this process of shifting services offered the concept of core competence shall be utilised. A company, or in this case a nonprofit, creates many differing products and services based upon a core of valuable knowledge and expertise. The real competitive advantage therefore lies not in the companies specific products, but in the underlying technology, this is known as the core competence.[75] A company or nonprofit can posses multiple core competences. The main source for this chapter will once again be *MARIN's* annual reports, with the English versions taking centre stage as they contain highly detailed information regarding *MARIN's* scientific advancements. Certain Dutch newspapers articles covering *MARIN* also present unique information on *MARIN's* activities. *MARIN's* Dutch annual reports contain its revenue broken down per categories or market segments. A successful core competency is directly reflected in a successful line of products, so analysing *MARIN's* market segments should allow for a greater insight into the actual success of *MARIN's* core competence. For

[75] Prahalad, "The Core Competence of the Corporation", 90.

this reason this question will once again use some quantitative methods to achieve an overall qualitative answer.

MARIN's financial situation during the decline of Dutch shipbuilding in the 1970s and 1980s.

The vacuum tank is built

The 1970s and 1980s were a tumultuous time for *MARIN*. The institute went through multiple large expansions and endured long financial hardships. *MARIN's* financial situation during this period would however be heavily affected by a decision made in 1968. The timing of the construction of this tank is the reason 1968 and 1969 are included in the gathered dataset. They serve to contextualise the enormous change that the building of the vacuum tank brought to the organisation.

In 1968 Marin executives had decided to construct a large new towing tank in Ede to expand capacity. In the annual reports this facility is regularly referred to as the depressurised towing tank. It was not built in Wageningen, where the rest of *MARIN's* facilities were, but in Ede. Ede is the next town over to the north of Wageningen with a distance between them of only about ten kilometres. These facilities were however noted down separately in *MARIN's* annual reports.[76] The facilities are only combined on the balance sheet from 1984 onwards, with the balance sheets additional elaboration still keeping them separate.[77]

The main reason for the construction of the vacuum tank was that *MARIN's* deep towing tank could not fulfil all of the demand for large scale towing tests at the time. *MARIN's* executives predicted this demand would keep growing. A second, lesser reason, is also provided: Ships kept growing. To reliably simulate these vessels their scale models grew along with them.[78] A new large facility was needed in order to accommodate these vessels' scale models. Crucially the decision was also made to build the new towing tank with the capacity to depressurize, steeply increasing the cost.[79] The ability to depressurize would give the vacuum tank the ability to produce realistic cavitation on scale models; this greatly diversified its possible applications. It was decided that there was enough demand for

[76] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1972*, 16.
[77] Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1984*, 17.
[78] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968*, 23.
[79] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968*, 22-23.

this type of test to justify the expense. This particular property made the facility state of the art and ensured that it was one of a kind when built.[80]

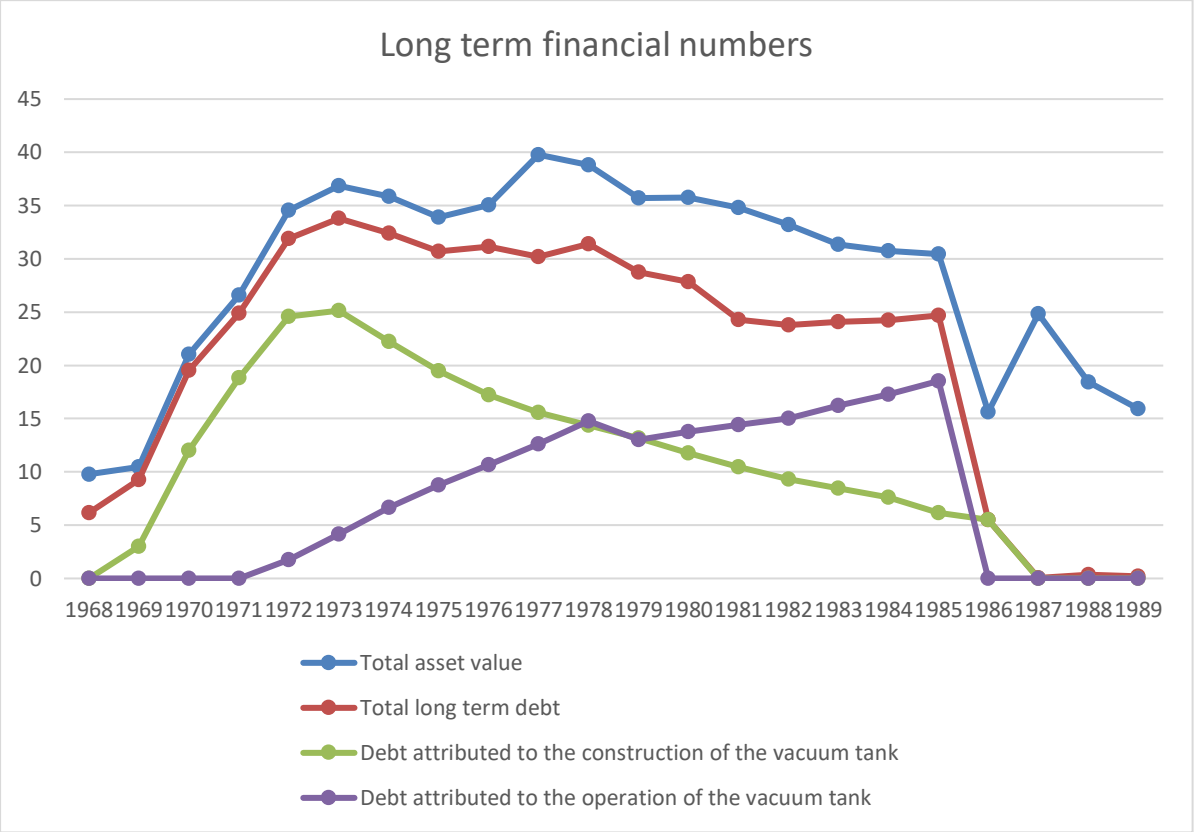

Figure 2: Some of *MARIN's* long term financial numbers in millions of 1968 guilders from 1968 till 1989. Sources: Data from Hoeveel inflatie, "Inflatie in Nederland per jaar;" Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Figure two depicts several of *MARIN's* key long term financial figures during the 1970s and 1980s. The full data from this figure is presented in appendix two. These numbers have been chosen in order to illuminate the enormous long term financial effects of the construction of the vacuum tank. In 1969 *MARIN* starts taking loans to build the vacuum tank. The eventual total amount of just over 30 million guilders is in line with newspaper reports.[81] This number differs from the number in figure two, since the graph is presented in 1968 guilders. The

[80] "Scheepsbouwkundig Proefstation krijgt vacuumsleeptank," *De waarheid*, May 30, 1970, https://resolver.kb.nl/resolve?urn=ABCDDD:010849594:mpeg21:a0330.
[81] "Nederlands scheepsbouwkundig proefstation leent," *Trouw,* October 2, 1970, https://resolver.kb.nl/resolve?urn=ABCDDD:010849594:mpeg21:a0330.

choice to compensate for inflation was made to counteract the long term inflation in *MARIN's* assets, meaning that the same assets would seem to grow in value. *MARIN's* total value rises by the same amount as the loans taken to afford the construction of the vacuum tank. From a valuation of below 10 million guilders to just over 40 million guilders in just 4 years is very high rate of growth. The loans are primarily taken from commercial investors, the one exception being a 10 million guilder loan form the *European Investment Bank*.[82] This is also the single largest loan taken by *MARIN* for the project. The vacuum tanks operation was guaranteed by the Dutch government. If the vacuum tank made losses, the Dutch government would compensate *MARIN* in the form of a loan. This ensured that, if the vacuum tank didn't turn out to be profitable, the commercial investors would still get their money from the Dutch government.

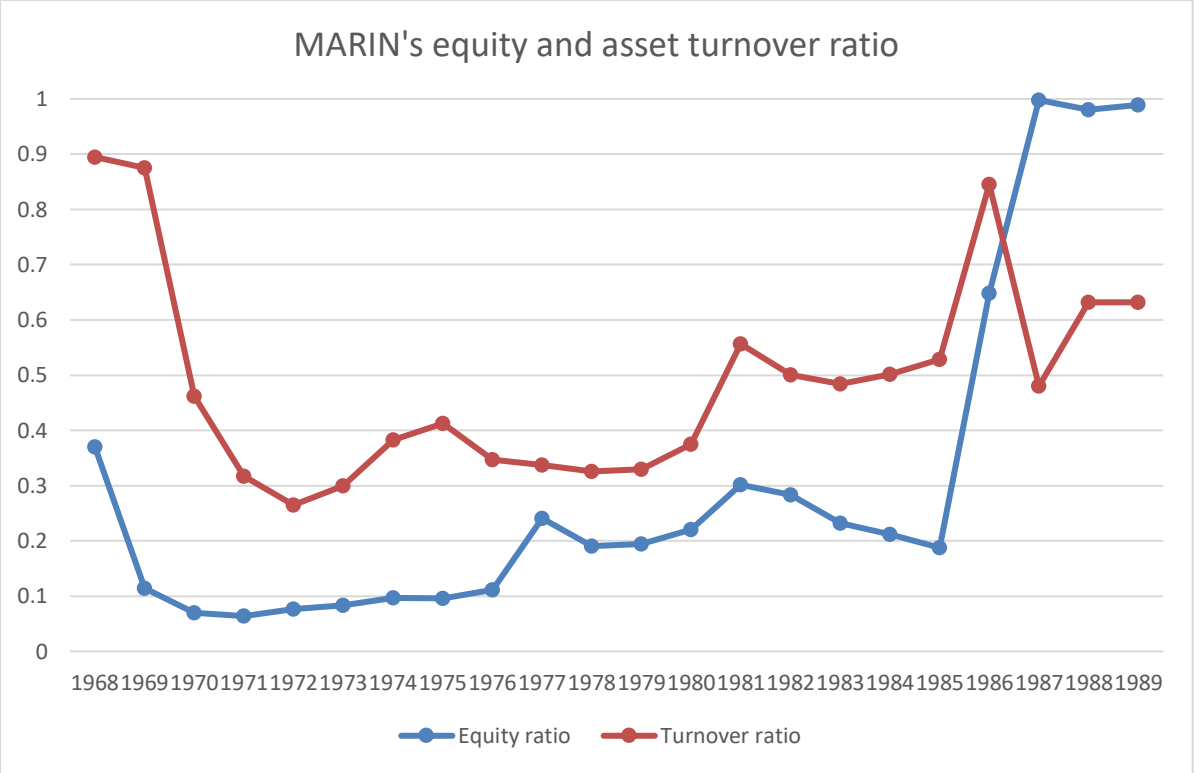

Figure 3: *MARIN's* equity and asset turnover ratio from 1968 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

With *MARIN's* new vacuum tank being financed entirely by debt it had a large impact upon

[82] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1972*, 22.

its equity ratio. This ratio (the ratio between its equity and debt) and *MARIN's* asset turnover ratio (the ratio between its turnover and its tangible assets) are presented in figure three. The data represented in this figure can also be found in appendix three. *MARIN's* equity ratio drops significantly in 1969 from a, by most standards, relatively healthy just 0.4 to a meagre 0.1. This shows just how much risk *MARIN* was taking on by constructing its new avantgarde facility. Of course these numbers would be much more meaningful if compared to those of *MARIN's* competitors, but those are beyond the scope of this thesis.

MARIN has to list income from its operations in each income statement. These operations include *MARIN's* publications, but mostly consist of research, calculations and tests under contract.[83] The base subsidies *MARIN* start receiving from 1981 onwards are included in these figures, so these are subtracted to attain the numbers presented in figure three and appendix three.[84] This is to provide a better view of *MARIN's* true commercial viability. *MARIN's* asset turnover ration from figure 2 drops sharply in 1970 as the loans are being taken and the vacuum tank is being built, thereby heightening *MARIN's* asset value, but not yet heightening its revenue.

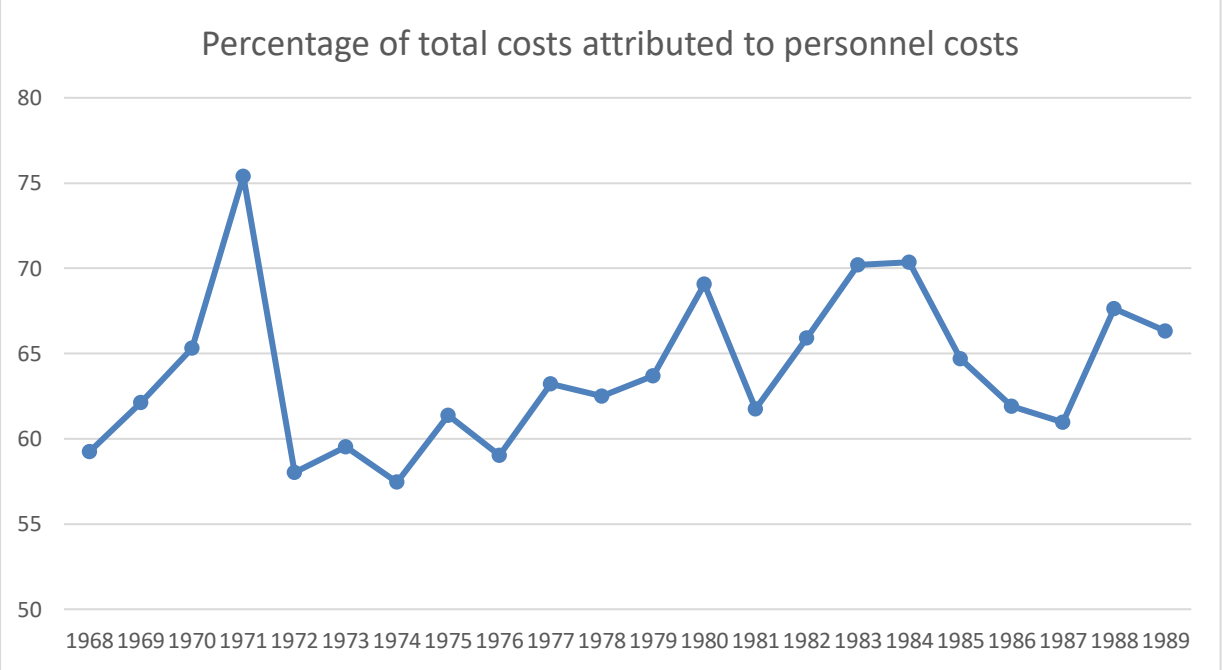

Figure 4: Percentage of *MARIN's* costs attributed to personnel costs from 1968 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands*

[83] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1969*, 55; Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1989*, 11.
[84] Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981*,17; Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1982*, 17.

scheepsbouwkundig proefstation Jaarverslag 1968-1980.

During the 1970s and 1980s personnel costs always made up more than half of *MARIN's* total costs. This fact is represented in figure four. These are also presented in appendix four. *MARIN's* grand new research facility, the vacuum tank, would have to be manned by a large number of new staff. This large increase in staff would have been a significant financial development for *MARIN's* executives. The number of people employed by the institute is graphed year by year from 1968 till 1989 in figure five, and the full data is listed in appendix four. *MARIN* consistently noted the amount of personnel it had employed, but changed the way it measured this number in the middle of the relevant period. In 1979 *MARIN* stopped counting parttime employees the same as fulltime employees.[85] Instead parttime employees would only count for the fraction of fulltime that they worked. So two employees working 20 hours per weeke each would count as one fulltime equivalent employee. This off coruse led to a decline in the listed employee numbers. Since every annual report also lists last years numbers for comparison, the 1979 report also features the fulltime employee equivalent number from 1978.[86] Thereby providing two datapoints for that year. Since the two methods of counting employees only differ slightly, they and numbers derived from them are compared are still compared to illuminate trends in the data. The hiring of the employees for the future vacuum tank already started in 1970, at total of 28 extra employees were hired in that year, as can be seen in figure five. This number would drop mildly in 1971 and sharply in 1972. During the latter year a large number of employees in Wageningen were let go in order keep costs under control.[87] These hrings can also be seen in figure four, as labour costs spike to 75% of *MARIN's* costs when MARIN begins hring for the new facility, before coming back down as the vacuum tank opened and its bills needed to be paid. *MARIN* was therefore not only building the new facility, but also shaping its workforce years in advance to be ready for its grand opening.

[85] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1979*, 7.
[86] Ibid.
[87] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1972*, 6.

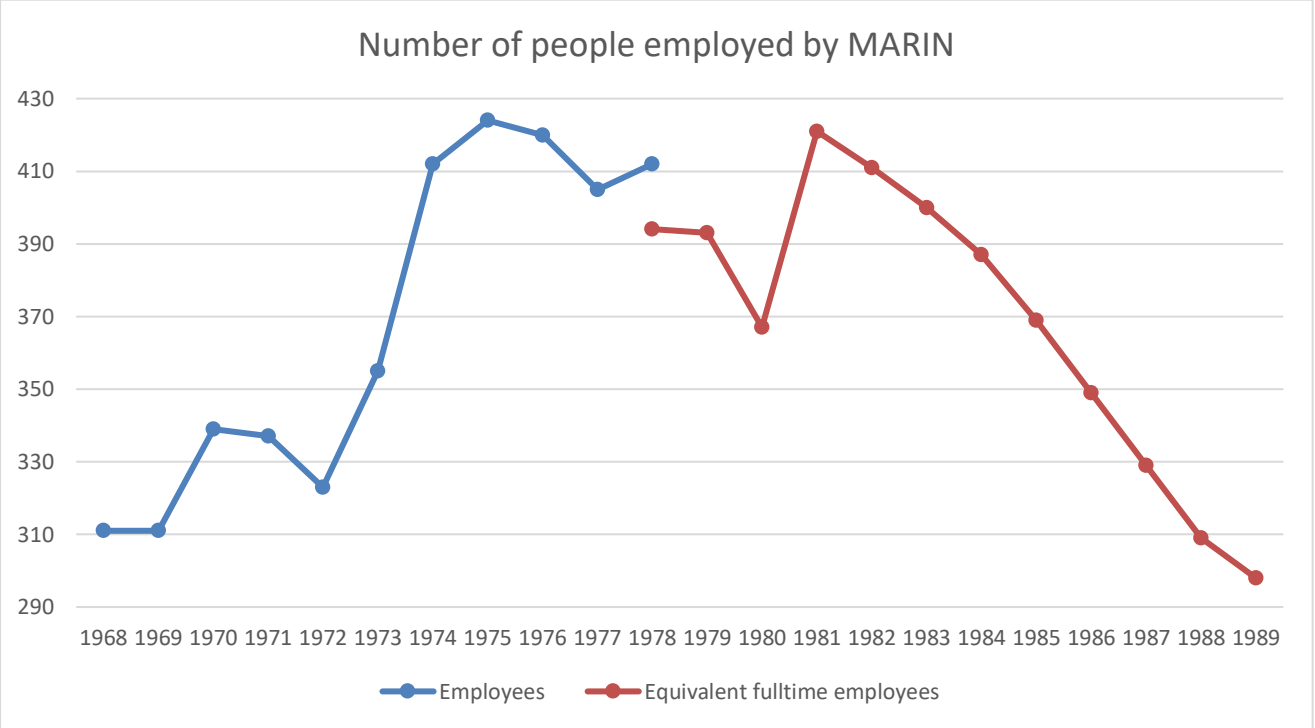

Figure 5: Number of people employed by *MARIN* from 1968 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Four years before the decision to build the vacuum tank was made the largest Dutch shipbuilders had sent a plea for aid towards the Dutch government. The *Commission 1965* had already concluded its investigation and government action was being taken based upon its *Keyzer rapport*. It therefore must have been abundantly clear to *MARIN's* executives at the time that the Dutch shipbuilding industry was in trouble. However the Dutch government had already started enacting its plans and providing the sector its support and subsidies. The failure of these policies to keep the large shipbuilders, like *RSV*, afloat was also not yet apparent. This means that there are three apparent reasons why the executives had little doubts about the financial security of the decision to build the vacuum tank.

Firstly as just mentioned: The government seems to have stepped in to solve the crisis, which means that the Dutch shipbuilding sector did not yet seem doomed to decline. The main reason for the construction of the vacuum tank that *MARIN* executives provide in their 1968 annual report could support this. It states the demand is too large for current facilities and growing. This could indicate that there was untapped demand for *MARIN's* services in the Dutch market and that the executives were confident this would not decline.

The other interpretation is that international growth made up for the loss in demand or market stagnation in the Netherlands. This growing international market is the second reason. It is likely that both these factors were at least present in some capacity since the annual report does not specifically call out growth in the Dutch or international market. The exact proportions of these two factors will become more apparent in the next chapter as *MARIN's* income from Dutch orders is measured.

The third reason is the aforementioned state guarantee. *MARIN* in principle wouldn't make losses upon the vacuum tank's operation since it was guaranteed by the state. Any losses would just be turned into loans to the government. This would allow *MARIN* to absorb losses from short term market shocks and eventually benefit from the better capitalisation upon long term market demand. A certain amount of market uncertainty could therefore safely be ignored. These reasons all explain why the construction of the vacuum tank was deemed financially feasible, but the second market shift mentioned by *MARIN's* executives in their annual report could paint a different picture. Newer larger ships demanded larger scale models and thereby large testing facilities. *MARIN* needed to construct a larger tank in order accommodate these new vessels. This would have meant an inaccessible market segment for *MARIN*. The motivation for *MARIN* to try to keep this market segment accessible likely was nothing more than keeping up with its competitors and pushing its own innovation forward. But a scenario with a bleaker outlook could have seen this market segment become a significant portion of the market, in which case its inaccessibility could have meant a large drop in market share and resulting financial turmoil for *MARIN*.

The vacuum tank starts making losses

In 1972 *MARIN*, or the *NSP* as it was known as back then, opened its 240 meter long vacuum tank.[88] The years surrounding and following the official opening of the vacuum tank would prove to be difficult for *MARIN*, as the organisation endured severe financial hardships. This is because in the years following its opening the vacuum tank made consistent and significant losses. Figure six presents *MARIN's* these losses in the form of its net income and the subsidies it received during the 1970s and 1980s. The full data from figure three can also be found in appendix five.

When it became operational the vacuum tank, as just mentioned, started immediately losing money. Therefore the state guarantee kicked in and the Dutch government began

[88] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242.

providing *MARIN* with a loan each year to cancel out the losses. From 1972 to 1975 these are represented as loans and income in order to keep the official net income near zero.[89] Starting in 1976 these loans are no longer regarded as income and the term deficit is used instead of net income.[90] In order to standardise the numbers in appendix five the choice was made to subtract the state guarantee loans from the net income in years which they are counted as such. This means that until 1975 *MARIN* is according to its bookkeeping not actually making a significant loss, but this achievement is meaningless since it includes money from loss prevention guarantees, which is immediately transformed into debt. *MARIN* also received direct subsidies, these do not generate any debt and are separated out of *MARIN's* revenue to show how viable *MARIN* was as a purely commercial operation.

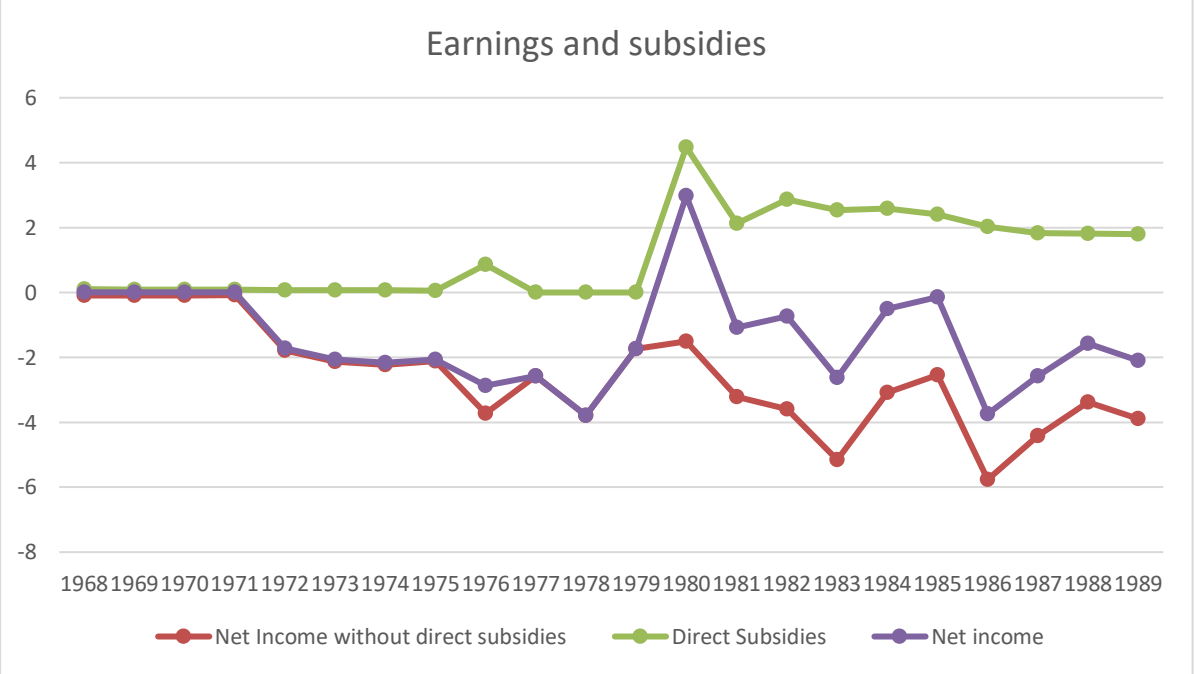

Figure 6: A comparison of *MARIN's* income and the subsidies it directly received in millions of 1968 guilders from 1968 till 1989. Sources: Data from Hoeveel inflatie, "Inflatie in Nederland per jaar;" Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

[89] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1972,* 19; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1974,* 11; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1975,* 23.

[90] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1976,* 14; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1977,* 14; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1978,* 12; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1979,* 14.

As seen in figure six, *MARIN* starts making a significant loss in as soon as the vacuum tank opens in 1972. It made a slight loss in the preceding years, that is entirely made up for by a 100.000 guilders subsidy. *MARIN* would continue to receive this subsidy until 1976.[91] This is an almost insignificant amount of money at this scale and *MARIN* could've very likely done without it. The 100.000 guilders subsidy ending after 1976 was likely due to the restructuring of the subsidies the Dutch government provided towards the institute. The fact that *MARIN* made no profit in the latter years of the 1960s is not unexpected, as it is a nonprofit. It shows that *MARIN* was in a financially healthy position until the 1970s.

The losses in 1972 are made by the new vacuum tank, which does not live up to the expectations of the executives.[92] In the first year of the vacuum tanks operation this can be attributed to the tank still being tested and it not being not fully operational. The losses incurred were made up for by the government guarantee, meaning the debt attributed to the operations of the vacuum tank, as seen in figure two, starts to build up. In 1973 the executives were however satisfied with the amount of orders, as all facilities were operating at full capacity.[93] The sheer scale of the new facility, and thereby the orders it could fulfil, becomes clear from figure four. The consistent and expansive growth in employees during the first half of the 1970s shows just how much *MARIN* was scaling up with the opening and utilisation of the vacuum tank. This once again shows just how much *MARIN* was betting on the facility being profitable. The fact that the vacuum tank still made losses, even when it processed the maximum amount of orders it could, indicates that the orders it fulfilled likely provided lower margins than expected. This is reflected in *MARIN's* asset turnover ratio in figure three. It rise minorly in 1973, but the new ratio comes nowhere near its pre-vacuum tank level. This indicates that the vacuum tank was simply not producing returns as efficiently as the rest of *MARIN's* assets. This expensive asset bought on massive loans underperforming caused it to not be able to pay these off, this is where its losses find their basis. The losses from the loans were being for by the state guarantee. Which means that in figure two it seems like the debt form the vacuum tanks construction is being paid off, while the debt form its operation rises. But the paying off of these loans is, at least partially, being

[91] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1976*, 14; Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1977*, 14.
[92] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1972*, 19; Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1974*, 11.
[93] Nederlands scheepsbouwkundig proefstation, *Annual report 1973,* Wageningen 1973, 3.

paid for by the increase of the operating debt. The normal steady payoff of *MARIN's* vacuum tank construction loans in figure two is therefore misleading, as these are effectively being refinanced into operating debt.

By 1974 the effects from the 1973 oil crisis would impact *MARIN's* business and only the facilities in Wageningen would be fully occupied.[94] Losses would however hold at a steady state. In 1975 neither of the locations were fully occupied and the executives for the first time admitted that *MARIN* would need to attain government subsidies to survive.[95] *MARIN* would have very likely also encountered some financial difficulties without the construction of the vacuum tank, since it was unable to fill even its old facility with orders in 1975. The scale and also likely the duration of the crisis was however heavily exacerbated by the large overhead from the new facility.

But while the vacuum tank made large losses, one financial indicator was positive: Revenue per employee. Since wages took up a majority of *MARIN's* budget during the 1970s and 1980s, a more efficient use of labour would have been one of the primary ways to cut costs. The efficiency of *MARIN's* employees is represented in figure Seven, by the simple formula of dividing *MARIN's* revenue by its number of employees. The full data from this graph is presented in appendix four. Employee efficiency rises steadily in the years following the opening of the vacuum tank. The extremely large state of the art facility likely made for a more efficient workplace than *MARIN's* old facilities in Wageningen. In its English annual reports *MARIN* consistently boasts about new more automated and computerised techniques during this period.[96] These innovations range from the automation of taking measurements, to the digital recording of the results, to using computers to quickly and accurately analyse the data. This development also likely played a role in the increase of employee efficiency. Both factors likely intertwined as a newer larger facility would leave more room and capacity for innovation.

[94] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1974*, 3.
[95] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1975*, 7.
[96] Nederlands scheepsbouwkundig proefstation, *Annual report 1972,* 4; Nederlands scheepsbouwkundig proefstation, *Annual report 1973,* 4; Nederlands scheepsbouwkundig proefstation, *Annual report 1976*, 10.

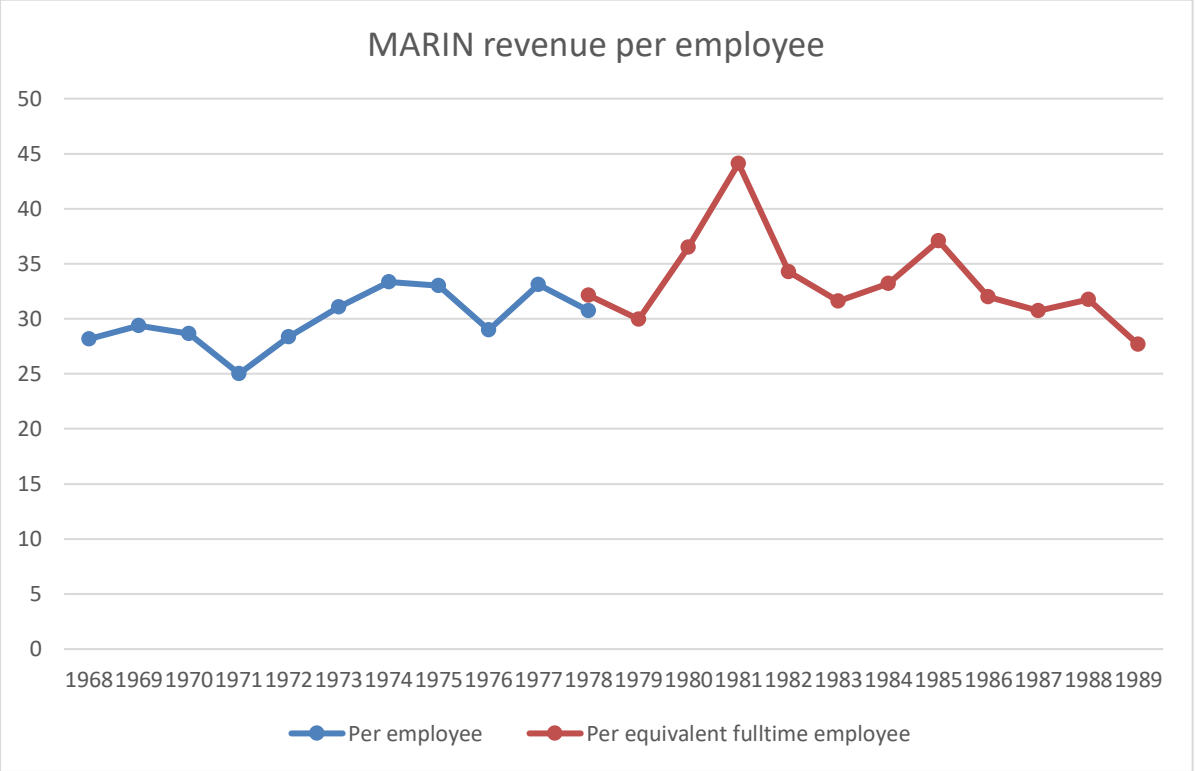

Figure 7: *MARIN's* revenue in thousands of 1968 guilders divided by its number of employees from 1968 till 1989. Sources: Data from Hoeveel inflatie, "Inflatie in Nederland per jaar;" Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

The 1976 liquidity crisis

In 1976 *MARIN* suffered from a liquidity shortage as a result of its poor performance and requested emergency aid from the government.[97] This call would not go unheard, and in December 1976 the Dutch minister of science officially instituted the *Commissie Relatie Overheid-Nederlandsch Scheepsbouwkundig proefstation (CRONSP)*.[98] *MARIN* was still named the *NSP* so the name of that commission translates to: commission relation government-*MARIN*. The commission, set up directly in response to *MARIN's* financial difficulties, set out to find the best organisational and financial between the government and *MARIN*. This mainly concerned subsidies, but also the way that *MARIN* operated and the facilities it owned. The commission would take until November 1978 to deliver its final

[97] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1976*, 7.
[98] Commissie Relatie Overheid-Nederlandsch Scheepsbouwkundig proefstation, *Eindrapport,* November 1978, *2.*

report.[99] The bump in subsidies in 1976 in figure six is the governments immediate response to *MARIN's* liquidity crisis.[100] This cash injection of 1.500.000 guilders was purely meant to keep *MARIN* afloat as the government set up the *CRONSP* to develop a long term solution.

Demand for *MARIN's* services would start to slowly recover near the end of 1976 and would continue to do so into 1977.[101] In this year executives also claim that *MARIN's* unsustainable position could not only be attributed to the oil crisis and its consequences, but also to "severe competition from subsidized industries." This competition would depress the prices for *MARIN's* services thereby limiting profit. The fact that *MARIN's* executives continuously mention global market factors instead of the Dutch shipbuilding market, which was slowly failing around them provides more pretext to the next chapter.

The *CRONSP* and its consequences

In 1978 the *CRONSP* would release its final report. It made two primary recommendations. Firstly *MARIN* should be subsidised more.[102] This would come in the form of a base subsidy and project based contributions. The base subsidy was primarily aimed at keeping the institute afloat, while the project based contributions would fund specific projects in order to push Dutch maritime technology forwards. Secondly *MARIN* should merge with the *Nederlands Maritiem Instituut (NMI)*. This is because the areas of research of *MARIN* and the *NMI* were quite similar. The *NMI* was receiving a large subsidies, so if *MARIN* would receive these too, then the similar institutes should merge to operate more efficiently as a whole. With the government stepping to aid, it also demanded certain other organisational changes to be made within *MARIN*. Most notable for this chapter is that in 1978 *MARIN* attained new external accountants, who subsequently suggested the introduction of a new information management system.[103] While the manner of accounting differs slightly throughout *MARIN's* annual reports, there is no clear shift in accounting when the new firm gets hired.

The recommended merger would take until 1981 to legally happen, although the executives note that the official process dragged on into 1982.[104] This is also when the *NSP*

[99] Commissie Relatie Overheid-Nederlandsch Scheepsbouwkundig proefstation, *Eindrapport, i.*
[100] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1976*, 7,14.
[101] Nederlands scheepsbouwkundig proefstation, *Annual report 1977,* 7.
[102] Commissie Relatie Overheid-Nederlandsch Scheepsbouwkundig proefstation, *Eindrapport,* ii.
[103] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1979*, 22.
[104] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1981*, 4.

gets renamed to *MARIN*. The bookkeeping is however still mostly separate in the years following the merger. *MARIN's* assets previously divided over Wageningen and Ede, now got a third location: Rotterdam. As this is were the *NMI* was located. It is only in 1986 that all *NMI* assets are located or sold and the two originations are fully integrated.[105] The merger would bring significant costs for the newly minted MARIN, but the *NMI* would bring its aforementioned base subsidy into the merger. It would take one additional year for the ex-*NSP* part of *MARIN* to receive its base subsidy too.[106] The period post merger can be summarized as a large and stretched organisation trying to reorganise and recentre itself into a more manageable form.

In the merger *MARIN* gets both the *NMI's* revenue and employees. Both make a stark difference in the data. The merger is clearly visible in figure four as the amount of fulltime equivalent employees employed by *MARIN* peaks and reaches its hightest ever point during the 1970s and 1980s. While *MARIN* technically employed three more people in 1975, the shift to fulltime employment in 1977 shows that this figure is certainly less than 1981's when expressed in fulltime equivalent employees. The merger is however preceded by a sharp dip in employees in 1980, the annual report simply states that these employees were let go.[107] The upcoming merger with the *NMI* could have provided an incetive to clean house to prepare.

Employee efficiency rises sharply in both 1980 and 1981. It might be assumed that these two increases are related. They do however have quite opposite direct causes. In 1980 *MARIN* lets an aforementioned large amount of employees go, while revenue still rises steadily.[108] This is part of the reorganisations recommended by the *CRONSP* final report. The sheer fact that revenue rise while *MARIN* commits its biggest firing of the measured period shows just how necessary these changes were. It is also possible that these specific firings are made as part of the preparation for the upcoming merger with the *NMI*. In 1981 the merger finally occurs. The *NMI* contributes a large number of employees and an even larger revenue stream to the combined institute.[109] So *MARIN's* number of employees surge,

[105] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1986*. Wageningen 1986, 7.
[106] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1982*. Wageningen 1982, 17.
[107] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1980*, 5.
[108] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1980*, 5,10.
[109] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1981*. Wageningen 1981, 5,10.

but the relatively larger stream of revenue these employees brought with them causes employee efficiency to rise overall. The reason for the difference in efficiency likely has to do with the employees skills and profession. Less than 15% of the *NSP's* emplotyees were academics, while the *NMI* employed more 30%, meaning that the ex-*NMI* employees had an on average more academic background than *MARIN's*.[110] This higlights the more practical and experimental nature of the *NSP's* work. The *NMI* performed different types of research using more educated employees to create a higher average employee efficiency. These academics would however have been paid more than less educated employees, which means that this increase in efficiency could have come along with a rise in labour costs per employee. This peak therefore may be misleading.

While the *NMI* provided a sizeable number of employees to the merger its assets where negligeable. The *NMI* only possessed 50.000 guilders worth of assets at the time of the merger, while contributing a more significant amount to *MARIN's* revenue.[111] This results in a rise in the turnover ratio, as seen in figure 3. This shows that while the pre-merger *MARIN* and the *NMI* specialised in the same general subject, the specific work they performed, and the ways they operated were very different.

Revaluations create fiscal space

From 1972 to 1976 *MARIN* had noted down the statue guarantees it received for the operation of the vacuum tank as income in its annual report. This meant that the total amount of these guarantees would be listed as an asset.[112] When in 1977 the institute switched to noting down a deficit, instead of including the state guarantees, this sizeable guarantee asset would disappear. However a massive decline in assets, without a corresponding decline in liabilities, would have left *MARIN* with negative equity. This meant the institute would have become insolvent. This was prevented by an appreciation of *MARIN's* assets in the form of a revaluation in January of 1977. [113]

In *MARIN's* case these are its buildings and the scientific equipment inside them. The old evaluation took the purchase price and depreciated it by a yearly sum dependent on

[110] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1980*, 5; Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1981*, 5.
[111] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1981*, 25.
[112] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1976*, 12.
[113] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1977*, 15.

the assets life expectancy.[114] By 1976 *MARIN's* assets in Wageningen had been depreciated almost entirely to a value of 2.418.908 Dutch guilders.[115] The 1977 revaluation replaced this with the assets replacement value.[116] By revaluing these assets at their current operating capacity *MARIN* significantly increased their value to be worth an extra 35.567.673 guilders.[117] This can be seen in figure two, as *MARIN's* total asset value is bumped up. This bump is not nearly as large as the number mentioned above since *MARIN's* deficit is removed from its assets at the same time. What the 1977 revaluation effectively entails is that *MARIN* looked at its old facilities, that it was about to replace, and decreed that they have to last another 20 years.[118] This lack of long term vision is a marquee sign of significant financial distress on the part of *MARIN*. The decision is also probably influenced in some way by the establishment of the *CRONSP* in the previous year. Whether this a move meant to show that *MARIN* could be saved, or a prerequisite of the commission is unknown.

The newly generated value in assets is represented on the equity and liabilities side of *MARIN's* balance sheet in a somewhat unusual construction. The value attributed to the revaluation of *MARIN*'s assets is put in an equity reserve, the total deficit is then subtracted from this.[119] The resulting equity combined with the founding capital is the total equity. The resulting increase in equity can be seen in figure three as the equity ratio bumps up in 1977. The financial construction allows *MARIN* to use its new reserve to absorb its deficits, while the founding capital stays the same. This created the fiscal space needed to allow *MARIN* to absorb its upcoming losses without becoming insolvent. These losses would, as seen in figure six, continue to mount with the single exception of a mass subsidy in 1980. The construction would last until 1985, but by that point its capacity to absorb losses is more than used up.[120]

By 1986 the equity reserve created by the 1977 revaluation had been more than used up. A new equity reserve was needed by *MARIN* in order to avoid insolvency due to its

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[114] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1976*, 15.
[115] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1977*, 13
[116] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1977*, 15.
[117] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1978*, 11.
[118] At the rate of depreciation that *MARIN* used at the time it would have taken roughly 20 years to fully depreciate the revaluated assets. Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1977*, 17.
[119] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1977*, 18.
[120] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1985*, 8.

continuous and sustained losses. Two big changes would happen simultaneously in order to create a replacement reserve.

The first is the waiving of all debt owed by *MARIN* to the government in order to form the basis of a new equity reserve.[121] This is not done in one step, but takes until 1987 to complete, as can be seen in figure two. As a result *MARIN's* equity ratio also jumps wildly to a value of almost one. This jump shows just how drastic this change was. The government had previously waived large amounts of interest in 1979 and 1981, but these relief efforts only made small dents in *MARIN's* total long term debt.[122]

The jump in equity does not however by itself reduce *MARIN's* total value, but it shapes the outcome of the other change. This is a second revaluation of *MARIN's* assets. *MARIN* switches back from valuing its assets by replacement value to its purchase value with depreciation. This means they are revaluated to be worth 35.198.434 guilders less. [123]This sharp decline in the value of *MARIN's* assets directly and drastically lowers Marin's total value. This revaluation is part of a bigger project by the Dutch government to renew and standardise its evaluation methods for all large government funded research institutes.[124]

The equity freed up by the waiving of the loans, reduced by the loss in value from the simultaneous revaluation, is put into multiple reserves.[125] These are then used to invest in *MARIN's* overdue maintenance, the updating of equipment and are used to once again absorb deficits. These reserves would get another mass cash injection from the government in 1987.[126] The simultaneity of the revaluation and clearing of *MARIN* debts was very likely planned, since the revaluation without the waiving of the debt would have been an on paper disaster for the institute. The revaluation can in essence be seen as the institute switching out of survival mode towards a more long term vision. The asset value and thereby extra equity provided by the replacement value evaluation is no longer needed, so *MARIN* can start planning for the long term by depreciating its assets again.

The function of the revaluation reserve construction from 1977 is still preserved in the new reserves from 1986. The presence of these large financial reserves for the purpose of absorbing deficits once again underlines the precarious financial position of *MARIN*. The fact that such a reserve is still present in 1989 shows that the institute had not yet recovered

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[121] Ibid.
[122] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1979*, 20; Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1981*, 16.
[123] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1986*, 8,10.
[124] Ibid, 10.
[125] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1987*, 8.
[126] Ibid.

from its financial troubles. The financing of the 1986 reserve by the Dutch government however shows real prolonged resolve to keep the institute afloat. This dedication alone makes Marin's financial position far more secure.

Slow decline

After years of *MARIN* being deep in the red it would, as can been seen in figure six, finally receive significant sustained subsidies from 1980 onwards. Subsidies for *MARIN* were, and still would be, sporadic and haphazard for the first couple years. The immense amount of subsidy received in 1980 make it appear that *MARIN* turned a profit that year, but looking at the net income without subsidies in figure six shows that this peak is entirely due to the amount of subsidies. These subsidies are attributed to ensuring solvency for the struggling institute.[127] Given the reason behind this subsidy there is likely only a technical profit to avoid bankruptcy.

MARIN starts receiving the *NMI's* roughly two million guilders base subsidy in 1981. This would be joined by a around four million guilders base subsidy for the ex-*NSP* part of *MARIN* in 1982. These subsidies decline in figure six because the graph it is inflation adjusted, while the base subsidy stays relatively constant. These base subsidies are called so because *MARIN* has to perform no particular action to obtain them, it just needs to fulfil its role in the maritime ecosystem.

One part of the recommendations by the *CRONSP* final report, the merger with the *NMI*, had been completed by 1982. The second part recommendation which is the restructuring and reorganisation of *MARIN* still had to be completed. The merger with the *NMI* added to the duration of this project as the costs it created would drag on for years. Both 1983 and 1986 suffer significantly form these costs, causing the greater losses during those years. *MARIN* would account for significant restructuring costs until 1987.[128] This is six years after the legal merger with the *NMI* and a full nine years after the publication of the *CRONSP* final report. This long and expensive restructuring period underlines the sluggishness of the governmental response to *MARIN's* financial situation.

The base subsidy proved for the remainder of the 1980s to mostly not be enough to ensure *MARIN* broke even. The amount subsidized would be sufficient for the *MARIN* of the 1970s, but the *MARIN* of the 1980s incurred much higher losses. The state guarantee would

[127] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1980*, 10.

[128] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1987*, 9; Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1989*, 11.

also stop providing loans with the waiving of debts in 1985.[129] This left *MARIN* entirely dependent on its reserves to eat up its losses. In 1983 the executives recognised that, while *MARIN* had done relatively well compared to its competitors, its market was shrinking and it was suffering from depressed prices from international competition.[130] It is likely that this competition was still better subsidized than *MARIN* was at the time. This resulted in a policy of consistently cutting jobs and cutting back in scale in continuous attempts to find more sustainability. This can clearly be seen in figure five. The job cuts would however not lead to structurally more efficient employees, as can be seen in figure seven. Employee efficiency does spike in 1985, but that is explained by steady firings being met with a small rise in income.[131] The increase in income, while firings continue at an average rate, shows the cuts may appear to have had some positive effect in the short term.

In 1984 and the aforementioned 1985 *MARIN* seems to be on the path to being sustainable on the then current level of base subsidy. As its losses near zero, which can be seen in figure six. The following downturn in 1986 can, as mentioned before, be partially attributed to large restructuring costs. The executives however point first and foremost at the drop in the price of oil during the year.[132] This sustained economic shock could be the cause of *MARIN's* poor performance during the latter half of the 1980s. The executives outlook on the market would significantly improve during 1987 and 1988, when they decreed that "the stagnation in the maritime sector has reached its deepest point and we are already experiencing a small recovery."[133] This would prove to be a false dawn in 1989 as they experience "a structural decline in orders."[134] The shrinking market with depressed prices from subsidized competition would just not get any better. One changing trend the executives do note in the latter half of 1980s is the increasing replacement of model testing by computer simulations.[135]

Partial Findings

The 1970s and 1980s were a bad time for the shipbuilding industry, from the oil crisis and its corresponding tanker crash of the 1970s to the general malaise and decline of the 1980s. These coming hardships where however not apparent to *MARIN's* executives in 1968 when

[129] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1985*, 8.
[130] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1983*, 6.
[131] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1985*, 5,9.
[132] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1986*, 4.
[133] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1987*, 4; Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1988*, 4.
[134] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1989*, 5.
[135] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1986*, 4; Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1989*, 5.

they decided to build a large and expensive new testing facility in Ede called the vacuum tank. Executives expected there to be sufficient demand to make the vacuum tank profitable, but it is not clear whether this was expected to come from the Dutch or international market. The vacuum tank would underperform expectations. Unable to generate the profits needed to pay back its loans used to finance the construction of the facility *MARIN* started making heavy losses. The saving grace from the construction of the vacuum tank is that its profitability was guaranteed by the Dutch government. This allowed *MARIN* to stay afloat in an otherwise untenable situation.

However by 1976 even this was not enough to avoid bankruptcy from a liquidity shortage and the government had to step in to provide direct support. *MARIN* would receive an annual base subsidy and on the governments recommendation it would merge with the *NMI* to get its current name. The relatively low level of the base subsidy and the costs attributed to the merger would ensure that *MARIN* would keep running a deficit. In response the institute would start cutting costs and scaling back. In 1977 and 1985 financial constructions were set up in order to absorb these losses in order to avoid insolvency. The result of all the government aid is that *MARIN*, while finding itself in a shrinking market with lots of well subsidize international competition, maintained its position relative to the market.

MARIN's reliance on income from Dutch sources during the 1970s and 1980s

Income from commercial sources

Figure eight presents the percentage of *MARIN* revenue attributed to Dutch orders, this data is also present in appendix six. As mentioned in the section discussing this chapters primary sources and research methodology, there is a gap in the data from 1979 to 1982, these years have been left out of the graph to provide a better overview. Reliance on the Dutch market hovers around 45% before dropping around the opening of the vacuum tank. The cause of these drops therefore likely has to do with the new facility. The new facilities large capacity would have had a large capacity that needed to be filled. The fact that the percentage drops, shows that this was, at least in the short term, mostly done by international orders. This could indicate that these international orders were the spare market capacity that *MARIN's e*xecutives were wanting to capitalise on when constructing the vacuum tank.

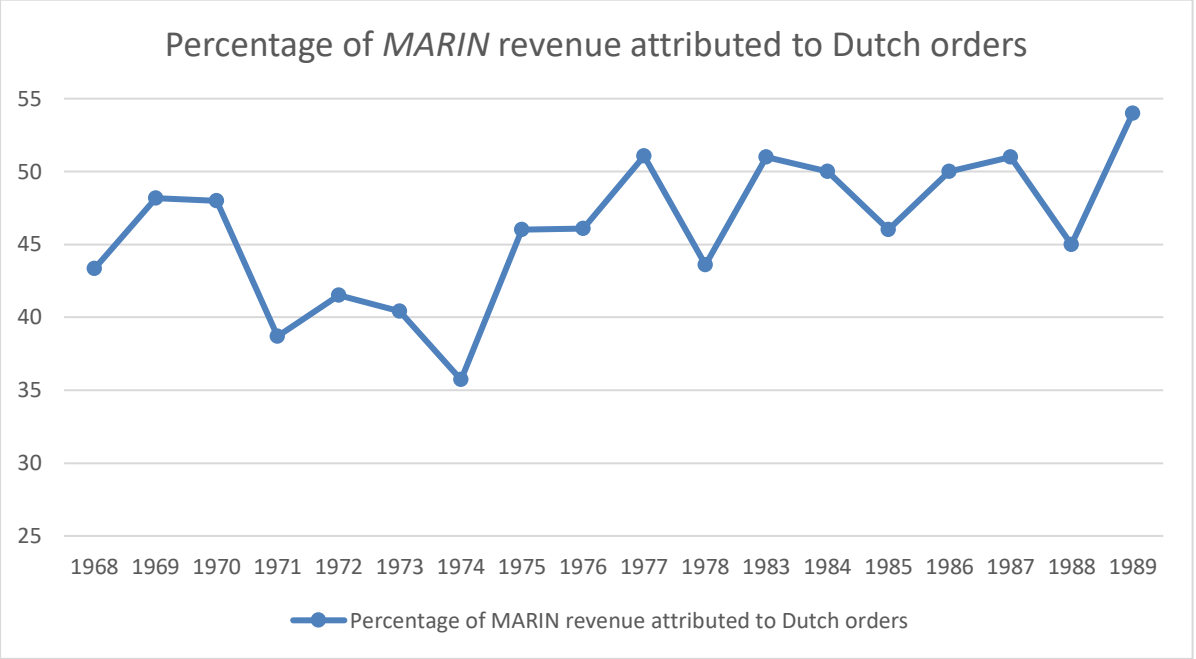


Figure 8: The percentage of *MARIN* revenue attributed to Dutch orders form 1968 till 1978 and from 1983 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1983-1989*; "Meer orders voor NSP uit het buitenland;" Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1977*.

After the data gap the percentage rests around 50%, which shows that *MARIN's* reliance on the Dutch market grew slightly during the two measured decades. This find is directly in contrast with expectations. The Dutch shipbuilding industry declined by a figure of about 60% during this period, so the percentage of *MARIN's* revenue attributed to Dutch orders should show a similar decline. This development could be explained by three factors.

The first is that *MARIN's* Dutch customer base was not significantly affected by the Dutch shipbuilding decline. This may have been due to *MARIN* specialising in providing services to market segments that were lesser affected by the decline. Three such market segments mentioned in the literature are: the navy, repair and offshore. The second factor is that *MARIN* secured more Dutch customers, thereby effectively gaining a larger share of the Dutch market during these years. A larger share of a smaller market could still work out to the same percentage. This gain in market share could be due to a relative increase in *MARIN's* technological capabilities. The main example here could be the vacuum tank.

There could also be a less outstanding reason for a gain in market share. *MARIN* was reliant upon the Dutch government's support to stay afloat. The Dutch government could have seen a decline in percentage of revenue attributed to Dutch orders as *MARIN* losing

importance to the Dutch shipbuilding sector. An institute less important to the Dutch industry might have gotten lesser, or even no, continued support from the government. *MARIN* could therefore have accepted substandard prices for its Dutch orders in order to conquer more market share, thereby proving *MARIN's* importance to the Dutch shipbuilding industry and preserving its funding. While it is unlikely that *MARIN's* direction would resort to such underhanded tactics, this strategy can only be fully counted out by a breakdown of *MARIN's* profitability per region. This nonstandard and therefore not expected figure is not provided in *MARIN's* annual reports.

The third factor has the to do with *MARIN's* size as an institute. During the 1980s *MARIN* was, as discussed in the previous chapter, cutting back and scaling down. This trend can be most directly seen by the consistently and sharply declining employee numbers in figure five. A declining amount of revenue from Dutch orders could make up the same percentage from *MARIN's* declining total revenue. This means that *MARIN* was cutting back its capacity along with the demand from the Dutch market. This explanation seems the most logical, since it allows *MARIN's* customer base to decline along with the broader Dutch shipbuilding market. This factor can be tested since *MARIN's* annual reports do provide each years revenue.

Neither the annual reports form 1985 or 1988 provide any explanation for the throughs in those years visible in figure eight. In 1989 *MARIN's* executives complain in the annual report about a structural decline of orders from the Dutch government or related organisations.[136] In the same year *MARIN's* reliance on Dutch orders grew by 9%, as can be seen in figure eight. This shows that *MARIN* was, at least in the short term, either able to find different less profitable Dutch orders to replace that gap, or that this expression was mainly politically motivated. The ability to find replacement orders in the Dutch market would indicate that *MARIN's* position may have been stronger than the numbers indicate. The political motivation of such a statement could have been to encourage the Dutch government to spend more on maritime research.

[136] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1989*, 5.

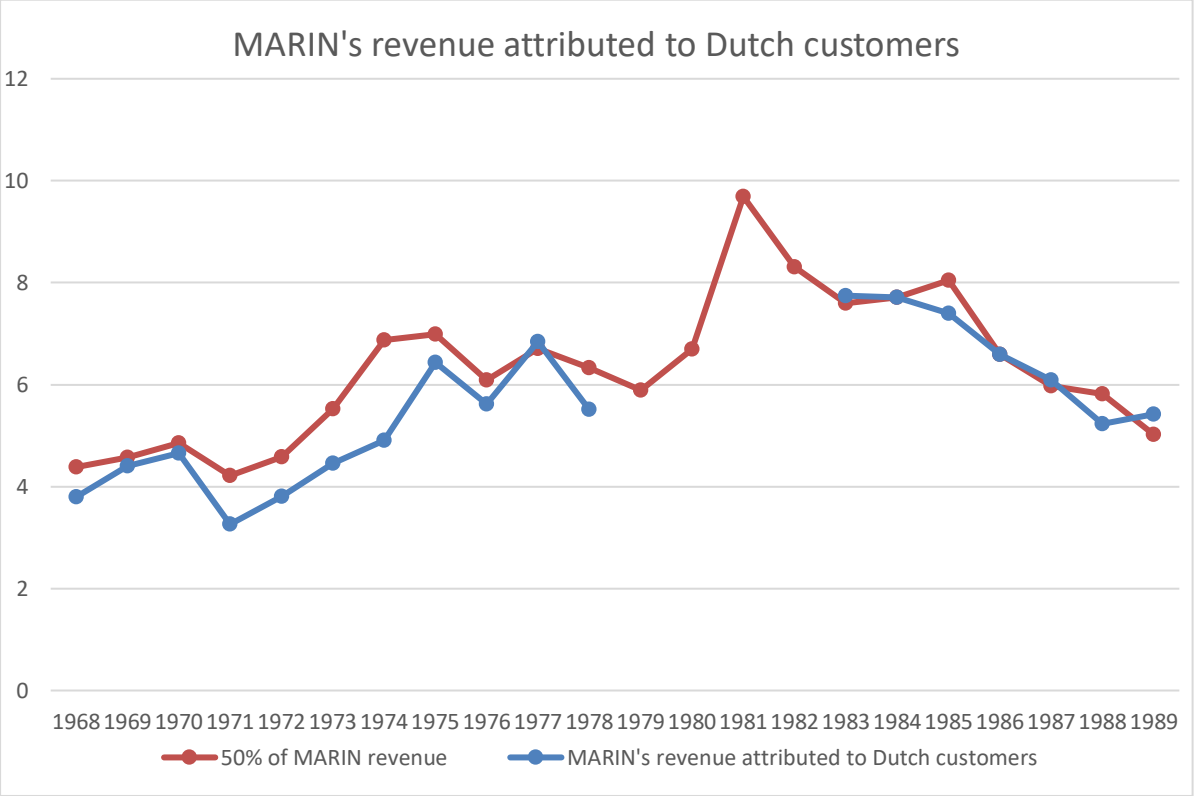


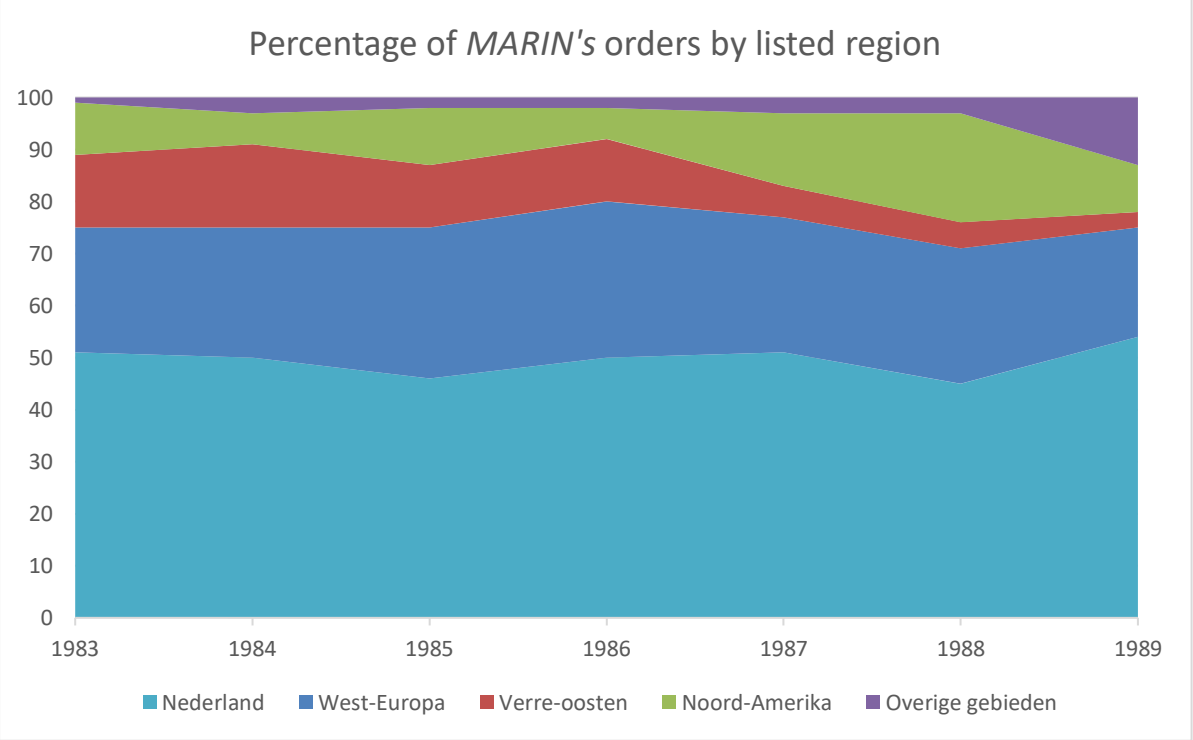
Figure 9: *MARIN's* revenue attributed to Dutch customers compared to half of *MARIN's* total commercial income in 1968 guilders from 1968 till 1989. Sources: Data from Hoeveel inflatie, "Inflatie in Nederland per jaar;" Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; "Meer orders voor NSP uit het buitenland;" Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Figure nine presents the same figures as in figure eight but then in total revenue, which means that they are also presented in appendix six. In the *MARIN* annual reports revenue for some years is in provided in absolute amounts, while others provide it in percentage of total revenue. To standardise the data the absolute revenue is converted to a percentage to provide the numbers in figure eight. All percentages are then multiplied by *MARIN's* total revenue from commercial income for the specific year to provide the numbers in figure nine. As mentioned previously *MARIN's* revenue form Dutch commercial orders seems to hover around 50% of its total commercial income. To further highlight and analyse this trend a line tracking exactly 50% of *MARIN's* total revenue is added for comparison.

Immediately obvious is that the drop around the opening of the vacuum tank from figure eight is due to the uptick of Dutch orders lagging behind the uptick in international orders. There is no decrease in Dutch orders present before *MARIN's* liquidity crisis, except

for 1971 where an overall dip due to the preparations for the opening of the vacuum tank is extenuated.[137] The dip from 1985 in figure eight can be identified as a spike in internationals order rather than a steep decline in Dutch ones. *MARIN's* post data gap revenue from Dutch sources tracks the 50% of *MARIN's* overall commercial income line very closely. *MARIN* seems able to adjust its Dutch orders to come close to meeting 50% of its total orders during this period. While the advice for such a split is not present in the *CRONSP* final report this may have been a policy due to a different agreement or just the executives initiative.

Even with *MARIN* scaling back during the 1980s its total revenue from Dutch commercial orders did not decline. Even while accounting for inflation, as is done in figure nine, this revenue is still 16% higher in 1989 than it was in 1970. The starting year of this comparison does however seem to be a peak, as can be seen in figure nine. If 1968 is taken as the starting year instead the total increase grows to a staggering 43%. It can therefore confidently be said that while *MARIN* shrunk, this shrinkage still left *MARIN* with a larger Dutch market at the end of the 1980s than at the start of the 1970s. *MARIN* did therefore not shrink alongside the Dutch market, but rather grew its Dutch market share. The Dutch shipbuilding crisis therefore does not seem to have significantly affected *MARIN's* orderbook, although prices may have been depressed its total inflation adjusted Dutch market actually grew.



[137] Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1971*, 47.

Figure 10: *MARIN's* revenue broken down per region in percentage from 1983 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1983-1989.*

In the annual reports from 1984 onwards *MARIN's* international orders are also broken down per region, instead of being grouped together. This data, is presented in figure ten and appendix seven. These figures are included to attempt to dive a little bit deeper into the markets that *MARIN* served. Most of Western Europe's non-Dutch shipbuilding sectors also declined in this period. Its share surprisingly shrinks only a small amount, this likely has to do with *MARIN* shrinking along with the European market during the 1980s. The annual report from 1989 lists no reason for the spike in amount of orders from the mysterious other areas. *MARIN's* revenue from the far east shrinks by a remarkable amount during the 1980s. This is likely due to the often mentioned sharp international competition and more importantly the establishment of home grown *MRI's* in those countries.

Funding from the Dutch government

Figure Eleven attempts to compare *MARIN's* reliance on subsidies from the Dutch government with that of its fellow *GTI's.* The numbers presented here for the three other *GTI's* are based upon the Dutch governments annual budgets. They are also presented in appendix eight. *MARIN's* fellow *GTI's* are the *Energieonderzoek Centrum Nederland (ECN),* the *Nationaal Lucht- en Ruimtevaart Laboratorium(NLR)* and the *Waterloopkundig Laboratorium(WL).* The *ECN* was known as the *Reactor Centrum Nederland*, or reactor centre Netherlands until 1976. This former name better explains its field of study since it did heavily invest in nuclear reactors.

These translate to the energy centre Netherlands, the national aerospace laboratory and the hydrological laboratory. Thes figures for these institutes aren't absolute, but rather serve as a lower bound due to missing budgetary memos. These also cause the missing data points. *MARIN's* plotted figure is its deficit minus the subsidies it received, representing how many subsidies the Dutch government would have to provide to *MARIN* for them to operate sustainably.

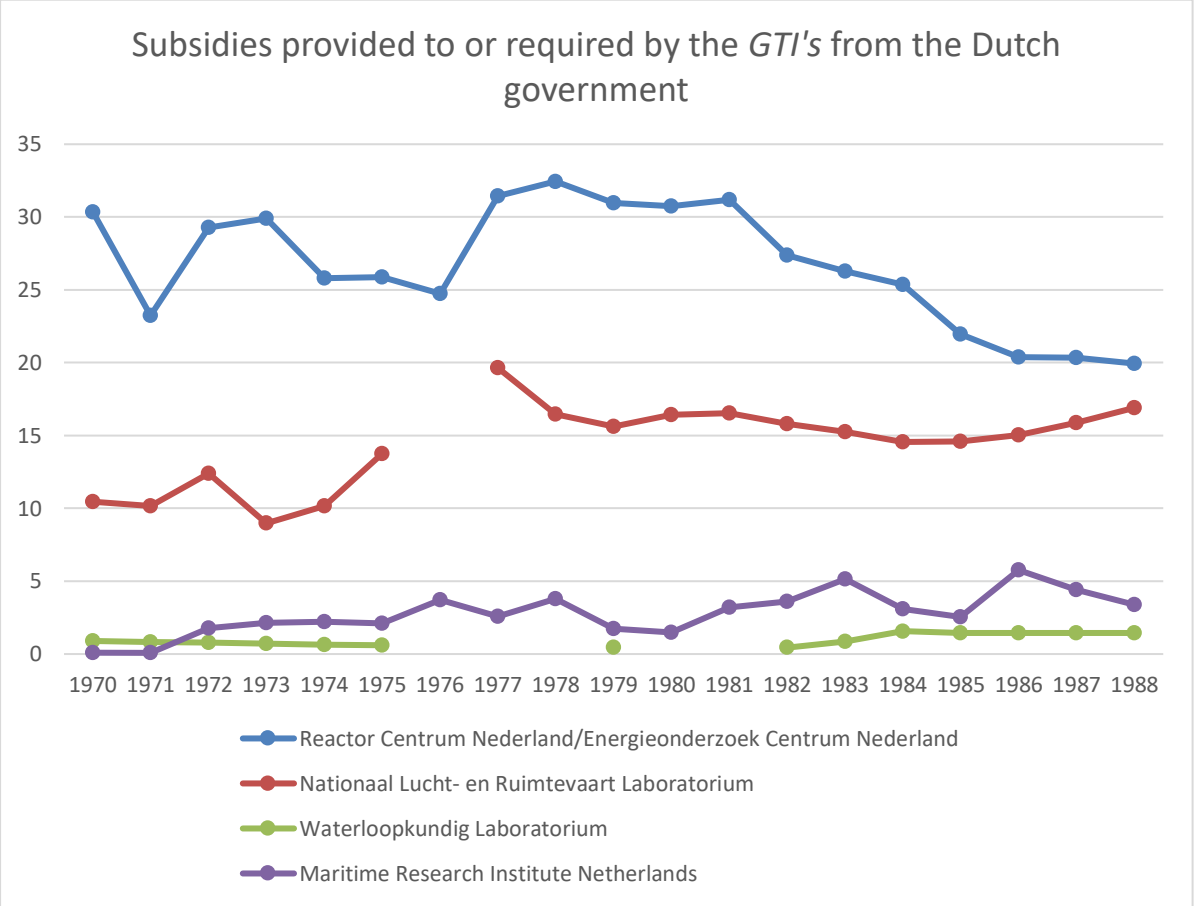


Figure 11: The budget allocated for three *GTI's* in the annual budgets of the ministries of the Dutch government in in millions of 1968 guilders compared to the inverse of *MARIN's* deficit without subsidies in millions of 1968 guilders from 1970 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1983-1989*; "Meer orders voor NSP uit het buitenland;" Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1970-1977*; "Staatsblad van het Koninkrijk der Nederlanden," 1970-1989.

MARIN's subsidy requirements are less than half of what both the *ECN* and the *NLR* received. This can likely be explained by a combination the other *GTI's* being larger and them lacking *MARIN's* dependence on the commercial sector. All subsidies generally follow a slow but steady rise that is cancelled in figure eleven by inflation, with the large hump from the *ECN* being explained by a particular very expensive test reactor program. The *WL* is the only institute that according to the gathered data got less subsidies than *MARIN* requires in this time period, this may however only be because a lot of its subsidies were memory items. This is also seen by the gaps in-between the datapoints. The *WL* may well have been closer to or even above *MARIN's* figure in this graph. This graph therefore shows

that the amount of subsidies that *MARIN* would need to sustain ably operate were not an unreasonable amount for a *GTI*, in fact it would be on the lower side for such an institute in the Netherlands. The specific nature of the *ECN's* and *NLR's* research likely skews the scales, but it is undeniable that *MARIN's* requirements would not have been unreasonable.

Partial findings

MARIN received two revenue streams from Dutch sources during the 1970s and 1980s: commercial income and subsidies from the Dutch government. These sources combined made up for more than 50% of *MARIN's* income during this time period, with *MARIN's* reliance on income from Dutch sources rising slightly higher throughout the decades. *MARIN's* Inflation adjusted Dutch market segment grew with 13% during the 1970s and 1980s. This is very unusual when it is considered that this market was in a severe decline. *MARIN* was able to grab a larger share of a shrinking market.

MARIN's Dutch market segment also grew relative to *MARIN's* total revenue. Which shows that instead of *MARIN* pivoting away from the declining Dutch market, it became further integrated with it. The subsidies that *MARIN* received were not out of proportion in comparison with its fellow *GTI's*, in fact in comparison to its peers *MARIN's* reliance on subsidies from the Dutch government during this time period was very low. In fact it requiring more subsidies could be seen as a shift more towards what was normal for a *GTI.* This combines to paint a picture of an institution that was not really hurt at all by the Dutch shipbuilding decline specifically, and that did not overly rely on the Dutch government to survive.

MARIN's core competence during the 1970s and 1980s

Ship Propulsion

To address *MARIN's* core competence in this period the capabilities it possessed at the start of the period must first be understood. When *MARIN* entered the 1970s it possessed an already well developed core competence in the area of ship propulsion. *MARIN's Wageningen B-series propeller* and its descendants had been international industry standard for decades. [138] This meant that *MARIN's* propellor design was the aspect of its research for which it gathered most of its international acclaim. But what was it that made *MARIN* so proficient at this specific task?

The critical concept to understand in propulsion at the time is cavitation. The

[138] Ferreiro, *Bridging the Seas: The Rise of Naval Architecture in the Industrial Age, 1800-2000*, 242; Carlton, *Marine Propellers and Propulsion*, 103.

propeller spinning rapidly underwater would create areas of low pressure in which air bubbles would form. These cavities would collide with the propeller to slowly damage it and cause sometimes severe vibrations. Not only did this damage the vessel and hurt crew and potential passenger comfort, but it also wasted the ships power. A propulsion setup that dealt better with cavitation would therefore: last longer, make for an overall smoother traveling experience and crucially provide better and more efficient power delivery.

The capabilities required to successfully optimise for the least amount of cavitation contained both theoretical and practical elements. Mathematical models would predict the cavitation produced by a certain screw in certain conditions. The screw would then be adjusted to minimise this mathematical cavitation. This optimalisation would in this period and before already be partially done using computers, although this was mostly just computing set equations at first. A model of the optimised screw could then be produced for testing. The screw would be ran in a specially lit tank, where specialized cameras would take pictures of its turbulence. The special lightning conditions allowed the cameras to clearly capture the cavitation on the screw. The resulting pictures would then be compared to the theoretical framework. So not only is the theoretical knowledge important to this core competence, but also the computing and testing facilities. A more advanced computing facility might allow for more complex models, while a better testing facility would more accurately replicate real world behaviour.

In 1968 *MARIN's* executives decided upon the design for a new facility. This facility would be known as the vacuum tank. While expanding *MARIN's* capacity was the main concern, one design decision had a major impact on *MARIN's* core competence. The new large towing tank was built with the ability to depressurize.[139] This particular property was shared by no other facility of its size when it opened in 1972.[140] The possibility to depressurize the entire vacuum tank would give the it the ability to produce more realistic cavitation on larger scale models than ever before. The ability to better simulate cavitation on a scale that was unheard of before would have undoubtedly been a large boon for *MARIN's* ship propulsion department. The fact that this facility was the only one of its kind world wide meant that this boon would have undoubtedly provided *MARIN* with a singular competitive advantage. This world-beater would have greatly strengthened *MARIN's* core competence in ship propulsion.

[139] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1968*, 22-23.
[140] "Scheepsbouwkundig Proefstation krijgt vacuumsleeptank."

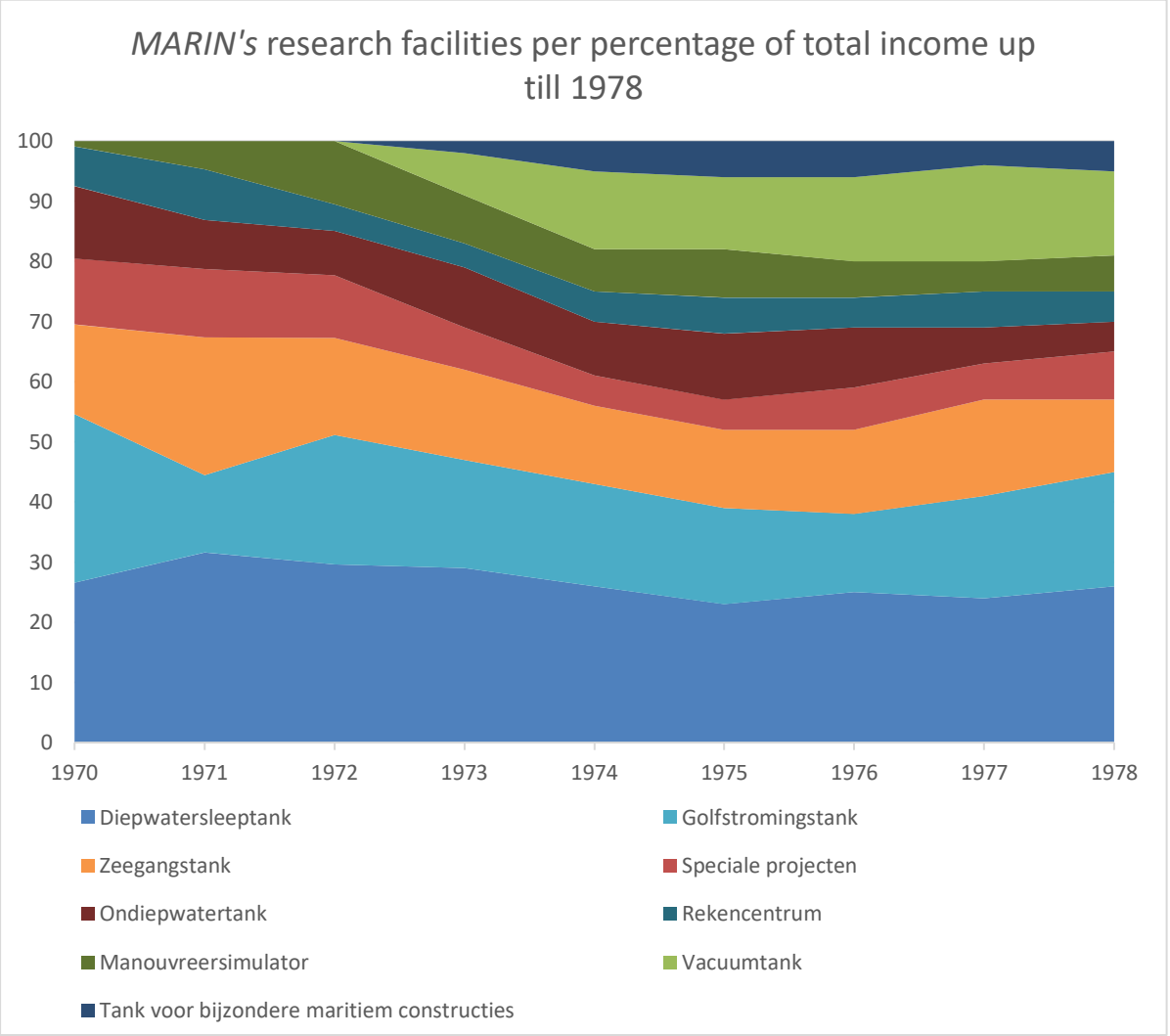


Figure 12: *MARIN's* research categories per percentage of total income from 1970 till 1978. Sources: Data from Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1970-1978.*

To see how much the new advanced facility was utilised *MARIN's* income from 1970 till 1978 is broken down per research facility in figure twelve. These data from is graph is also presented in appendix nine. The *Diepwatersleeptank* forms a large and steady basis as it performs most of the more basic model towing tests. It serves largely the same purpose as the vacuum tank, but cannot be depressurised. Besides the introduction of two new facilities no big shifts in competence would occur. What is surprising here is how little percentage of revenue the *Vacuum tank* possessed. This state of the art facility that was worth more than three times the rest of *MARIN's* assets only managed to produce 15% of its revenue. It was already apparent from the analysis of *MARIN's* financial situation that the facility, at least commercially, did not entirely pan out, but this does put it in some perspective. This means

that while the vacuum tank enhanced *MARIN's* ship propulsion abilities this did not translate in additional orders. There are three possible reasons for this.
Firstly either the ship propulsion market segment was shrinking, or *MARIN* already possessed such an advantage over its competitors that the new facility made little difference. Timing suggests the former option. The oil crisis would happen in 1973, which would also cause the tanker market crash in the following year. These are exactly the years that the vacuum tank becomes operational. This would align with the later statement by *MARIN's* executives that *MARIN* had done relatively well in a tough and shrinking market.[141] The other possible explanation for the vacuum tank not bringing in many orders is that the functionality it provided was simply not in a large demand. Cavitation testing on the scale that the vacuum tank allowed *MARIN* to perform may have been a luxury most shipbuilders did not need. In this way *MARIN* could have expanded its core competence but would have been unable to effectively bring these new capabilities to market.

From 1976 till 1978 the facilities were divided into three market segments. [142]The *Diepwatersleeptank, Speciale projecten* and *Vacuumtank* are listed under *Ship powering*. The *Rekencentrum* is left on its own and the rest is listed under *Ocean Engineering en Ship Handling.* In 1978 *MARIN* would hire new accountants as part of the process resulting from the *CRONSP*. These would recommend a new information management system which would be introduced in 1979.[143] This new system would reorganise *MARIN's* business under new market segments that align with the market segments from 1976. The fact that *MARIN* categorised its revenue now solely by market segment instead of facility shows how *MARIN* was evolving to focus more on the commercial aspect of its business in order to survive, instead of the pure science. The categories from 1976 till 1978 can, due to their clear definition, retroactively be applied to *MARIN's* earlier years. This provides one unified, clear and simple way to present the data the entire 1970s and 1980s. These numbers are presented in figure thirteen as well as appendix nine.

[141] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1983*, 6.
[142] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1976*, 8-9.
[143] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1979*, 22.

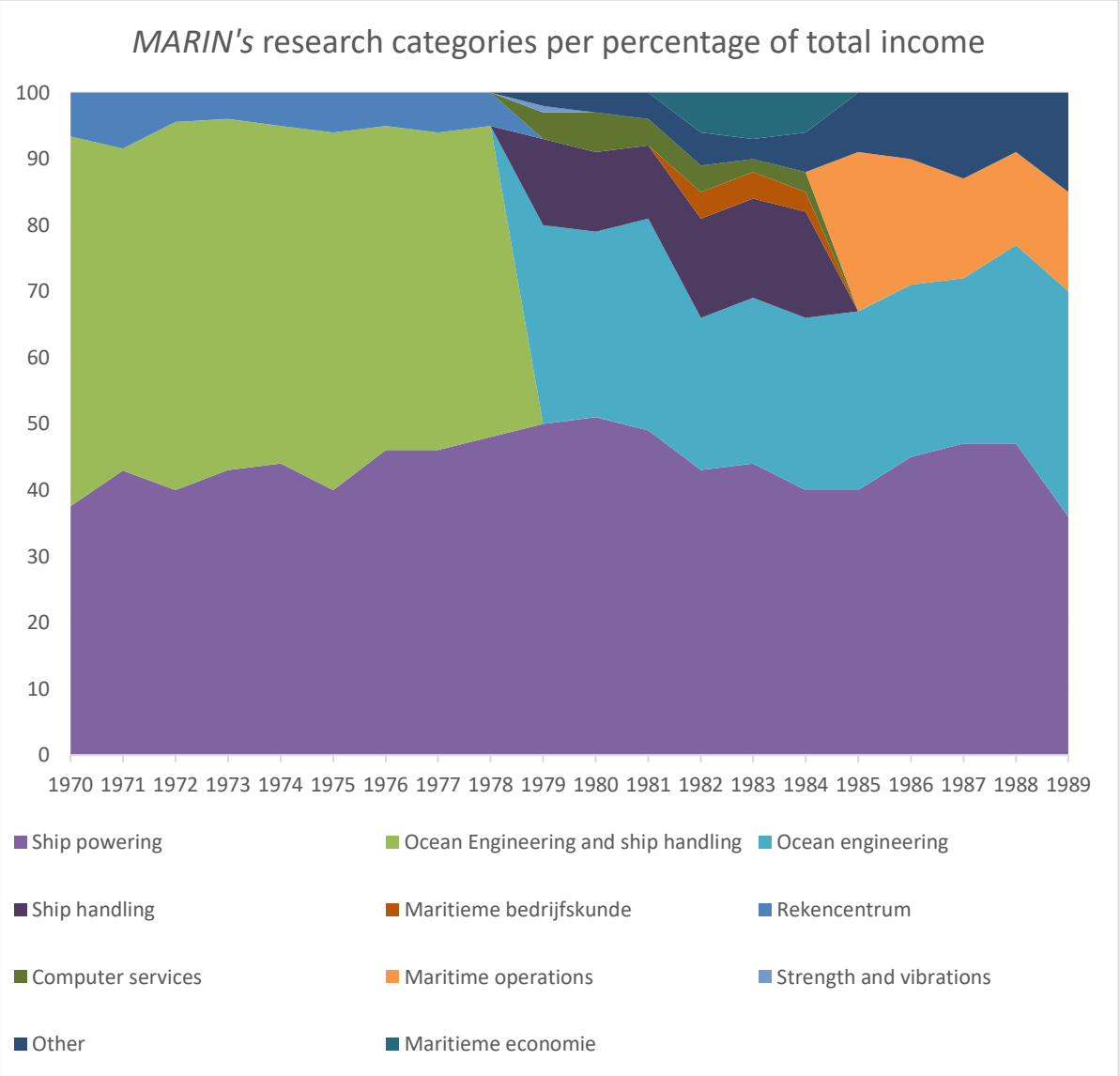


Figure 13: MARIN's post-1978 research categories per percentage of total income from 1970 till 1989. Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

This figure shows that *Ship powering*, the expertise that made *MARIN* known worldwide was still its backbone. Its steady nature shows that even in the longer term the vacuum tank did not greatly impact the size of this market segment for *MARIN*. During the period before *RSV's* bankrupcty, it was for years working on a so called tanker of the future.[144] *MARIN* was the shipyards scientific partner along the entire duration of this process. This shows that

[144]"Grotere schepen hoeven niet dieper te steken," *Het vrije volk*, September 30, 1970, https://resolver.kb.nl/resolve?urn=ddd:010957349:mpeg21:a0283;
"Reders en bouwers zoeken naar nieuw type schip," *NRC Handelsblad,* September 23, 1980, https://resolver.kb.nl/resolve?urn=KBNRC01:000026991:mpeg21:a0112.

MARIN's conventional core competence was, at least nationally, still aknowledged. But this core competence was also in demand in other ways. The core of ship powering is the design of the screw, since this component actually delivers the power to the water and therefore has an outsized impact on efficiency. Military submarines need to be as quiet as possible in order to avoid detection and the screw, since it is a fairly large fairly fastly rotating mass of metal, plays a large part in this aspect. *MARIN* was able to use its expertise to attain both Dutch and international military research and design contracts in this market segment.[145] This effectively secured orders in a second of the three Dutch market segments which did not suffer a large decline during this period.

The manoeuvring simulator

Besides the vacuum tank *MARIN* constructed one other cutting facility in the early 1970s. This was the *Manouvreersimulator* or ship manoeuvring simulator. In this time period the largest cargo ships like oil tankers became much wider and began having flat bottoms. This shape was optimized for cargo efficiency, but had a terrible effect on the ships handling. The result is that helmsmen now needed more and more experience to properly pilot these vessels. *MARIN* attempted to fill this market gap by designing a simulator in which crews could be safely and cheaply trained.

The simulator already performed some work in 1970, but officially opened in 1971 as the worlds first ever full ship handling simulator.[146] By 1973 it would receive a twin in Delft, but this machine 3.4 million guilder priced machine was still the only design in its field.[147] The simulator allowed *MARIN* to perform crew training better than any other institute, thereby gaining it a second core competence. As can be seen in figure twelve the 3.4 million guilders costing world-beater made up for a bit less than 10% of *MARIN's* revenue, this is a far more reasonable return than the vacuum tank. This could be at least partially due to the simulators versatility. Besides its main use to train tanker crews, *MARIN* would also find different ways to use its core competence of being a ship handling simulator. In 1975 *MARIN* prepared crews of Dutch tugboats for the arduous task of pulling massive concrete oil rigs in the Nordic sea.[148] So the core competence of ship handling simulation

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[145] Korteweg, *Nederlandse Scheepsbouw: dynamiek in dertig gesprekken*, 129; Lemmers, "The Pillars of Dutch Naval Shipbuilding after 1945," 272-273.

[146] "Scheepnabootser in Nederland,", *Tubantia,* May 21, 1971, https://resolver.kb.nl/resolve?urn=KBPERS01:003334017:mpeg21:a00218.

[147] "Scheepnabootser in Nederland;"
"Mens is tanker niet meer de baas," *De Volkskrant,* June 2, 1973, https://resolver.kb.nl/resolve?urn=ABCDDD:010849594:mpeg21:a0330.

[148]"Smit Rotterdam gaat zware projecten slepen," *NRC* Handelsblad, April 16,1975,

was applied more widely. More generally where the vacuum tank seems to have failed the simulator seems to have succeeded.

One last thing to acknowledge is that the Dutch shipbuilding decline would likely not even have hit the simulators business. This is because Dutch personnel, and foreign personnel from Dutch companies that would utilise the simulator would also serve on foreign built ships. The Dutch shipbuilding decline therefore would not have directly affected the numbers of Dutch trainees for the simulator. The simulator could therefore have easily preserved its position in the Dutch market without any special conditions.

Computation

One other aspect in which *MARIN* was a leading institute in the 1970s was computerisation. *MARIN* diffused its knowledge into the Dutch shipbuilding market and forged ahead in 1977 by buying the joint biggest computer in the Netherlands.[149] *MARIN* was a leader in this segment in the Netherlands, but that does not seem to be the case internationally. Since *MARIN's* main competitionwas located outside of the Netherlands this does not seem to have given *MARIN* any competitive advantage. It simply seemed to have been performing its role by being a leader within the Netherlands and then diffusing its knowledge to the Dutch shipbuilding industry. Because for all the praise of *MARIN's* computational pioneering during the 1970s, the *Computer services* division is one of the disappearing ones. Was this category simply too insignificant to bother tracking alone and added to *Other*, or was it split up and the relevant parts absorbed by each major category. This second version of events would reflect the electronic computer maturing as a technology and being integrated closer into *MARIN's* practical operations in order to achieve more synergy.

Retaining focus

In 1981 *MARIN* fused with the *NMI*. The *NMI's* division would still be listed entirely separately in 1981, before being added to *MARIN's* categories in 1982.[150] These are: *Maritiem economisch research centrum*, which was renamed to *Maritieme economie* in 1984 and *Centrum voor bedrijfsvoering en organisatieontwikkeling*, which was also renamed in 1984 to *Maritieme bedrijfskunde*. The division called *Maritieme economie* would almost

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https://resolver.kb.nl/resolve?urn=KBNRC01:000032713:mpeg21:a0194;
"Shell-directeur Wagner over 1974: Moeilijkste jaar sinds Tweede Wereldoorlog," *NRC* Handelsblad, April 18, 1975, https://resolver.kb.nl/resolve?urn=KBNRC01:000032715:mpeg21:a0107.

[149] "Beslissende rol computer bij scheepsbouw," *Trouw*, October 29, 1971, https://resolver.kb.nl/resolve?urn=ABCDDD:010828179:mpeg21:a0281;
"Kortom," *De Volkskrant*, December 14, 1977, https://resolver.kb.nl/resolve?urn=ABCDDD:010880615:mpeg21:a0075, 2.

[150] Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981*, 17; Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1982*, 17.

immediately afterwards be spun off in 1985 into an independent institute under its old name.[151] This spinning off of a part of *MARIN* that was deemed not relevant enough to rest of tis operations shows that *MARIN* was committed to retaining a focus on its core business. In the same year a new category would be formed called *Maritime operations*. The categories *Ship Handling*, *Ship Handling* and *Computer services* would all be split up and either form the basis of this new category, or be merged into *Other*.[152] This complex evolving web of categorisations also shows that *MARIN* was consistently reorganising itself into a form it found more relevant.

The offshore sector

MARIN claimed that the offshore sector had always been an important market segment for them.[153] This claim seems to be confirmed by figure thirteen. Work performed for the offshore sector is referred to by *MARIN* as the *Ocean engineering* market segment. [154] Under this guise it makes up roughly 30% of *MARIN's* total orders during the 1980s. Until 1979 *Ocean engineering* was still combined with *Ship Handling* muddling the picture, but its very possible that *Ocean engineering* possessed a similar percentage during those years. The offshore sector is, not a core competence of its own, but as mentioned earlier, one of the sectors that better survives the Dutch shipbuilding decline and even thrives during the period. A resilient market segment making up a significant portion of *MARIN's* market share definitely contributed to *MARIN* remaining relatively unaffected by the Dutch shipbuilding decline. Although if *Ocean engineering* was *MARIN's* only resilient Dutch market segment its share of *MARIN's* revenue should have grown, since all other market segment would decline. This not significantly being the case, as can be seen in figure thirteen, shows that *MARIN's* other Dutch market segments would also likely have been resilient.

Partial findings

By the start of the 1970s *MARIN* acquired two new bleeding edge facilities: the vacuum tank and the ship manoeuvring simulator. These both provided *MARIN* with a competitive advantage over its competitors, but *MARIN* seemingly was only really able to properly capitalise on the success of the simulator. *MARIN* did come into the period with an international reputation for ship propulsion excellence, so the capabilities form the vacuum tank only added to this preexisting core competence, while the simulator created and entire

[151] Maritiem research instituut Nederland*, Jaarverslag Maritiem research instituut Nederland 1985*, 4-5.
[152] Ibid, 16.
[153] Ibid, 37.
[154] Nederlands scheepsbouwkundig proefstation*, Nederlands scheepsbouwkundig proefstation Jaarverslag 1976,* 8,9.

new one on its own.

MARIN also possessed a nationally leading computer segment, but this did not develop into an international structural advantage, but rather seemed to fade into the background. Besides its core competence two of *MARIN's* major market segments: *Ocean engineering* and *Ship handling* seem to have been more resilient to the Dutch shipbuilding decline. *Ocean engineering* was resilient because it served the resilient Dutch offshore sector. *Ship handling* was resilient since the simulator served seafaring personnel, not shipbuilders. A decline in shipbuilding would therefore not directly affect it.

Conclusion

The 1970s and 1980s were a bad time for the global shipbuilding industry, from the oil crisis and its corresponding tanker crash of the 1970s to the general malaise and decline of the 1980s. But *MARIN* entered the decade in a financially secure position. The coming hardships where however not apparent to *MARIN's* executives in 1968 when they decided to build a large and expensive new testing facility in Ede called the vacuum tank. The vacuum tank, while certainly pushing *MARIN's* technical and scientific pedigree of *Ship powering* forwards, did not provide the revenue that was hoped for. With the vacuum tank and the ship manoeuvre simulator *MARIN* had two world-beaters, advancing its core competence of *Ship powering* and attaining an entirely new one in the field of maritime training. But it seems that *MARIN* attained the vacuum tank just at the wrong time, as the 1973 oil crisis hits just as the facility becomes operational. Unable to generate the profits needed to pay back its loans *MARIN* started making heavy losses.

While *MARIN* is producing heavy losses the amount of revenue *MARIN* generated from the Dutch market did not decline, and even when adjusted for inflation, it slightly rose instead. This unexpected behaviour means that *MARIN* was able to generate more revenue from a smaller market by increasing its market share. One factor that played a role here is that some of *MARIN's* larger market segments like the offshore industry and crew training were more resilient to the Dutch shipbuilding decline. This further nuances the Dutch shipbuilding decline by showing that at least *MARIN's* customers did relatively well. But to generalise: *MARIN's* losses where not due to the specific Dutch shipbuilding collapse, but instead due to a general malaise in the shipbuilding sector combined with strong foreign competition.

After a looming bankruptcy the Dutch government provided emergency relief and set up the *CRONSP* to provide a long term solution. This would result in *MARIN* merging with the *NMI* to receive its current name and annual base subsidy. *MARIN's* situation was still not

sustainable in the long term, but this annual subsidy combined with government loans ensured *MARIN's* survival for now. The subsidies *MARIN* would have needed to reach sustainability were significantly less than some of its fellow *GTI's* were receiving. This means that while *MARIN* relied on government funding for survival, this amount was less than expected for a Dutch public institute of its size. Analysing how this compares to *MARIN's* international competition, was outside of the scope of this research, but would make for great follow up research.

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Appendix 1 Inflation

	Inflation	index
1968	3.4	1
1969	6.9	0.931
1970	4.1	0.892829
1971	7	0.83033097
1972	7.2	0.77054714
1973	7.4	0.71352665
1974	8.8	0.65073631
1975	9.4	0.58956709
1976	8.1	0.54181216
1977	6.2	0.50821981
1978	3.8	0.48890745
1979	3.9	0.46984006
1980	6	0.44164966
1981	6.2	0.41426738
1982	5.5	0.39148267
1983	2.6	0.38130412
1984	3.1	0.3694837
1985	2.1	0.36172454
1986	0.2	0.36100109
1987	-0.5	0.36280609
1988	0.7	0.36026645
1989	1	0.35666379

Sources: Data from Hoeveel inflatie, “Inflatie in Nederland per jaar.”

Appendix 2 Long term

In millions of 1968 guilders	Totaal value assets	Long term Debt total	Debt vacuum tank	Debt guarantee vacuum tank
1968	9.78578863	6.16393568	0	0
1969	10.4439622	9.251617642	3.02575	0
1970	21.02590895	19.55393121	12.01941975	0
1971	26.5913078	24.89248874	18.83783812	0
1972	34.56597666	31.9226481	24.57308127	1.755754435
1973	36.87766974	33.7937751	25.14072009	4.16876323
1974	35.86259174	32.38516906	22.21354929	6.66467636
1975	33.92746478	30.68502334	19.45705124	8.754110393
1976	35.06576756	31.16530821	17.24550829	10.68582191
1977	39.77849985	30.20145998	15.55875089	12.62327889
1978	38.80676602	31.40398458	14.35136883	14.77214556
1979	35.70906065	28.7531664	13.17640143	13.0369186
1980	35.75253178	27.86619611	11.79049127	13.79228689
1981	34.82389382	24.30833986	10.47730216	14.4259878
1982	33.21054512	23.80642702	9.30780866	15.0171493
1983	31.36481513	24.09022489	8.47309354	16.23005485
1984	30.73447447	24.23148346	7.608607793	17.25454536
1985	30.42965865	24.71403258	6.179912902	18.53411968
1986	15.59960146	5.48377983	5.48377983	0
1987	24.83619308	0.05012529	0	0
1988	18.41296943	0.360266452	0	0
1989	15.9032292	0.178331894	0	0

Sources: Data from Hoeveel inflatie, “Inflatie in Nederland per jaar;” Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Appendix 3 Ratios

	Equity ratio	Turnover ratio
1968	0.370114	0.894857
1969	0.114166	0.875126
1970	0.070008	0.461959
1971	0.063886	0.316961
1972	0.076472	0.264997
1973	0.083625	0.299315
1974	0.096965	0.383091
1975	0.09557	0.412264
1976	0.111233	0.347392
1977	0.240759	0.337186
1978	0.19076	0.32608
1979	0.194794	0.329806
1980	0.220581	0.37477
1981	0.301964	0.556508
1982	0.283167	0.500616
1983	0.231935	0.484197
1984	0.211586	0.501776
1985	0.187831	0.52862
1986	0.648467	0.845583
1987	0.997982	0.480701
1988	0.980434	0.631746
1989	0.988786	0.631577

Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Appendix 4 Labour

In thousands of 1968 guilders where appicable	Employees	Employees FTE	Revenue per employee	Revenue per FTE	Total costs	Labour costs	percentage of costs attirubted to labour
1968	311	0	28.15717222		9191.256	5445708.84	59.24879764
1969	311	0	29.38837204		10084113	6263801.57	62.11554526
1970	339	0	28.65226412		11184134	7306574.88	65.32982369
1971	337	0	25.01008525		10839418	8172253.81	75.3938441
1972	323	0	28.35879307		16218047	9412335.99	58.0361847
1973	355	0	31.09305536		20180810	12012330.61	59.52353093
1974	412	0	33.34616404		25686580	14755678.75	57.44508896
1975	424	0	32.98838534		28503542	17491609.32	61.36644016
1976	420	0	29.00370887		31467638	18574297.18	59.02666381
1977	405	0	33.11790769		31628507	19998109	63.2281157
1978	412	394	30.71390191	32.11707509	33414788	20888422	62.51250794
1979	0	393		29.96710212	35135012	22371779	63.673748
1980	0	367		36.50950692	34099633	23551444	69.06656151
1981	0	421		44.10600681	45515182	28101643	61.74125152
1982	0	411		34.24816065	44806666	29532012	65.90986261
1983	0	400		31.62771002	43236700	30345147	70.18377212
1984	0	387		33.1855572	40887819	28761721	70.34300607
1985	0	369		37.09442305	42001974	27174776	64.69880678
1986	0	349		31.98054346	39966525	24736498	61.89304174
1987	0	329		30.71478134	38819573	23670166	60.97482319
1988	0	309		31.75253265	35369305	23925123	67.64374646
1989	0	298		27.65617807	34727059	23027736	66.31064266

Sources: Data from Hoeveel inflatie, “Inflatie in Nederland per jaar;” Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Appendix 5 Income

In millions of 1968 guilders	Revenue from commercial operations	Revenue-base subsidy	Saldo-(subsidy+guarantee Ede)	Directly received subsidies	Net income/loss
1968	8.75688056	8.75688056	-0.09923297	0.1	0.00076703
1969	9.139783706	9.139783706	-0.091927331	0.0931	0.001172669
1970	9.713117538	9.713117538	-0.087808	0.0892829	0.0014749
1971	8.428398728	8.428398728	-0.081187836	0.083033097	0.001845261
1972	9.159890163	9.159890163	-1.791914417	0.077054714	-1.714859703
1973	11.03803465	11.03803465	-2.130024898	0.071352665	-2.058672233
1974	13.73861958	13.73861958	-2.223842476	0.065073631	-2.158768846
1975	13.98707538	13.98707538	-2.120578599	0.058956709	-2.06162189
1976	12.18155773	12.18155773	-3.731642388	0.866899454	-2.864742934
1977	13.41275261	13.41275261	-2.568638949	0	-2.568638949
1978	12.65412759	12.65412759	-3.790560593	0	-3.790560593
1979	11.77707113	11.77707113	-1.739656594	0	-1.739656594
1980	13.39898904	13.39898904	-1.501191479	4.481038822	2.979847343
1981	19.37976439	18.56862886	-3.220681557	2.134493202	-1.086188355
1982	16.62572068	14.07599403	-3.592514744	2.865084346	-0.727430398
1983	15.18675643	12.65108401	-5.158591428	2.535672425	-2.622919003
1984	15.42180684	12.84281064	-3.077981345	2.578996199	-0.498985145

1985	16.08571407	13.6878421	-2.53516777	2.397871966	-0.137295804
1986	13.19075779	11.16120967	-5.763726067	2.029548125	-3.734177942
1987	11.93878507	10.10516306	-4.413217964	1.833622004	-2.57959596
1988	11.63231924	9.811532588	-3.387899243	1.82078665	-1.567112593
1989	10.04411985	8.241541066	-3.895081713	1.802578783	-2.09250293

Sources: Data from Hoeveel inflatie, “Inflatie in Nederland per jaar;” Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Appendix 6 NL%

In millions of 1968 guilders where appicable	NL	INT	Total	NL%	INT%	NL%*Total commercial revenue	Total commercial revenue/2
1968	3.9	5.1	9	43.33333	56.66667	3.794648243	4.37844028
1969	4.65	5	9.65	48.18653	51.81347	4.40414448	4.569891853
1970	5.35	5.8	11.2	47.98206	52.01794	4.660554155	4.856558769
1971	4.1	6.5	10.6	38.67925	61.32075	3.260041018	4.214199364
1972	4.9	6.9	11.8	41.52542	58.47458	3.803683203	4.579945081
1973	6.1	0	15.1	40.39735	59.60265	4.459073602	5.519017327
1974	7.5	0	21	35.71429	64.28571	4.906649851	6.869309792
1975	0	0	0	46	54	6.434054677	6.993537692
1976	0	0	0	46.1	53.9	5.615698112	6.090778864
1977	0	0	0	51.05	48.95	6.84721021	6.706376307
1978	0	0	0	43.6	56.4	5.517199627	6.327063793
1979	0	0	0	0	0		5.888535566
1980	0	0	0	0	0		6.69949452
1981	0	0	0	0	0		9.689882197
1982	0	0	0	0	0		8.312860339
1983	0	0	0	51	49	7.745245781	7.593378217
1984	0	0	0	50	50	7.710903419	7.710903419
1985	0	0	0	46	54	7.399428472	8.042857035
1986	0	0	0	50	50	6.595378897	6.595378897
1987	0	0	0	51	49	6.088780383	5.969392533
1988	0	0	0	45	55	5.234543657	5.816159619
1989	0	0	0	54	46	5.423824719	5.022059925

Sources: Data from Hoeveel inflatie, "Inflatie in Nederland per jaar;" Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; "Meer orders voor NSP uit het buitenland;" Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.

Appendix 7 regions

	West-Europa	Verre-oosten	Noord-Amerika	Overige gebieden	
1968	0	0	0	56.66667	
1969	0	0	0	51.81347	
1970	0	0	0	52.01794	
1971	0	0	0	61.32075	
1972	0	0	0	58.47458	
1973	0	0	0	59.60265	
1974	0	0	0	64.28571	
1975	0	0	0	54	
1976	0	0	0	53.9	
1977	0	0	0	48.95	
1978	0	0	0	56.4	
1983	24	14	10	1	
1984	25	16	6	3	
1985	29	12	11	2	
1986	30	12	6	2	
1987	26	6	14	3	
1988	26	5	21	3	
1989	21	3	9	13	

Sources: Data from Hoeveel inflatie, Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1983-1989*; "Meer orders voor NSP uit het buitenland;" Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1978*.

Appendix 8 GTI's

In millions of 1968 guilders	Nationaal Lucht- en Ruimtevaart Laboratorium	Reactor Centrum Nederland/Energieonderzoek Centrum Nederland	Waterloopkundig Laboratorium	Requirements NSP
1970	10.45681325	30.356186	0.892829	0.087808
1971	10.17902736	23.24926716	0.83033097	0.081187836
1972	12.38269254	29.29928446	0.77054714	1.791914417
1973	8.974738226	29.9046155	0.713526652	2.130024898
1974	10.17270038	25.80820191	0.650736306	2.223842476
1975	13.7634438	25.8678458	0.589567094	2.120578599
1976		24.73155781		3.731642388
1977	19.64269547	31.43542783		2.568638949
1978	16.47422552	32.44634309		3.790560593
1979	15.60573766	30.96199024	0.469840062	1.739656594
1980	16.44438337	30.74102446		1.501191479
1981	16.52139736	31.19226233		3.220681557
1982	15.79045364	27.39400008	0.440418008	3.592514744
1983	15.23920062	26.26384676	0.857934279	5.158591428
1984	14.56135247	25.36801161	1.574000546	3.077981345
1985	14.59232961	21.94401913	1.442919184	2.53516777
1986	15.02053333	20.37056948	1.447253368	5.763726067
1987	15.8934466	20.3338304	1.463922593	4.413217964
1988	16.91739207	19.94471106	1.449712204	3.387899243
1989		19.42890317		

Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1983-1989*; "Meer orders voor NSP uit het buitenland;" Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1970-1977*; "Staatsblad van het Koninkrijk der Nederlanden," 1970-1989.

Appendix 9 categories of research

	Diepwaterrsleeptank	Speciale projecten	Vacuum tank	Golfstromingstank	Zeegangstank	Tank voor bijzondere maritiem constructies	Binnenvaarttank/Ondiepwatertank	Manouvreersimulator	Rekencentrum
1968	33.3	14.5	0	22.2	15.7	0	8.6	0	5.7
1969	29.8	8.3	0	31.9	17.8	0	6.2	0	6
1970	26.6	11	0	28	14.9	0	12	0.9	6.6
1971	31.6	11.3	0	12.9	22.9	0	8.2	4.7	8.4
1972	29.6	10.4	0	21.5	16.2	0	7.4	10.5	4.4
1973	29	7	7	18	15	2	10	8	4
1974	26	5	13	17	13	5	9	7	5
1975	23	5	12	16	13	6	11	8	6
1976	25	7	14	13	14	6	10	6	5
1977	24	6	16	17	16	4	6	5	6
1978	26	8	14	19	12	5	5	6	5

	Computer services	Ship handling/ Navigation research and shiphandling	Maritiem economisch research centrum/ Maritieme economie	Centrum voor bedrijfsvoering en organisatieontwikkeling/ Maritieme bedrijfskunde	Strength and vibrations
1979	4	13	0	0	1
1980	6	12	0	0	0
1981	4	11	0	0	0
1982	4	15	6	4	0
1983	2	15	7	4	0
1984	3	16	6	3	0

	Ocean Engineering and ship handling	Calculated ship powering	Ship powering	Listed ship powering	Ocean engineering	Maritime operations	Other
1968	46.5	47.8	47.8	0	0	0	0
1969	55.9	38.1	38.1	0	0	0	0
1970	55.8	37.6	37.6	0	0	0	0
1971	48.7	42.9	42.9	0	0	0	0
1972	55.6	40	40	0	0	0	0
1973	53	43	43	0	0	0	0
1974	51	44	44	0	0	0	0
1975	54	40	40	0	0	0	0
1976	49	46	46	0	0	0	0
1977	48	46	46	0	0	0	0
1978	47	48	48	0	0	0	0
1979	0	0	50	50	30	0	2
1980	0	0	51	51	28	0	3
1981	0	0	49	49	32	0	4
1982	0	0	43	43	23	0	5
1983	0	0	44	44	25	0	3
1984	0	0	40	40	26	0	6
1985	0	0	40	40	27	24	9
1986	0	0	45	45	26	19	10
1987	0	0	47	47	25	15	13
1988	0	0	47	47	30	14	9
1989	0	0	36	36	34	15	15

Sources: Data from Maritiem research instituut Nederland, *Jaarverslag Maritiem research instituut Nederland 1981-1989*; Nederlands scheepsbouwkundig proefstation, *Nederlands scheepsbouwkundig proefstation Jaarverslag 1968-1980*.