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Industrial Renewal Processes in Danish Shipbuilding 1975-2015

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**Transforming an industry in decline:
Industrial renewal processes in Danish shipbuilding 1975-2015**

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Summary

This paper explores the transformation of Danish shipbuilding from 1975-2015. It identifies 27 firms that were spun out during the closure of four Danish shipyards and finds that several of these firms were able to apply the inherent resources in new activities with more value added. The paper also finds that the competencies of the redundant workers from the four shipyards were useful in other parts of the Danish labor market. The paper sheds new light how internal and external factors influence the transformation of mature industries.

Key words: Industrial transformation, shipbuilding, creative destruction, spin-offs, innovation

Introduction

The second half of the twentieth century saw a major shift in global shipbuilding from Europe to East Asia. From 1977 to 1985 the market share of European shipyards dropped from 41 % to 18 % while shipyards in Asia increased the market share from 46 % to 70 % (Stopford, 2009). A combination of modern production facilities, low wages, and massive state support allowed shipyards in Japan and Korea to successfully outcompete the European shipping industry (Amsden, 1989; Chida & Davis, 1990; Bruno & Tenold, 2011).

The decline of European shipbuilding has been studied thoroughly in the past decades (see for example Stråth, 1987; Bohlin, 1989; Todd, 1991; Lorenz, 1991, Burton, 1994; De Voogd, 1995, 2007; Johnman & Murphy, 2002; Poulsen and Sornn-Friese, 2011). However, there is a lack of studies that explore the long term consequences of the shipyard closures (exceptions are Andersen and Storrie, 1996; Olesen, 2016; Larsen, 2016; Holm et al., 2017).

This paper examines the closure of four Danish shipyards: Burmeister and Wain (B&W) in Copenhagen (closed in 1980), Nakskov Shipyard (closed in 1986-87), Aalborg Shipyard (closed in 1987-88), and Danyard Frederikshavn (closed in 1999). The paper explores four research questions: (1) what activities were continued from the four shipyards? (2) How did these activities evolve after the shipyard closures? (3) What happened to the redundant shipyard employees? And (4) what factors influenced the transformation of the Danish shipbuilding industry?

The paper identifies 27 spin-off firms that continued activities from the four shipyards. By 2013 twelve firms remained. These firms had used the inherent resources to develop new products, access new markets, and establish new industrial organizations. Several of the spin-offs had evolved into

global market leaders in the areas of marine engine design, marine boilers, inert-gas systems, thermal fluid systems, diesel power plant contracting, and software systems for shipyards. The paper also finds that between 60 and 70 % of the 9,399 redundant shipyard workers had found new employment three years after the closures. This suggests that the resource at the shipyards were also useful in other parts of the labor market. The paper concludes that the transformation was influenced by the market dynamics and the institutional environment (external factors) as well as the resources and the dynamic capabilities at the shipyards (internal factors).

Theoretical framework

The paper applies Joseph Schumpeter's theories of creative destruction and entrepreneurial profit as an organizing framework (Schumpeter, 1934, 1939, and 1943). Schumpeter identified the creative destruction process where old firms vanish and new firms will appear as the engine of the capitalist system. The process is driven by innovative entrepreneurs who in the pursuit of entrepreneurial profit tear down old structures and make new combinations. Schumpeter identified five innovative processes through which entrepreneurs could obtain entrepreneurial profit: (1) the introduction of a new and more efficient method of production, (2) development of new or better products, (3) accessing new markets, (4) introducing new raw materials or semi-finished products that make the end product cheaper, and (5) through the establishment of a new industrial organization. The analysis section in this paper will be structured around these modes of innovation.

The decline of the Danish shipbuilding industry

During the first half of the 20th century global shipbuilding was completely dominated by countries in Western Europe. Great Britain was by far the largest shipbuilding nation in the world but Danish

shipyards also played an important role in global shipbuilding. The first Danish steel shipyards were established in the 19th century. Among these were B&W in Copenhagen (established in 1843) and Frederikshavn Shipyard (1870). The early 20th century saw a second wave of new shipyards including the shipyards in Aalborg (1912) and Nakskov (1916) (Olesen, 2016). Most of the shipyards were owned by the leading Danish shipping companies. Odense Steel Shipyard was owned by A.P. Møller, Aalborg Shipyard, Danyard Frederikshavn, and Elsinore Shipyard by J. Lauritzen, and Nakskov Shipyard was by the East Asiatic Company. B&W in Copenhagen was one of the few Danish shipyards that were not owned by a shipping company (Lange, 2001).

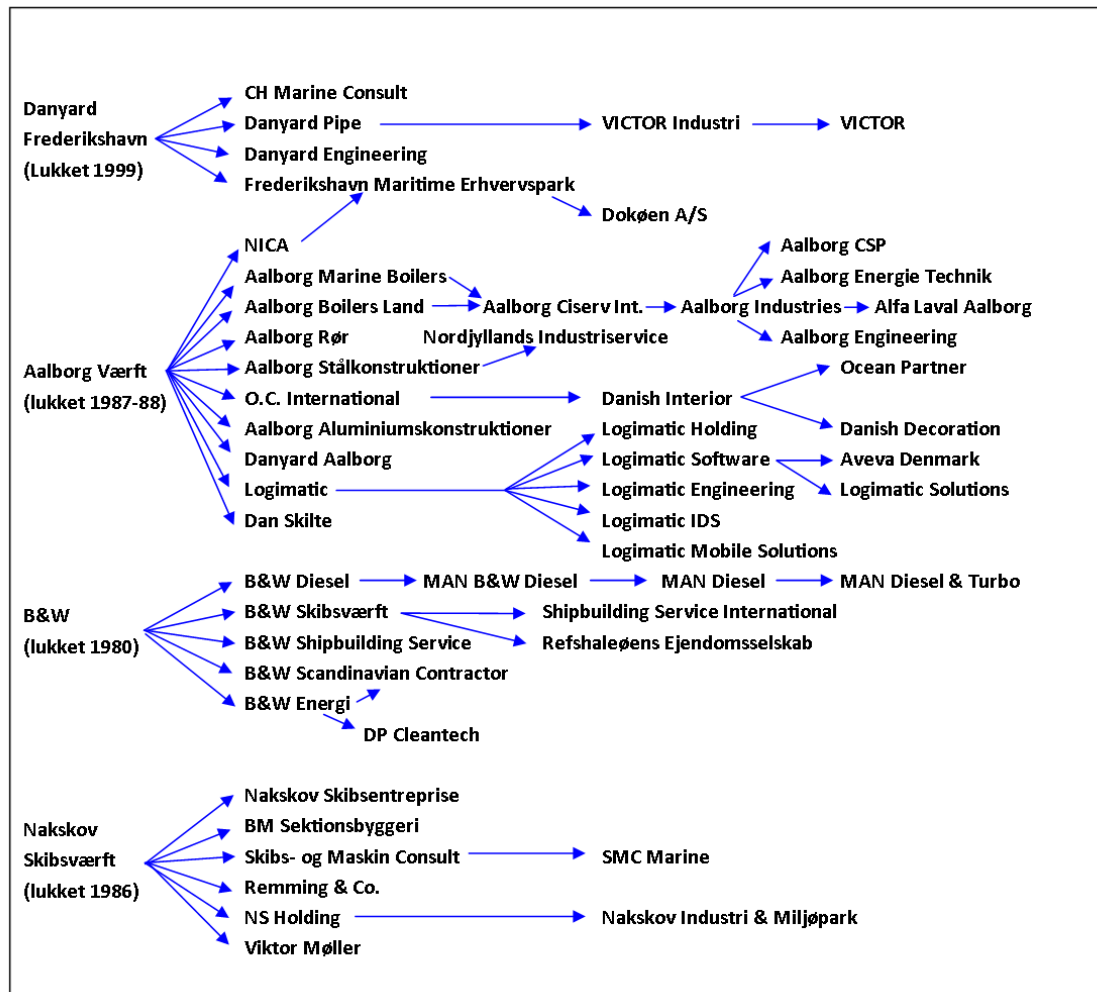
After the Oil Crisis in 1973 the European shipbuilding industry began to experience difficulties caused by the low demand for new ships and increased competition from heavily subsidized shipyards in Asia. Danish shipyards were not immune to these challenges, but responded by streamlining and diversifying the production. The Danish government introduced a number of supporting measures including favorable tax and export credit schemes, direct investments, and state orders. And the Danish shipping companies who owned the shipyards prevented several bankruptcies through cash injections and placement of new orders (Poulsen and Sorren-Friese, 2011). Despite these initiatives, the Danish shipyards continued to struggle, and in November 1980 B&W went bankrupt. This marked the beginning of a series of Danish shipyard closures in the 1980's and 1990's. Elsinore Shipyard was closed in 1983 followed by Nakskov Shipyard (1986-87), Aalborg Shipyard (1987-88), the reestablished B&W Shipyard (1996), Nordsøværftet (1997), Svendborg Shipyard (1999), Aarhus Flydedok (1999), and Danyard Frederikshavn (1999). In 2012 the last major Danish newbuilding steel shipyard at Lindø was closed (Olesen, 2016).

Analysis

The establishment of new firms from the closed shipyards

The closure of the Danish shipyards forced the owners, workers and managers to consider how to use the competencies and production facilities at the shipyards in new ways. During the closures of the four shipyards at least 27 new firms were spun out (figure 1). Spin-offs are in this case defined as new firms where the majority of employees were previously hired at the shipyards.

Figure 1: Spin-off from the four Danish shipyards



During the 1980 bankruptcy of B&W, the management spun out and divested a number of divisions and departments. The engine division (spun out as B&W Diesel) was the second largest designer of two stroke ship engines in the world. The steam division (B&W Energy) produced boilers to the industry and power plants. The contractor division (B&W Scandinavian Contractor) contracted turn-key power plants, and the design office was spun out as B&W Shipdesign. In 1981 a new shipyard (B&W Skibsværft) was created by the management, and by 1983 the shipyard site was spun out in a real estate firm (Refshaleøens Ejendomsselskab) (Olesen, 2016).

When Nakskov Shipyard closed in 1986-87 the management spun out the design activities (Skibs og Maskin Consult), a blacksmith firm (Remming & Co.), and a maritime business consultancy firm (Viktor Møller). A group of local businessmen established a repair shipyard (Nakskov Skibsentreprise), and acquired the steel production facilities (BM Sektionsbyggeri). And finally the owner, the East Asiatic Company, converted the shipyard site into a business park (Olesen, 2016).

During the closure of Aalborg Shipyard in 1987-88 the management spun out the boiler division (Aalborg Boilers Land and Aalborg Marine Boilers), that designed and produced boilers for industry, power plants and ships. The management also spun out the steel production facilities (Aalborg Stålkonstruktioner), the pipe factory (Aalborg Rør), and transformed the shipyard site into a business park (NICA). The shipbuilding activities were restructured by the management as two separate firms: Danyard Aalborg made warships in fiberglass, and Aalborg Aluminiumskonstruktioner made lightweight aluminum catamaran ferries. A local businessman established a firm that specialized in outfitting passenger ships (O.C. International and later Danish interior). And finally, three firms were established by the shipyard workers: A sign workshop (Dan Skilte), a blacksmith firm (Nordjyllands Industriservice), and a consulting engineering firm (Logimatic) (Olesen, 2016).

In Frederikshavn the management spun out the pipe factory (Danyard Pipe) and parts of the design office (Danyard engineering). The owner (J. Lauritzen) turned the site into a business park (FME), and the neighboring shipyard (Ørskov Christensen Steel Shipyard) rented and later bought the dock area. Finally, a maritime consultant engineering firm (CH Marine Consult) was established by an engineer from the design office (Olesen, 2016).

Two observations stand out from the analysis of the four shipyard closures: (1) that the shipyards were characterized by very diverse product portfolios, and (2) that the activities in the spin-off firms were initially very similar to the activities of the closed shipyards. The new firms were mainly engaged in (1) reconstructed shipbuilding activities, (2) as suppliers for other shipyards (ship engines, marine boilers, steel sections, pipes etc.), (3) in power plant activities (contracting and boiler systems), (4) as (maritime) consultant engineering firms, and (5) as business parks where the production facilities at shipyard site was rented to other firms. It is thus evident that the shipyard closures did not see any immediate creative initiatives. Rather it took a few years before the spin-off firms began to experiment with different types of innovation.

Spin-offs with the same challenges as the shipyards

In 2013 – almost 35 years after the closure of B&W – 15 of the original 27 spin-offs had disappeared. Most of the spin-offs that had vanished had failed to transform themselves. They had continued the shipbuilding activities or had become suppliers for the remaining Danish shipyards (see table 1). As a consequence they also faced the same challenges as the closed shipyards: B&W Skibsværft continued to produce bulk carriers and product tankers until its bankruptcy in 1996. BM Sektionsbyggeri made steel sections for B&W Skibsværft and went out of business when the shipyard closed. Aalborg

Stålkonstruktioner and Aalborg Rør delivered pipes and steel sections to Danyard in Frederikshavn, and when Danyard was closed in 1999 both firms went out of business. The majority of these spin offs failed launch new innovative initiatives. They kept on doing what the shipyards had done and as a consequence they went out of business in the 1990's or 2000's.

Table 1: Spin-offs from the Danish shipyards that were closed

Spin-off firm	Parent	Activity when established	Activity when closed	Closed
B&W Skibsværft	B&W	Shipbuilding	Shipbuilding	1996
Danyard Aalborg	Aalborg	Shipbuilding	Shipbuilding	2009
Aalborg Aluminiumskonstruktioner	Aalborg	Shipbuilding	Shipbuilding	1996
Nakskov Skibsentreprise	Nakskov	Ship repair	Ship repair	2006
Skibs og Maskin Consult/ SMC Marine	Nakskov	Ship repair Consulting engineers	Ship repair Consulting engineers	1994
Remming & Co.	Nakskov	Blacksmith	Blacksmith, electrician and plumbing firm	2008
BM Sektionsbyggeri	Nakskov	Steel constructions	Steel constructions	1996
Aalborg Stålkonstruktioner	Aalborg	Steel constructions	Steel constructions	1998
Aalborg Rør	Aalborg	Pipe factory	Pipe factory	1997
Danyard Engineering	Danyard	Consulting engineers	Consulting engineers	2003
Shipbuilding Services Int.	B&W	Consulting engineers	Consulting engineers	2009
Viktor Møller	Nakskov	Management consultants	Management consultants	2001
O.C. International	Aalborg	Ship interior	Ship interior	1992
Danish Interior	Aalborg	Ship interior	Ship interior	2008

Source: Olesen, 2016

Note: It has not been possible to track B&W Shipbuilding Service after it was sold to DFDS in 1980

Development of new products

While some spin-offs were unable to transform their business model other were more successful in adapting to the changing conditions. By 2013 several of the 12 remaining spin-offs had used the competencies and knowhow from the shipyards to develop new products (see table 2).

Table 2: Spin-offs remaining by 2013

Spin-off firm	Shipyard	Activity when established	Activity in 2013
MAN Diesel & Turbo	B&W	Production and development of ship diesel engines	Development of ship diesel engines (production has been outsourced – mainly to license takers in Asia)
B&W Energy	B&W	R&D and production of boiler systems for coal power plants	Development of boiler systems for biomass- and coal power plants. Production has been outsourced.
B&W Scandinavian Contractor	B&W	Contracting of diesel power plant	Contracting, financing, operation and maintenance of biomass and diesel power plants
Alfa Laval Aalborg	ÅV	Development and manufacturing of boilers for industry, power plants, and ships.	Development and (offshored) production of marine boilers, thermal fluid systems, Inert-gas systems and industrial boilers
Logimatic	ÅV	Consulting engineers	Software developers Consulting engineers
Dan Skilte	ÅV	Production of signs	Production of signs
NIS	ÅV	Steel and shipbuilding activities	Steel and shipbuilding activities
VICTOR	DY	Pipe production	Pipe production and cooling systems
CH Marine Consult	DY	Consulting engineers	Consulting engineers
FME	DY	Business park	Business park
Refshaleøens Ejendomsselskab	B&W	Property management	Property management
Nakskov Industri- & Miljøpark	NS	Business park	Business park
Source: Olesen, 2016			

Among the best example of product innovation is the spin-off firm Logimatic which was established in 1987 by four electrical engineers from the automation department at Aalborg Shipyard. The entrepreneurs wanted to form a maritime consultant engineering firm, and in order to support this activity they developed an inventory management system called MARS. MARS was initially only intended for internal use but it proved to very efficient for managing the flow of materials at shipyards. In the early 1990's the system was further developed in close collaboration with the Danish shipyard Aarhus Flydedok and Kværner Masa Yards in Finland. With the world's largest producer of cruise ships on the reference list the firm got its global breakthrough, and today MARS is used by shipyards all over the world. Logimatic has furthermore developed the MARS platform to target other customer groups. Today the firm offers waste management systems, retail store inventory management systems, and maintenance systems for shipping companies. In 2010 Logimatic Software was sold to Aveva which is the world's leading provider of software systems to the shipbuilding industry (Olesen, 2016).

B&W Scandinavian Contractor is another example of a shipyard spin-off that has developed new products. When the firm was spun out from B&W it contracted diesel power plant. In the 1980s, however, the management saw a business opportunity in offering lifetime maintenance on the power plants that were contracted, and in 1992 it engaged in its first full time operation and maintenance (O&M) contract in the Philippines. Today O&M has become the firm's most important activity. During the 1990 the firm also expanded into the biomass plants in order to meet the demand for green energy solutions. And in 2013 it began to offer financing solutions on the power plant projects (Olesen, 2016).

Identifying new markets

Apart from developing new products, a number of firms have successfully been able to target new markets. Spin-offs such as Dan Skilte, Nordjyllands Industriservice, CH Marine Consult and Danyard Pipe have identified local or regional niches where they have established themselves as craftsmen or service providers. These firms are all relatively small spin-offs established by former shipyard employees (Olesen, 2016).

Another group of spin-offs have developed in a completely different direction. These firms have established themselves as global players that generate their main revenue abroad. Among these firms are some of the largest spin-offs including B&W Diesel, Aalborg Boilers, B&W Scandinavian Contractor, B&W Energy, Logimatic, and Aveva Denmark. Most of these firms originate from divisions that were spun out by the shipyard management. They are characterized by a much larger turnover and employment compared to the local and regional spin-offs mentioned above. B&W Diesel, Aalborg Boilers and Aveva Denmark are all suppliers to the shipbuilding industry. For these firms, the global dislocation of the shipbuilding industry in the past decades has meant that the main customers are today situated in Asia. They furthermore have after-sales activities all over the world. A similar pattern can be identified in the power plant segment where B&W Scandinavian Contractor has customers in the Caribbean and Asia, while B&W Energy has been dependent on the European market.

Growth through new industrial organizations

In addition to creating new products and developing new markets, Schumpeter argues that entrepreneurs can innovate through new industrial setups. In this regard we have seen that the largest shipyard spin-offs have undergone profound changes in the past three decades. The Danish shipyards

were characterized by very concentrated value chains, where all activities from research and development to production and after-sales were located in Denmark. This was initially also the case for most of the spin-offs. Today, however, all of the major spin-offs have established global value chains. This decision has partly been taken to reduce production costs, but also to be closer to the customers. The manufacturing activities have increasingly been dislocated to low-wage countries near the customers, while more value-added activities such as R&D has been kept in Denmark (Olesen, 2016).

B&W Diesel exemplifies this development. When the firm was spun out in 1980 the production facilities were located in Denmark. The dislocation of shipbuilding activities to Asia however saw a declining demand for ship engines in Europe, and in 1987 the factory in Copenhagen was closed. This was followed by the closure of the production sites in Holeby and Frederikshavn in 2005 and 2010. Today MAN Energy Solutions (the former B&W Diesel) has no manufacturing activities of significance in Denmark, and the two stroke ship engines are mainly produced by licensees in Asia. B&W Scandinavian Contractor and B&W Energy have also outsourced all manufacturing activities while Alfa Laval Aalborg (the former Aalborg Boilers) has offshored these activities to China.

The firms have also undergone a significant change in terms of ownership. Apart from B&W, Danish shipyards were owned by the Danish shipping companies. By 2013, however, all of the largest spin-offs were owned by multinational firms with headquarters abroad. B&W Diesel was acquired by the German company MAN in 1980. B&W Scandinavian Contractor was owned by the Swedish firm Götaverken from 1980 to 1990 and is today owned by the Japanese firm Mitsui. B&W Energy was sold in 1980 to F. Lentjes in Germany. Aalborg Boilers was acquired by the Swedish firm Alfa Laval in 2011. And finally, Logimatic Software was sold to the UK based firm Aveva in 2010 (Olesen, 2016).

The ability to develop new products, identify new markets and form new industrial setups has not been any guarantee for success or even survival. Many of the firms that have disappeared (see table 1) attempted to adapt to the changed conditions. Danyard Aalborg used the GRP factory and the employees' knowhow on fiberglass to develop new luxury yachts but went out of business in 2005. Aalborg Aluminiumskonstruktioner developed a groundbreaking aluminum catamaran ferry design, but was unable to compete with shipyards in Australia. O.C International, Skibs og Maskin Consult, and SMC Marine found new customers abroad. However, they went bankrupt when these customers failed to meet the terms of payment. And finally, Nakskov Skibsentreprise and Danyard Aalborg created a new organizational setup where they reduced the fixed organization to a minimum and relied on subcontractors that were hired in for each task. None of these attempts were, however, successful.

Status in 2013: Fewer employees but more value added

In the creative destruction process entrepreneurs combine the existing factors of production in new and more viable ways. In this regard it is relevant to compare the activities at the shipyards with the activities in the spin-off firms. Table 3 shows the employment, turnover and results of the four shipyards in 1975 when their deliveries peaked.

Table 3: Employment, turnover and result and result for the shipyards in 1975

	Employees	Turnover (DDK)	Result (DKK)
B&W	7.838	1.767 million	25,1 million
Nakskov Skibsværft	2.245	337,2 million	-3,2 million
Aalborg Værft	2.766	467,7 million	14 million
Danyard Frederikshavn	1.112	230,8 million	2,5 million
Total	13.961	2,8 billion	38,4 million
Sources: Annual reports from the four shipyards in 1975			

Table 4: Employment, turnover and result og result for the spin-offs in 2013

	Employees	Turnover (DKK)	Result (DKK)
MAN Diesel & Turbo	DK: 1.916 (2013)	DK: 7.5 billion. (2007)	DK: 1 billion (2007)
BWSC	DK: 296 (2013) Total: 450 (2013)	DK: 1.3 billion (2013) Total: 1.5 billion (2013)	DK: 59 million (2013) Total: 65 million (2013)
BWE	DK: 140 (2013)	DK: 327 million (2013)	DK: 3 million (2013)
Alfa Laval Aalborg	DK: 465 (2013) DK: 524 (2010) Total: 2.523 (2010)	DK: 1 billion (2013) DK: 1.3 billion (2010) Total: 2.6 billion (2010)	DK: 86 million (2013) DK: 332 million (2010) Total: 332 million (2010)
Logimatic	Total: 68 (2013) Total: 131 (2009)	Total: 59 million (2013) Total: 128 million (2009)	Total: 6 million (2013) Total: 13 million (2009)
Dan Skilte	DK: 9 (2013)	-	DK: 78,000 (2013)
NIS	DK: 35 (2013)	-	DK: 1 million (2013)
CH Marine Consult	DK: 18 (2013)	-	DK: 4,8 million (2013)
VICTOR	DK: 65 (2013)	-	DK: -4 million (2013)
FME	DK: 10 (2013)	DK: 18 million (2013)	DK: 0.84 million (2013)
Refshaleøens Ejendomsselskab	DK: 10 (2013)	DK: 32 million (2013)	DK: 2.5 million (2013)
Nakskov Industri- & Miljøpark	-	-	-
Source: Navne & Numre Database (for MAN Diesel & Turbo: Annual Report 2007, p.7)			
Note: For MAN Diesel & Turbo the latest key figures are from 2007. For Logimatic and Alfa Laval Aalborg I have added the key figures for the year prior to their merger with Aveva and Alfa Laval (2009 and 2010) to give an impression of the size of these activities before they were acquired.			

Table 4 shows the same information for the spin-offs by 2013. Some reservations have to be made when comparing these numbers. Logimatic Software and Aalborg Boilers were acquired by multinational enterprises in 2010 and 2011 and integrated in the new organization. This makes it difficult to trace the original activities in 2013. I have therefore included the key figures from the last year before the acquisitions. A second reservation has to be made regarding the key figures from MAN

Diesel & Turbo. Here the latest available data is from 2007 when the shipbuilding and ship engine markets experienced a hitherto unprecedented upswing. In comparison 2013 was characterized by depressed market conditions. With these reservations in mind, however, it is possible to compare the activities in the spin-off firms with those of the shipyards.

First, I find that there has been a drastic reduction in the employment when comparing the shipyards and the spin-offs. The four shipyards employed 13,961 workers in 1975. In 2013 the 12 remaining spin-offs employed approximately 3,000 people. I have also identified a change in the composition of employees. At the shipyards approximately 75 % of the employees were blue-collar workers and 25 % white collar workers. Today this balance has tipped in favor of employees with academic backgrounds. In 2011 61 % of the employees at B&W Scandinavian Contractor had a bachelor degree, a master degree or a PhD degree (Olesen 2016).

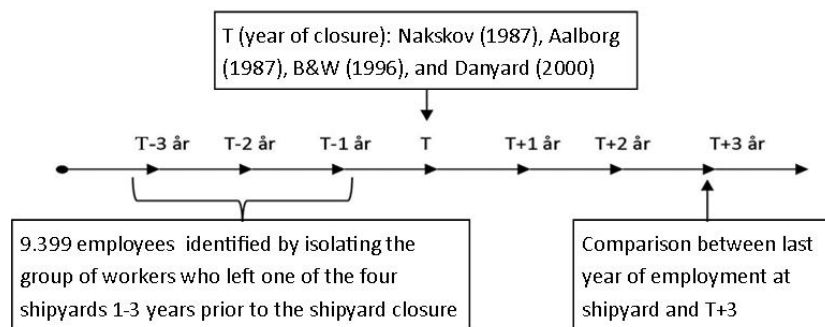
Second, the spin-offs deliver far higher profits than the shipyards. In 1975 the four shipyards delivered a result of 38.8 million DKK (169 million DKK in 2010 prices) from a turnover of 2.8 billion DKK (12.3 billion DKK in 2010 prices). In 2007 the Danish activities in MAN (the former B&W Diesel) made a profit of 1 billion DKK from a turnover of 7.5 billion DKK (1.07 billion DKK and 8.04 billion DKK in 2010-prices). If you add the key figures from Logimatic and Aalborg industries the last year before they were acquired (in 2009 and 2010 respectively), and the 2013 key figures from the remaining firms we reach a profit of 1.5 billion DDK from a turnover of 12 billion DKK. If we only include the Danish activities the numbers are 1.15 billion DKK from a turnover of 10.5 billion DKK (in 2010 prices). Despite the fact that these are rough numbers and that certain reservations have to be made, it clear that the spin-offs were far more profitable than the shipyards. It may be more surprising

that by 2013 the turnover of the spin-off firms equaled that of the shipyards in 1975 (corrected for inflation).

The workers at the Danish shipyards

Not all workers were able to continue their careers in the spin-off firms. In order to get a clearer idea of how the resources from the shipyards were used, this section examines what happened to the 9.399 employees that lost their jobs when the four shipyards closed. The study is based on quantitative data from the Danish Workforce Database (IDA) which is provided by Statistics Denmark. Every November since 1980 data Statistics Denmark has collected register data on each individual worker and workplace in Denmark. By connecting the individual worker and workplace it is possible to study movements in the Danish labor market over time.

Figure 2: Data collection for study of redundant shipyard employees



First, I have identified all the workers that left the four shipyards three years prior to the closure. Second, I examine what had happened to this population of workers three years after the closure (figure 2). As the data does not allow me to examine the closure of B&W in 1980, I have included data from the 1996 closure of B&W Shipyard, which continued the shipbuilding activities from B&W.

Table 5: Education, mobility, wages, and dispersion of re-employed shipyard workers

	Nakskov		Aalborg		B&W		Danyard	
Data collection period	1984-1986		1984-1986		1993-1995		1997-1999	
Employees who left the shipyards	1,382		4,599		2,042		1,376	
Re-employed after 3 years (in percent)	855	(61.9)	3,189	(69.3)	1,443	(70.7)	884	(64.2)
Re-employed worker has... (in percent)								
... higher education	37	(4.3)	228	(7.1)	109	(7.6)	47	(5.4)
... moved to other municipality	140	(16.4)	407	(12.8)	279	(19.3)	78	(8.8)
... higher hourly wage	663	(87.5)	2,286	(86.0)	665	(49.8)	457	(55.8)
... higher taxable income	460	(53.8)	1,753	(55.0)	508	(35.2)	313	(35.4)
... employment in i top-5 firm	269	(31.5)	1,390	(43.6)	142	(9.8)	205	(23.2)
Source: Statistics Denmark, IDA database Note: Top-5 firms are the five firms where most shipyard employees were hired.								

Table 5 shows the employment characteristics of the shipyard workers three years after the closure. The first row shows the data collection period while the second row show the number of employees that left the individual shipyard in that period. The third row shows the number of employees that found new jobs after three years and the percentage of reoccupied workers for each shipyard (e.g. 1,382 workers left Nakskov. 855 were reoccupied after three years. This amounts to 61.9 percent of all the workers who left Nakskov). The following rows show the retraining, mobility, income, and dispersion of the re-employed workers (e.g. of the 855 re-employed workers from Nakskov 37 had obtained a higher level of education after they left the shipyard. This amounts to 4.3 % of the 855 re-employed workers from Nakskov. The same employee can appear several times (e.g. if a worker has taken a higher education and has moved the worker will appear in both rows).

Table 5 shows that between 62 % (Nakskov) and 71 % (B&W) of the redundant shipyard workers had found new jobs three years after the closures. Two factors may explain the high

reemployment rate: First, the establishment of spin-offs from the shipyards provided jobs for many of the shipyard workers (especially in Aalborg and probably also in the 1980 closure of B&W). Second, the employees had very different skills ranging from metal workers, machine operators, painters, carpenters, electricians, engineers, sales people, accountants etc. This made it easier to integrate them in other parts of the labor market (Kamedula et al., 1987).

Table 6: Migration to other sectors (in percent)

Shipyard and year of closure	Nakskov (1987)	Aalborg (1987)	B&W (1996)	Danyard (2000)
Workers employed three years after closure	855	3,189	1,443	884
Primary sector total	2.0	0.5	0.1	1.9
Manufacturing of...				
... food and textiles	3.0	1.9	1.3	5.8
... wood and paper	0.4	0.5	1.2	0.7
... chemistry and plastics	5.7	3.9	3.7	1.9
... steel and machinery	33.7	38.4	18.2	19.2
... electronics	4.6	1.9	3.5	6.0
... transportation (shipbuilding)	5.9	19.2	1.9	17.7
Secondary sector total	53.3	65.8	29.8	51.3
Supply service (e.g. in the energy sector)	2.5	2.4	1.4	0.1
Construction	8.4	7.2	13.1	15.8
Trade, hotels, and restaurants	6.4	4.9	11.2	5.4
Transport (e.g. bus driver or taxi driver)	8.4	3.5	11.4	4.0
Business service (e.g. banking)	9.0	6.1	14.4	8.6
Public sector service	8.0	9.0	12.1	8.6
Other services	2.0	0.6	6.4	4.2
Service sector total	44.7	33.7	70.0	46.7
Total	100.0	100.0	99.9	99.9
Source: Statistics Denmark				

Table 5 shows that the level of retraining was very low (between 4 % and 8 %) and that the hourly wage increased more than the taxable income. This suggests that many shipyard workers became employed part-time (e.g. in the construction sector). Table 6 furthermore shows that most workers went to job in manufacturing of steel products and machinery (18 to 38 %) or shipbuilding (2 to 20 %). The high rate of reemployment, the low level of retaining, and the migration to neighboring sectors suggest that the competencies of the shipyard workers were useful in other parts of the Danish labor market.

Discussion: What factors influenced the transformation of Danish shipbuilding 1975-2015?

The transformation of Danish shipbuilding was influenced by several external and internal factors. External factors included the market dynamics and the institutional environment. Internal factors included the resources at the shipyards (i.e. the physical, human, and organizational assets that could be used to implement value creating strategies) and the dynamic capabilities in the firms (i.e. the ability of to obtain a competitive advantage by altering the resource base to address changing environments) (Teece, Pisano, and Shuen, 1997; Eisenhardt and Martin, 2000).

Extant, research suggests that the depressed shipbuilding market of the 1970's and 1980's created a push for a renewal of the Danish shipbuilding industry. Poulsen and Sornn-Friese (2011) have found that Danish shipyards responded to the market development by adopting best-practice technologies and move into niche production of complex high-value vessels. Olesen (2016) has furthermore found that the depressed shipping markets pushed shipyard managers to target customers in the power plant contracting, steel production for land based construction, the offshore sector etc.

While the market dynamics created a push for renewal, a more profound transformation of the industry was hindered by the institutional environment. Shipbuilding was an important source of employment in Denmark. As a consequence, the government – strongly supported by the labor unions – kept the shipyards artificially alive through direct subsidies, government orders, and favorable tax schemes (Poulsen and Sornn-Friese; 2011). Interestingly, the government was completely absent in the reconstruction phase that took place after the closures (Kamedula et al. 1987). The vertical integration of the Danish shipbuilding industry also postponed a transformation, as the owners kept the industry alive with cash injections and strategic orders (Poulsen and Sornn-Friese, 2011). It was thus not until after the shipyard bankruptcies of the 1980's and 1990's that the resources were set free from the constraint of the shipyards. In this regard it should be mentioned, that the owners played an important role in securing a controlled downsizing of the shipyards that allowed managers to identify viable activities.

The present paper has mainly explored how internal factors (resources and dynamic capabilities) influenced the transformation of the Danish shipbuilding industry. I found that Danish shipyards were characterized by a very diverse product portfolio. For decades they had developed and produced ship engines, ship designs, ship interior, boilers, power plant installations, and steel sections etc. This meant that they contained resources that could be used for other purposes than shipbuilding. In the 1970's several of these side activities were turned into independent divisions that operated as small firms within the shipyard organizations. When the shipyards closed, these entities did not rely on being part of a shipyard. Divisions were spun-out by shipyard managers, business parks were created by the owners, and smaller spin-offs were created by the employees. Over the next decades, many of these spin-offs successfully applied the resources they had inherited for new purposes. This suggests

that the resources from the shipyards and the strong dynamic capabilities in the industry were important factors in the transformation of the industry.

Conclusion

This paper has explored the transformation of the Danish shipbuilding industry from 1975 to 2015. It has identified 27 spin-offs that continued the activities from the closed shipyards and analyzed how several of these spin-offs have applied the inherent resources in new and more value added activities. Today the spin-off from the Danish shipyards are global leaders in the markets for two stroke ship engines, marine boilers, thermal fluid systems, inert-gas systems, contracting and operating diesel power plants, and software development for the shipbuilding industry. The high reemployment rate, the low level of retraining, and the migration to neighboring sector furthermore indicates that the competencies at the shipyards were useful in other parts of Danish industry. From these findings the paper concludes that the resources at the shipyards and dynamic capabilities in the industry were crucial in the transformation process.

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