1 INTRODUCTION

Fuel economy and reliability have been the principal attributes of large engine for many years. By the year 2000 the emissions issue was becoming important, in anticipation of pending worldwide legislation, all engine manufacturers had ongoing research programs for low emissions diesel engines. In 2001 the idea of a large scale international R&D project on Marine Engines was floated at the CIMAC World Congress in Hamburg. The R&D Programme HERCULES is the outcome of a joint vision by the two major European engine manufacturer Groups MAN and WÄRTSILÄ. In 2002, high-level discussions started between MAN and WÄRTSILÄ with a view of establishing a common thematic set for a joint R&D programme on large engine technologies. By teaming-up there was also possibility of support by the European Union. In the year 2003, a common long-term R&D programme was put forward, planning for 10 years duration and 100 Million EUR research budget, to develop new technologies for marine engines, with general aims: increase engine efficiency, thus reduce fuel consumption and CO2 emissions, reduce gaseous & particulate emissions and increase engine reliability. The HERCULES programme was the first time that these two engine maker groups, which together hold 90% of the world's market, participated together in a project with commonly defined research areas, whilst independently maintaining their specific product development targets.

2 THE HERCULES PROGRAMME

In the year 2004, the Integrated Project HERCULES-A (High Efficiency Engine R&D on Combustion with Ultra Low Emissions for Ships) commenced. HERCULES-B was the Phase II of the Programme from 2008 to 2011 and the HERCULES-C project (2012-2015), was the Phase III. The recently concluded HERCULES-2 was the Phase IV of the HERCULES Programme. The evolution in the thematic content of HERCULES is shown in Figure 1. The Hercules-A project considered a large spectrum of technologies in the three themes of efficiency, emissions and reliability. After assessment at the end of the project, some of these technologies were considered to be dead-ends, whilst others were selected as worth developing further, within HERCULES-B. Different technologies that could be used in combination to achieve the set objectives in efficiency, emissions and reliability were grouped and integrated in the next project HERCULES-C. The HERCULES-2 project considered the issues of long term flexibility in operation and the optimum performance over the lifetime of the power plant.

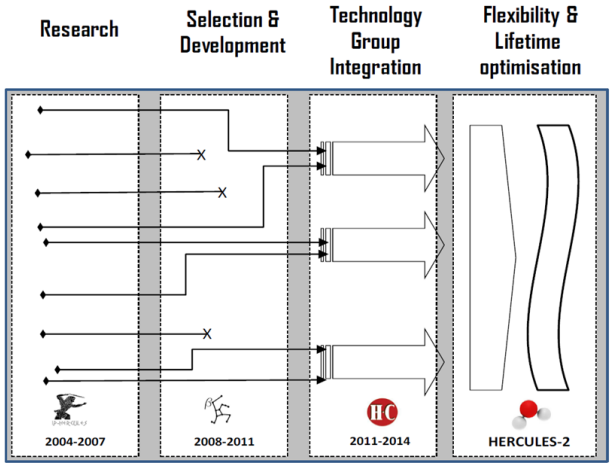

Figure 1. HERCULES-A, B, C to HERCULES-2

The overall timeline of the 4 HERCULES projects is presented in Figure 2. It can be observed that the sequence of the 4 projects was almost seamless.

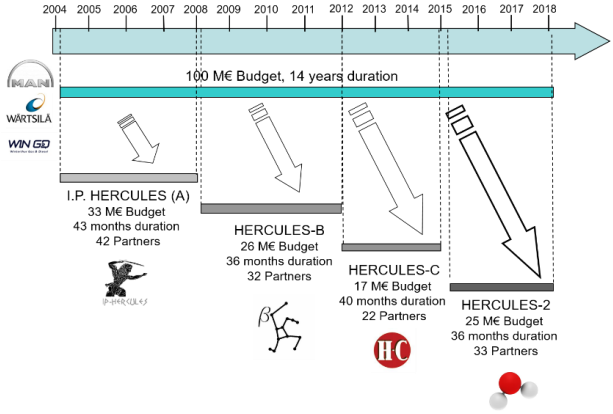

Figure 2. HERCULES Timeline

The progression from each HERCULES project to the next and the links in the R&D themes are shown in Figure 3. It can be seen that starting initially with a wide spectrum of R&D areas, there was a successive filtering, combination and further development of fruitful technologies.

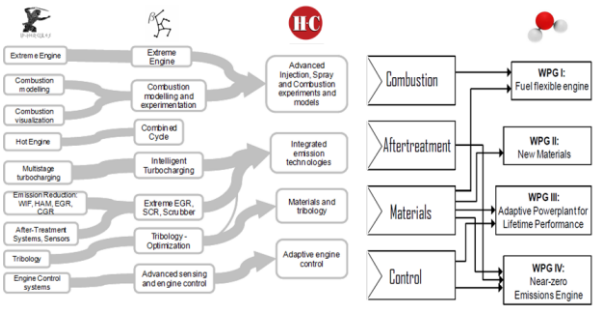

Figure 3. Links from H-A, H-B and H-C to H-2