Projektsammanfattning

Projekttitel på svenska (max 80 tecken) Tillförlitlig lättviktsdesign av gjutna komponenter i tåg och lastbilar	
Projekttitel på engelska (max 80 tecken) Reliable lightweight design of cast components in trains and trucks	
Akronym (max 10 tecken) LIGHTrain	
Erbjudande ☒ Förprojekt ☐ FoI-projekt	Projektet bygger vidare på resultat från ett tidigare projekt ☐ ja, med stöd från Vinnova (Projekts diarienummer: diarienummer) ☐ ja, med stöd från finansiär (avser offentlig finansiering). ☒ nej
Projektet är ☐ i sin helhet samma projekt som har insänts till annan finansiär, nämligen: finansiär ☐ i delar samma projekt som har insänts till annan finansiär, nämligen: finansiär	
Finns uppgifter om affärs- och driftsförhållanden som skulle kunna leda till skada om de offentliggörs ☐ ja ☒ nej	

Sammanfattning (max 1500 tecken) – *Denna ska skrivas så att en extern bedömare ska kunna förstå syftet och innehållet i projektet.*

Förprojektet LIGHTrain har som mål att utveckla tekniska verktyg som gör det möjligt att effektivt minska vikten på konstruktionsgjutna komponenter. Detta har betydande fördelaktiga effekter för transporteffektivitet, tillverkningskostnader samt miljön vid tillämpning på järnvägs- eller vägfordon. Tre motstridiga mål måste beaktas samtidigt: 1) Optimerad vikt, 2) Utmattningshållfasthet och 3) Gjutbarhet. Med topologioptimering är det möjligt att bestämma den mest optimala konstruktionen genom att ta bort underutnyttjat material, men de motstridiga målen för utmattningshållfasthet och lättviktskonstruktion utgör fortfarande en teknisk utmaning. Svårigheten ökar när krav från gjutningsprocessen beaktas, speciellt eftersom restspänningar som härrör från gjutningssekvensen påverkar utmattningslivslängden. Detta förprojekt syftar till att utveckla en preliminär optimeringsmetod som underlättar lättviktsdesign med krav på utmattningslivslängd och gjutbarhet. Arbetet kommer att utgöra grunden för ett FoI-projekt som syftar till att utveckla en generell process för att integrera både kraven på utmattningshållfasthet och gjutbarhet, tidigt i lättviktsoptimering av gjutna komponenter. Projektpartnerna, ledda av Bombardier Transportation i samarbete med Ausferritic AB, Scania CV AB och KTH hållfasthetslära, representerar tågutveckling, avancerad materialutveckling, lastbils- och bussutveckling respektive akademisk forskning inom hållfasthetslära.

Sammanfattning på engelska (max 1500 tecken)

The pre-project LIGHTrain is devoted to development of engineering tools that make it possible to efficiently lower the weight of structural cast components. This has strong beneficial effects for transportation efficiency, manufacturing costs and the environment when applied to rail or road vehicles. There are three conflicting objectives that must be considered simultaneously: 1) Optimized weight, 2) Fatigue life and 3) Castability. Topology optimization has the potential to find the most optimal design by removing under-utilised material, however, the conflicting goals of fatigue resilience and lightweight topology remain a true technological challenge. The challenge increases when the requirements of the casting process are considered, particularly as residual stresses resulting from the casting sequence will influence the fatigue life. This pre-project aims to develop an initial optimisation methodology that facilitates lightweight design within the constraints of fatigue and casting requirements. The work will lay the foundation for a full project aiming at the development of a general process for incorporating fatigue requirements and casting constraints early in the lightweight optimization of cast components. The project partners, led by Bombardier Transportation with Ausferritic AB, Scania CV AB and KTH Solid Mechanics, represent train development, advanced material development, truck and bus development, and academic solid mechanics research respectively.

Startdatum	Slutdatum
1/11-2017	1/8-2018
Totalt sökt stöd (SEK)	**Total medfinansiering (SEK)**
500 000	642 500

1. Project Idea

Many sectors of Swedish industry are reliant on cast iron structures. Lightweight design of such components is typically constrained by durability requirements and the need to avoid fatigue failure. Although topology optimization is being increasingly used in many applications, and optimization with fatigue constraint is an active research field, the integration of fatigue life considerations combined with the constraints of the casting process in the topological optimisation process remain challenging and is heavily reliant on the experience of the individual designer. This project aims to develop an initial methodology for incorporating fatigue life requirements and casting constraints early in the topology optimisation of cast components. This development of a clear methodology for lightweight design optimisation will help to lower costs and shorten development times. The methodology will be documented and is expected to be applicable across a wide range of industrial sectors. It is envisaged that this work will be continued in a full Vinnova project with development and validation of this methodology in different industrial settings in cooperation with a range of commercial partners.

2. Project contribution to program objectives

There are clear similarities in the design constraints for large castings used in Bombardier Transportation's rail vehicles and Scania's road vehicles. The proposed process with simultaneous consideration of both fatigue life and castability requirements in the lightweight topological design aims at reducing the time required for optimisation and facilitates design decisions. Furthermore, there are clear environmental benefits in reducing the weight of such vehicles. The methodology will be tested by assessing the fatigue life of a prototype electric railway traction motor housing where a 25 % decrease in weight is targeted. A new design using the existing ductile cast iron will be produced and the potential for further weight reductions will be investigated using new advanced ausferritic materials and bi-metallic casting. The final Technology Readiness Level of this pre-project is therefore related to both concept development as well as validation in laboratory environment. The developed methodology will also be used for educational purposes in an advanced design course at KTH.

3. Project team

The project contains challenges of industrial importance as well as current academic issues. The four partner organisations involved represent train development and production (Bombardier Transportation AB), truck and bus development and production (Scania CV AB), advanced materials development (Ausferritic AB) and academic solid mechanics research (KTH). The collaboration between these partners aims at the industrial application of the newest solution strategies from the research community. The proposed development of design guidelines through collaboration with KTH effectively bridges the gap between industry and academia whilst allowing further advances in the topology optimisation methodologies pioneered at KTH. In addition, the new advanced materials developed by Ausferritic AB will be utilised to explore new possibilities in the lightweight design of cast components.