

# Danish SMEs can unlock modular potential with AI

**Adaptable products, low complexity in the value chain, and an improved bottom line. These are just some of the numerous benefits that companies can achieve with a modularization strategy. Many large companies, both in Denmark and abroad, are starting to realize that modularization is a lever for competitiveness - and some of them are already reaping the rewards of their modular endeavors. Danish SMEs, on the other hand, do not see the same level of progress: Many have limited know-how and many face challenges when trying to convert their modular ambitions into targeted and executable initiatives. With artificial intelligence (AI) as a springboard, the AIMO project will introduce a range of new approaches and technologies to support modular product development and calculate how modularization affects overall costs in a company. The aim is to give Danish SMEs guidelines and tools to ensure a solid modularization journey.**

There are several reasons why it can be particularly challenging for a small or medium-sized company to implement modularization: Limited knowledge and resources to hire new employees or external consultants with modular expertise are common entry barriers. Another widespread hindrance for SMEs is time, as employees typically handle multiple tasks and responsibilities, which makes everyone a crucial part of the daily operations. This creates poor opportunities to carry out a modular development project on the sideline of core production efforts.

"If you have infinite resources, you can choose to redesign all your products from start to finish, but that's not the reality for most companies," says Carsten Keinicke Fjord Christensen, project manager in AIMO.

The fact that SMEs often find themselves forced to deprioritize or abandon their modular ambitions before they even get off the ground indicates a need for new approaches and tools that are tailored to companies that wish to embark on modularization but are challenged by sparse knowledge, resources, and time.

In a company's efforts to optimize operations, there is also a pitfall in narrowing down the focus to direct costs, such as salaries and materials. If one overlooks how a modularization strategy can reduce costs throughout the rest of the company, it creates an incomplete understanding of the overall cost savings that the strategy can enable. In other words, a significant savings potential may go unnoticed if a company does not approach modularization and optimization with a holistic perspective.

Research in new production technologies indicates that artificial intelligence is an effective tool to support modularization. AI can, among other things, be used to provide an overview of the financial benefits (including cost savings) that a modular strategy is expected to generate in a company. With such estimates, the prerequisites for setting realistic goals for the modularization journey are increased, and AI can also act as a helping hand in the development of modular products. For Danish SMEs, artificial intelligence can therefore be the key that unlocks the many competitive advantages that can be achieved with modularization throughout the value chain. This is what AIMO aims to pave the way for.

**AIMO = AI + MODULARIZATION**

## AI helps engineers make superior choices

Companies can utilize AI to support modularization in various ways. One of them is to create cases for product components that compare the impact on a product's costs and lifespan when using either a standardized component (modular design) or a component without a standardized interface (traditional integrated design). In most cases, modular design proves to be the superior choice, and the AI case helps make the benefits tangible. This can provide reassurance when embarking on the modularization journey and increase the incentive to get started quickly. Based on data on costs and savings potentials across a company, AI can also be trained to recognize different product components and suggest alternatives that are less costly and more sustainable to produce.

When applied correctly and mindfully, AI contributes to making a company's processes more transparent and its expertise more practically applicable because artificial intelligence automates the time-consuming and resource-intensive task of manually selecting the right information from a sea of data. The various departments within a company (sales, procurement, production, etc.) typically possess unique insights that should ideally be considered in each product development process but are often deprioritized to save time and resources. This sometimes happens at the expense of efficiency and quality. By converting the departments' specialized knowledge into data that is directly linked to the products in an IT system, AI can provide estimates of the effects that specific choices in the product development process have on the rest of the company. This can include aspects such as finances and work hours, where it may turn out that a product that is easy to design and produce is not necessarily the best solution when considering factors like procurement, sales, and service. As such, AI can be used for impact estimation to prevent unwelcome surprises later in the product's lifecycle.

## HOW AI CAN SUPPORT A MODULAR STRATEGY

- AI can automate calculations and evaluations that provide insights into how different decisions affect different departments within a company.
- AI can recognize virtual 3D models of products and components, enabling comparisons of different solutions and suggesting the best available alternative.
- AI can associate expected costs from across the company with the products in a database, such as material costs, procurement costs, and actual as well as potential labor hours throughout the product's lifecycle.

Although AI can offer perspectives that an engineer may not have considered, it is ultimately the engineer who initiates a project, makes the final decisions regarding a product's design, and performs quality control on the proposals and results generated by AI models. Artificial intelligence cannot replace human labor or expertise and should instead be regarded as an addition to engineers' existing knowledge, expanding the solution space, and enhancing the prerequisites for making decisions that are profitable, sustainable, and reduce the workload across the company. This saves time in the short term but also facilitates access to knowledge that typically requires years of experience to acquire. This can help newly arrived engineers fulfill their potential and create value in their companies quicker.

## Finding the right approach

Ultimately, there are costs associated with transitioning to a modular business strategy. Therefore, there is significant value in getting indications of how modularization can facilitate savings that can offset the expenses. Artificial intelligence can provide insights in this regard, just as AI-generated calculations can indicate which areas within a company hold a particularly large potential for modularization - and thus particularly advantageous to focus efforts on. This is a significant asset to have at hand, as limited benefits and slow progress are among the potential risks when a company's endeavors focus on areas with limited potential for modularization.

In collaboration with four Danish SMEs, AIMO's project team is testing how the combination of business insights and AI-generated calculations can support and facilitate implementation of modular principles. The companies all belong to the industrial sector but differ from each other in products, size, and sales numbers. So far, the activities in the project have indicated that each company can reduce costs through modularization, albeit in widely different ways. This underscores an important point: Different business models require different approaches, and a company should always adapt its modular strategy, efforts, and ambitions based on its own characteristics. There is no one-size-fits-all solution for successful modularization, but one rule of thumb is nearly universally applicable:

"Most companies need to take it one step at a time: Make a plan and gradually work towards modularizing their product range," says Carsten Keinicke Fjord Christensen and continues:

"It can, however, be a significant challenge to figure out where to start and in which direction to go. Therefore, AIMO aims to explore and clarify what is wise to do for companies that are to embark on their modularization journey."

In the current phase of the project, all activities surrounding AI models are based on products and parts that already exist in the case companies' respective portfolios. The focus is on specific parameters that can be utilized to achieve savings, e.g., product parts that use the least amount of material. Later, the AI models will be expanded to also include offerings of products and parts from other databases, which is to be used when developing modular product solutions. These databases are already available to the case companies, so the goal of implementing AI is to automate the search process, making it easier and faster to find less costly and more sustainable alternatives from subcontractors.

## MAIN PRIORITIES IN AIMO

**To develop methods for estimating variant costs for lifecycle costs across the value chain**

**To facilitate sustainability by suggesting better alternatives in product design phases**

**To implement and test prototypes of design assistance tools in four case companies**

A core characteristic of the AI technology used in AIMO is that it bases its calculations and proposals on data that the case companies already have access to and full control over. Unlike AI language models (e.g., chatbots), the data processing occurs in a closed system, ensuring a high level of security. Unknown and potentially questionable sources cannot be included in the analyses and the risk of information leakage remains very low.

AIMO (2022 - 2025) is executed collaboratively by Danish universities [DTU](#) and [AU](#). The project is owned by the [North European Modularization Network \(NEM\)](#) and funded by [Industriens Fond](#) and [Thomas B. Thriges Fond](#).

