

In the last years, DCSC has funded hardware local computing centres which have helped to establish and develop HPC competences in major Danish Universities. DCSC centres have also provided local support for researchers which would have been otherwise centralized and, consequently, far from the end users.

The main importance of establishing the DCSC centres at universities was to create local competences in computational science where these were not present at the time. Local support for the researchers has been instrumental, and it has indeed worked well as intended. Today strong research groups, taking full advantage of modern HPC systems, are present in all major universities.

Even if DCSC centres have been instrumental in the past and they still provide a good local support structure, they have some important intrinsic limitations as HPC facilities:

1. **Fragmented HPC landscape**

Even in the biggest DCSC centres no single high-capacity machine is present. DCSC centres hosts literally tens of small HPC systems. Denmark is very rapidly losing contact with high-end computing. *No single public Danish machine is present* in the current [Top500 list](#) of supercomputer's sites, and only one in the industry which however is quite low in the list (#153). This should be compared to 3 sites in Norway, 6 in Sweden and 3 Finland. While smaller clusters can suit the majority of researchers' needs, bigger projects simply cannot be accommodated within this framework, and Danish researchers are forced to seek resources beyond the national borders (e.g. through PRACE).

2. **Sharing of resources is impossible**

Also due to the past funding model, with hardware grants given to specific projects, it is nearly impossible to share HPC resources among users of different DCSC centres or even among user of the same DCSC centre, barring initial agreements among the users themselves.

3. **Increasing operating costs**

The ever increasing complexity of the local DCSC centres with many, diverse computing architectures acquired over the years, translates directly into high operating costs for cooling, electricity and staff required to manage the hardware.

A national HPC centre of high-international profile is in perfect line with the stated DelC's strategic goals to "ensure national development of e-Infrastructures at an international level" and "develop and deliver services at a national level" and it would overcome all the above drawbacks, while providing substantial benefits:

1. Danish competitiveness for research and industry

National HPC infrastructures are considered a strategic investment in all of the most developed economies in Europe, USA and Asia in view of the clear correlation between investment in such infrastructure and long-term growth.

A national HPC centre will boost the competitiveness of Danish research and industry with strategic benefits for society.

SME as well as bigger industries can easily benefit from the presence of such a national infrastructure for innovation and rapid development of the most diverse products, from design to chemicals, as demonstrated in many other countries with similar facilities.

2. New possibilities for e-Science

An high-profile national centre would provide a much more flexible solutions to researchers. While still able to accommodate smaller projects, a large national installation allow Danish scientists to be competitive with large projects at international levels.

3. Common resources

A common pool of shared resources guarantees an optimal utilization of national resources. National calls for projects can be made at regular intervals for scientists. A simple and efficient business model can be set up also allowing the industry to access to the machine.

4. Reduced costs

All around the world, larger facilities are proven to be much more cost-effective, i.e larger installations significantly reduce operating and maintenance costs compared to many smaller facilities with the same total capacity. It is not by accident that national HPC infrastructures are present in the vast majority of European countries, USA, China and Japan and many others.

5. **New national skills**

Access to state-of-the-art technologies, otherwise too expensive to acquire and operate for single institutions, is crucial for Denmark's long term competitiveness and innovation capacity. Not only a common, national solution is often the only viable way to get access to expensive technologies, but it also guarantees maximum benefits among all the potential users across Denmark.

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