



INTRODUCTION

Headquarters



Executive Committee

Jørgen M. Clausen
President & CEO

Niels B. Christiansen
Vice CEO

Kim Fausing
Executive Vice President & COO

Frederik Lotz
Executive Vice President & CFO

Corporate
Functions
&
Services

Danfoss
Ventures

Danfoss Refrigeration & Air Conditioning Division

Kjeld Stærk
President

Danfoss Automatic Controls

Danfoss Compressors

Danfoss Electronic Controls & Sensors

Danfoss Heating Division

Nis Storgaard
President

Danfoss Comfort Controls

Danfoss District Heating

Danfoss Burner Components

Danfoss Floor Heating

Danfoss Heat Pumps

Danfoss Water Controls

Danfoss Motion Controls Division

Sven Ruder
President

Danfoss Drives

Danfoss Gearmotors

Danfoss Silicon Power

Danfoss Solar Inverters



Owner share
38.2%

Danfoss Services Division

Roland Fritsch, President

Danfoss Global Business Services

Danfoss Industri Service

Danfoss IT

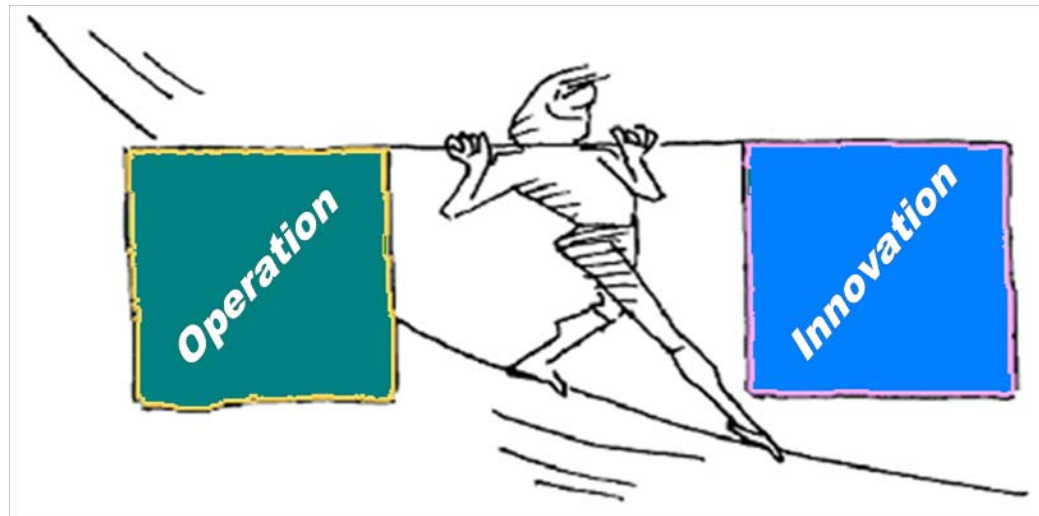
Group figures

- Danfoss is a family-owned, global company (no public shares, but approx. 3% employee shares)
- Net sales 2007: EUR 2,900 mill
- Employees: 22.323 worldwide (January 2008)
- Production of 250,000 items per day

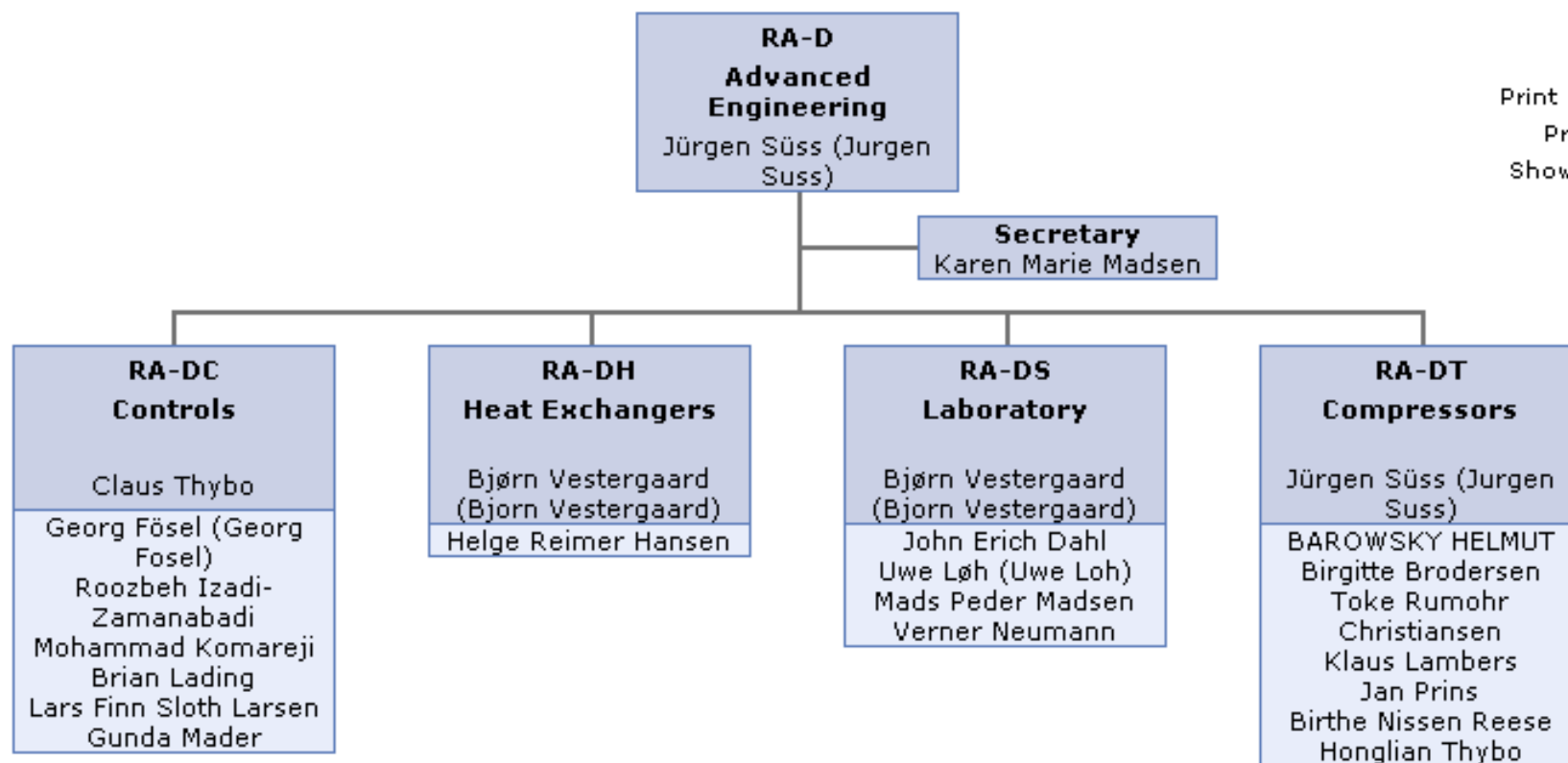
	Europe	North America	Latin America	Africa	Asia	Pacific	Total
Manufacturing sites	50	12	2	1	5		70
Sales companies	83	10	5	1	13	2	114
Agents and distributors							~115

Advanced Engineering RA-D

2008 RA-D Priorities



Organisation

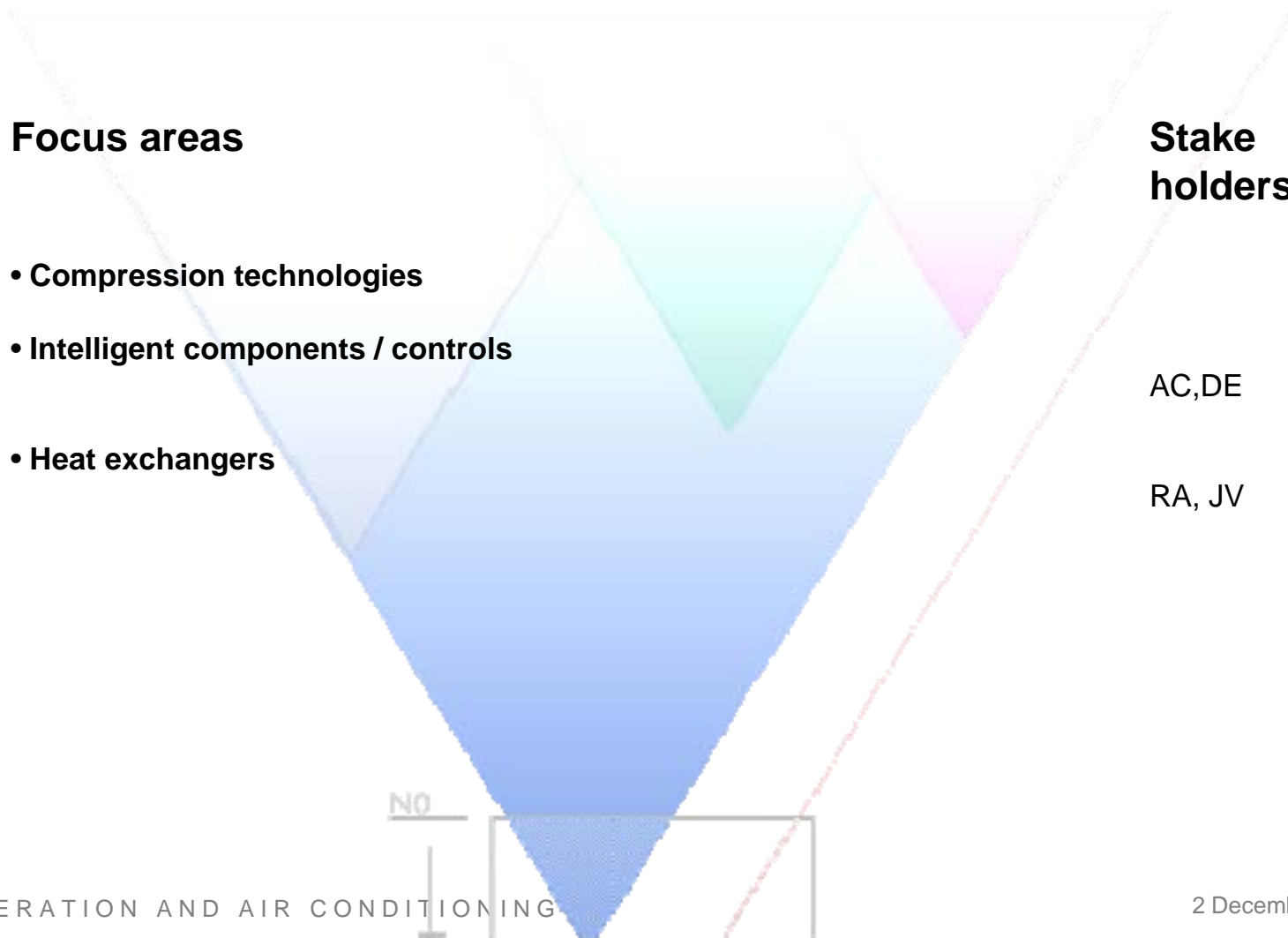


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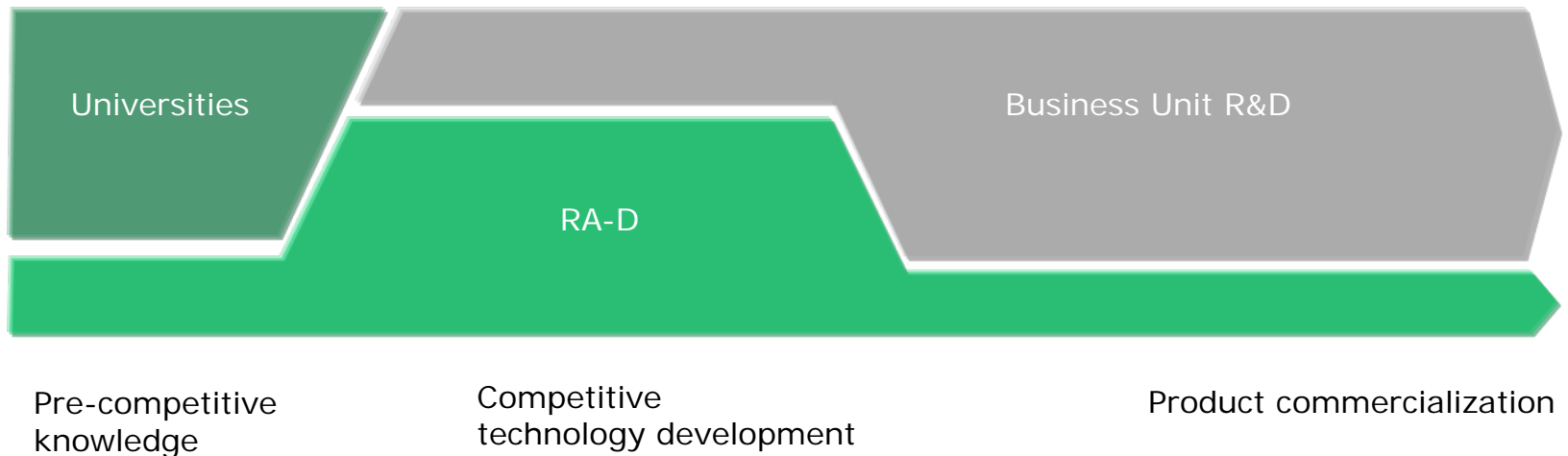
- 
- **Technology development**
 - **Consulting**
 - **Exploit internal and external synergies**

NO

RA-D focus areas, related projects & stake holders



RA-D's structured process for transforming pre-competitive knowledge into profit



RA gets out of the process...

- the relevant technologies at the right time
- to know what is the cutting edge in the industry
- the opportunity to recruit the best candidates

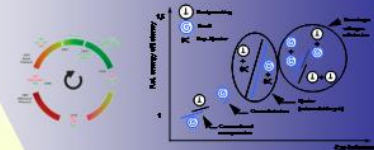
RA-D

BU

Focus on Environment and Efficiency



Generate Strategy for Systems, Refrigerants &



Components



Discovering

Prototyping

Commercializing

Screening

- CO₂ compressor
- Supermarket refrig. System FDD
- CO₂ Valve
- Refrigeration Cassette
- Rotary compressor
- Check valve
- CO₂ Heat Pump
- Heat Exchanger
- Distributor valve
- Automatic Mapping of Turbo Compressor
- Compressor cycling reduction
- Semi-hermetic compressor
- New scroll geometries
- Three cylinder CO₂ compressor
- Economizer cycles
- Voorhees concept
- Two phase cooling Vortex tube
- Wind driven heat pump
- Ejector cycle
- Magnetic cooling



- Universities
- Politics
- Research centers
- Customers
- Market
- Conferences
- BA's

Generation of product related know-how

Generation of Strategic Knowledge

RA-D

Management

AC DC DE

Joint projects with MC

Ventures

Joint projects with HE

Branding Danfoss as global technology leader

Secure Danfoss freedom of action

- Conferences
- Cooperation with customers
- Projects with universities
- Publications
- Patents
- International organizations
- Technical publications

Market challenges

We are mainly a component manufacturer, but we also make subsystems

- Our controllers are application specific, but general purpose within the application. Hence we know the generic type, but not the specific type of components.
- The installer is typically an independent refrigeration installer that employ all brands of controllers.
- The installation costs is likely to exceed the cost of the controller.
- We are mass producing the components in a competitive market.

Market challenges

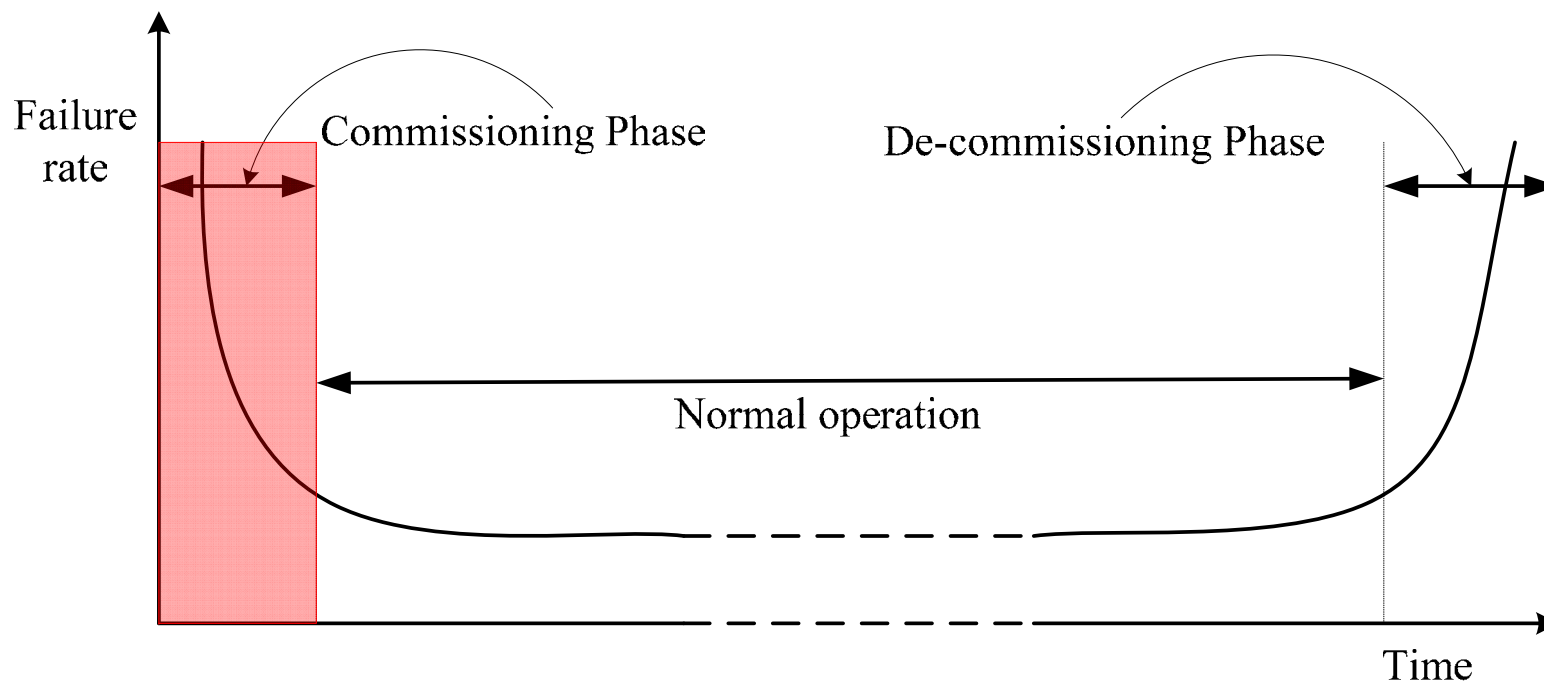
To gain market advantages we need to focus on the lifetime cost of the components

- Commissioning costs are in the same order as the control system
- Faulty configurations are very expensive (food quality as well as energy consumption) and questions the quality of our refrigeration control systems

Hence,

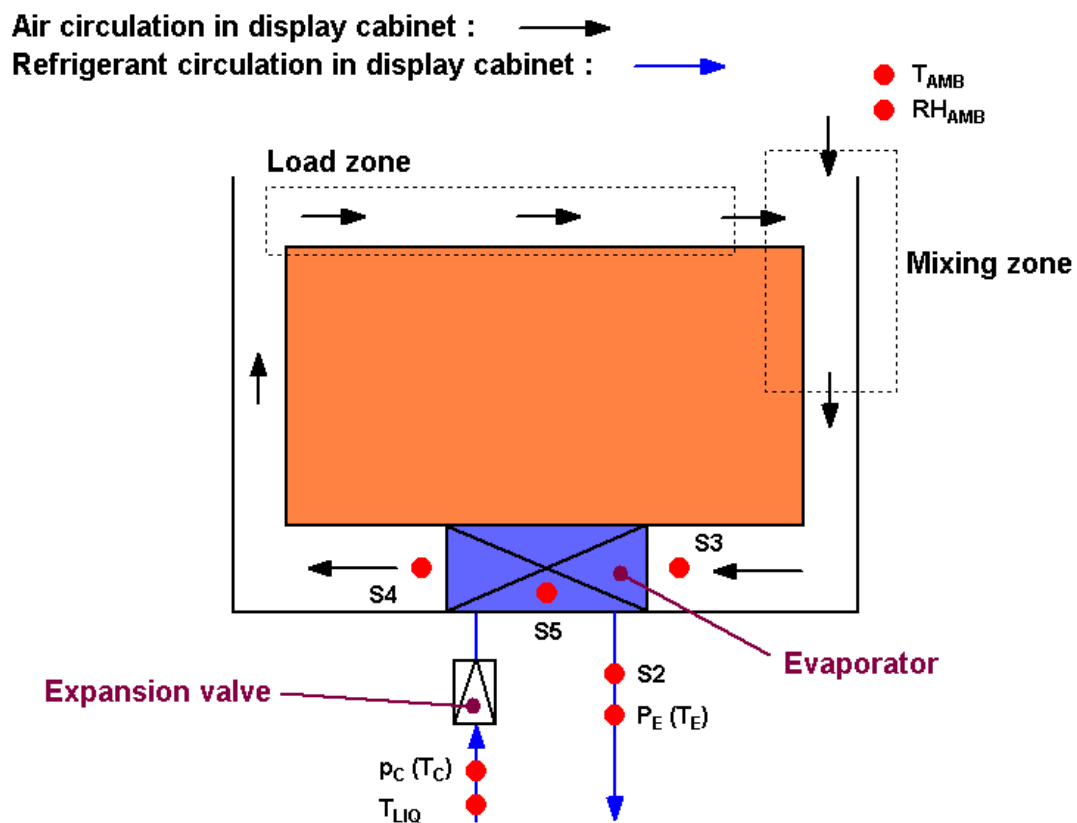
- We need to reduce the configuration/installation time and reduce the number of faulty installations to gain competitiveness.

Failure rate



A simple example

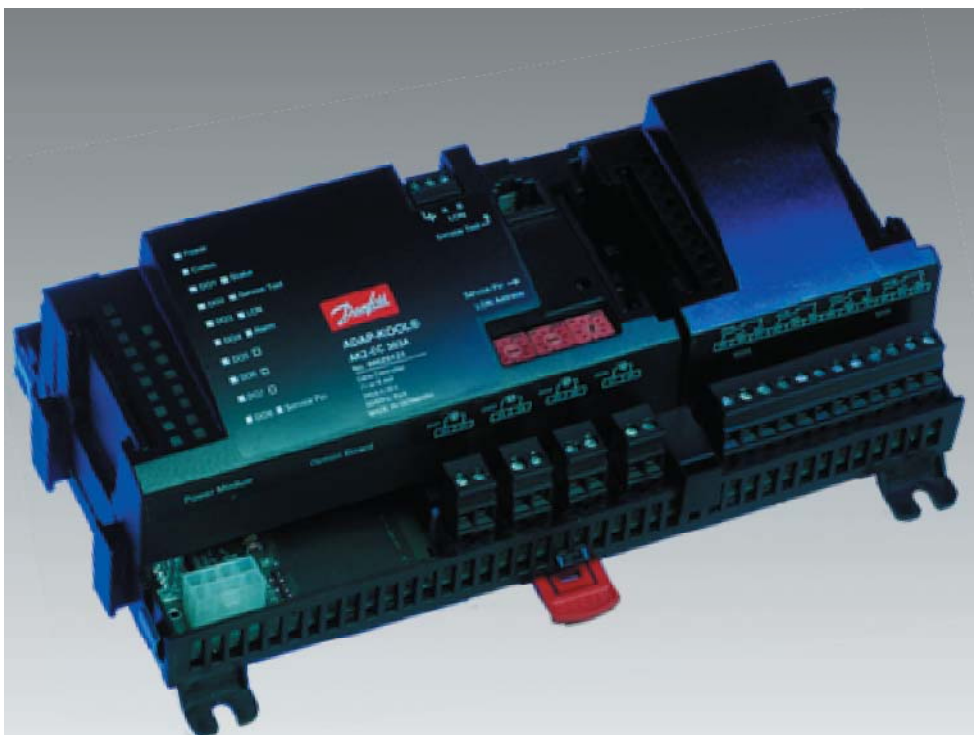
– a supermarket display case



A simple example

– a supermarket display case

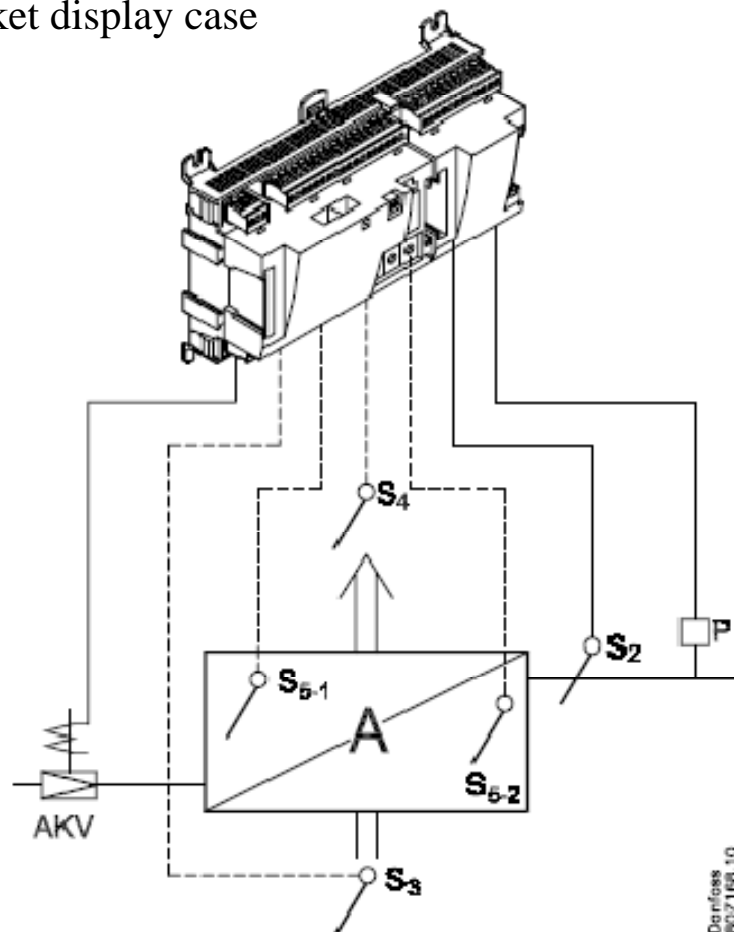
The controller



A simple example

– a supermarket display case

- wiring of the controller
- a controller handles 1-4 evaporators.



A simple example

– a supermarket display case

A simple application example – a supermarket display case

Problems

- A sensor is not connected -solved
- A temperature and pressure sensor are switched -solved
- Two temperature sensors are switched
 - on the same evaporator -unsolved
 - on different evaporators -unsolved
- A wrongly placed temperature sensor -unsolved

Theoretical challenges

- Generic (and robust) solution is desired
→ Depends highly on the type of model abstraction
- Applications exhibit nonlinear behaviour
- Hybrid dynamics (different actuators, when active, change the dynamic behaviour of the system -).

----- Additional challenges -----

- Software complexity (have not looked at yet):
 - Different modes of Operation \leftrightarrow faults' diagnosability (and vice versa)
 - New code representing new functionality is added (how does it affect the existing functionality and vice versa).
- Plug & play requirements:
 - Software/Hardware architecture that can deal with it.
 - Controller design and analysis

Conclusions

Objectives

To develop concepts for automatic configuration validation of systems during commissioning and service.

Vision

To enable a dramatic reduction in commissioning cost related to configuration validation of sensors and actuators in refrigeration systems.

Added value:

- Increased installer confidence in controller ability to achieve first time setup success

- Increased supermarket management confidence in the ability of Danfoss controllers to reduce extended commissioning time

- Decreased life-time cost due to more efficient service and commissioning process

Summary

- Components for control (mass production) in large networks are different than dedicated control applications
- Efficient use is of paramount importance. Automated configuration validation is one approach that addresses this issue.
- Sensors are getting cheaper, but we need to address the commissioning efficiency to gain competitiveness.