

# Asset Management Operation and Maintenance of State Roads in Denmark

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# Asset Management – Operation and Maintenance State Roads in Denmark

**Michael Ebbesen**

Director Operation and Maintenance  
State Roads, Danish Road Directorate



# State Road Network i Denmark

Consists of **3.820 km\***

**1.243 km** of which are motorways

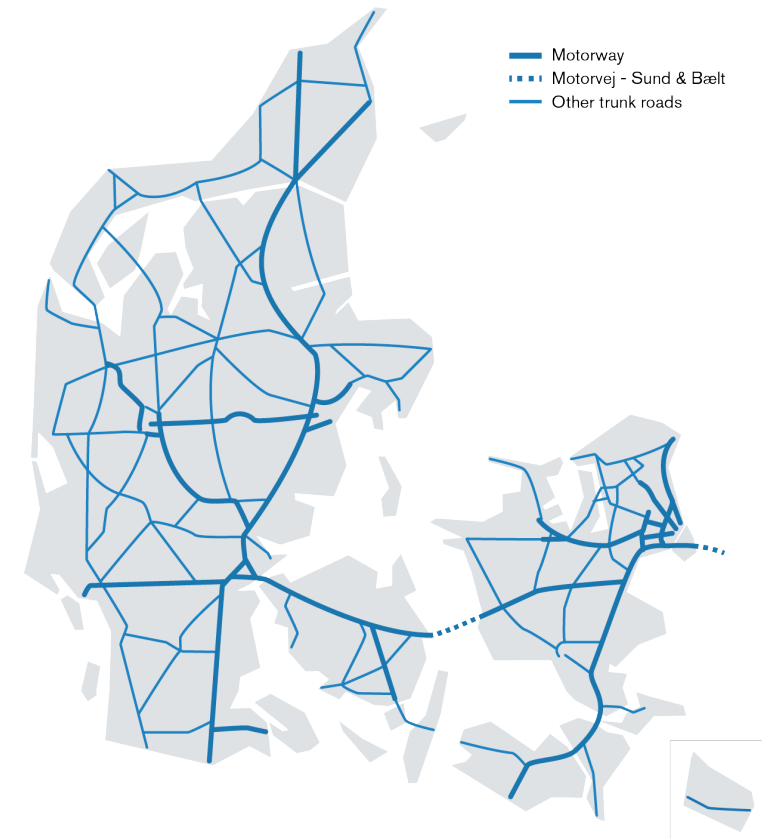


- 2.500 small structures.
- 2.300 retaining walls, gantries etc.
- 70 large bridges and tunnels.

This corresponds to approximately  
of the total public road network  
in Denmark (appr. 75.000 km) **5%**

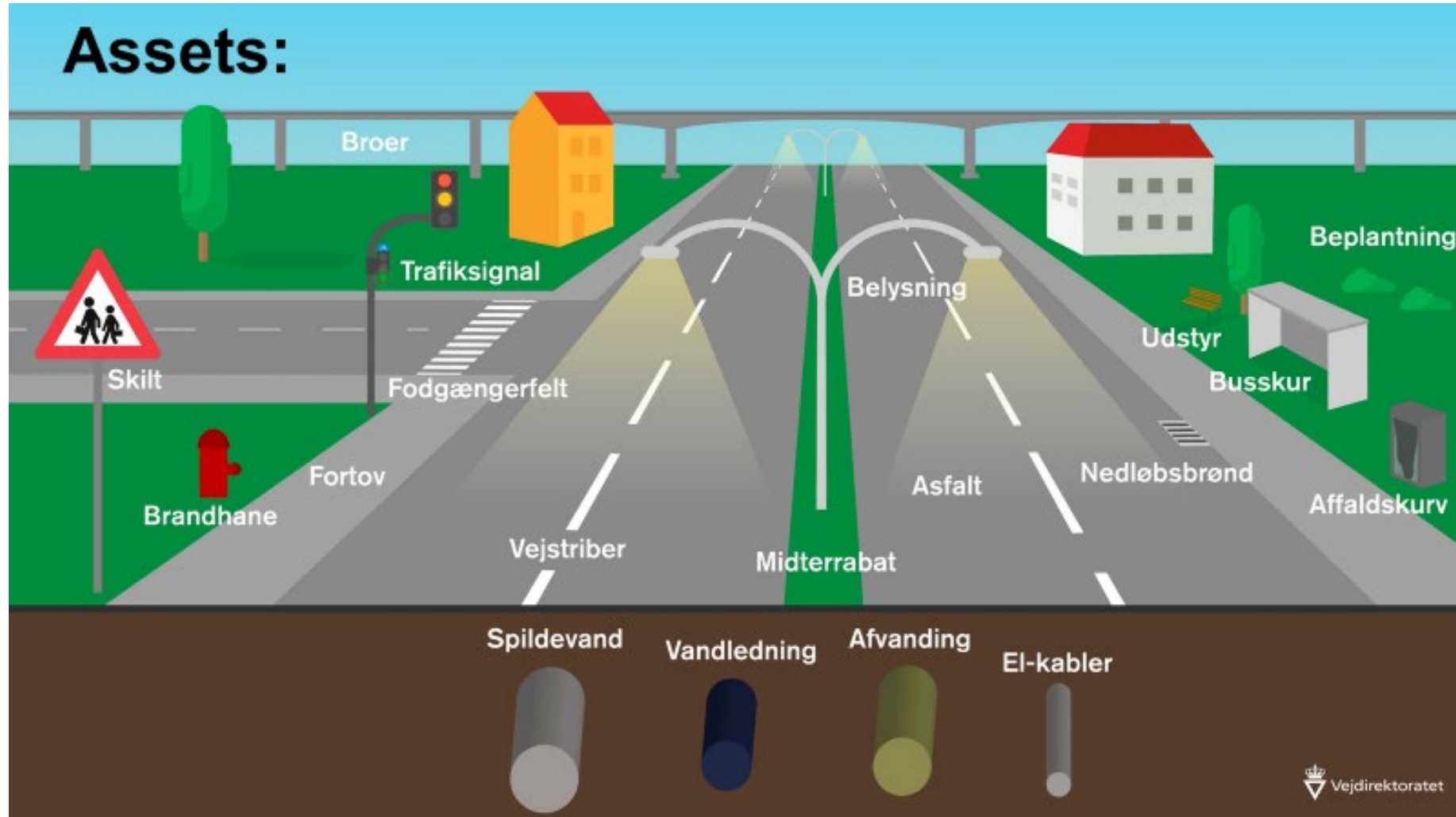


Approximately  
of road traffic runs on  
the State road network **47%**



\* Eksklusive Sund & Bælt Holdings 41 km

# State Road Network consists of many assets!



# Capital Value in State Roads

The value of the state's roads - **the road capital** - is in 2024 assessed to more than **DKK 300 billion...!**

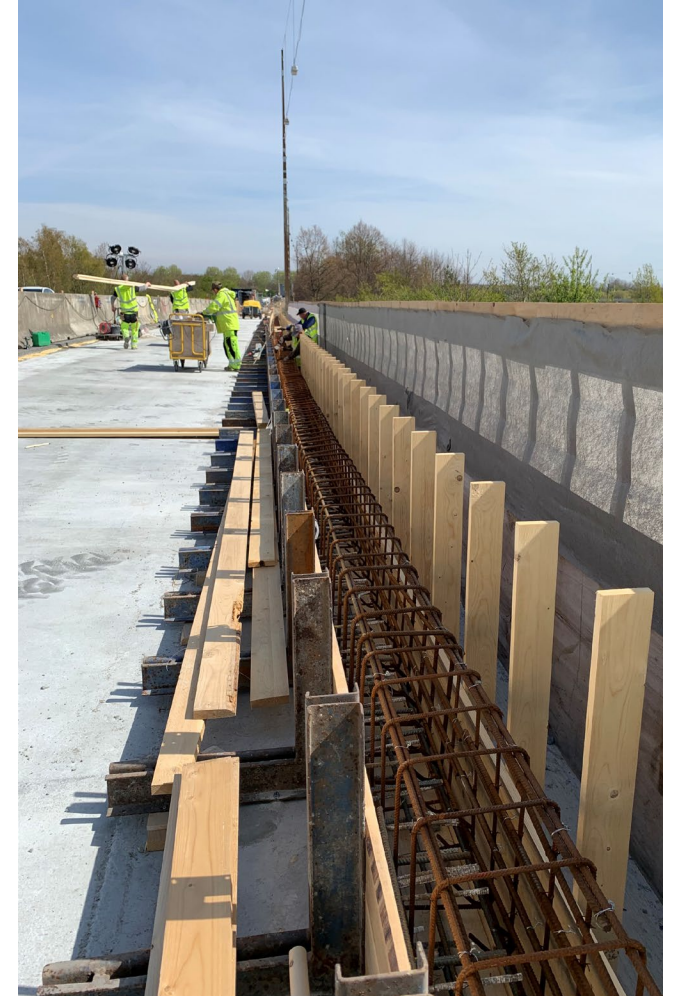
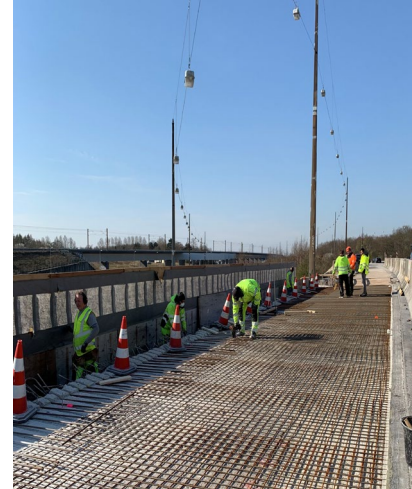
- Structures alone account to more than DKK 50 billion...!



# Need for Operations and Maintenance in the coming years

The **next 10 years**, an estimated need of approx. **DKK 22 billion** has been identified for **operations and maintenance**

- approx. DKK 10 billion for routine operations and winter services
- approx. DKK 12 billion for capital-preserving maintenance



# Asset Management – Operation and Maintenance



Ensures functionality and service level

Routine Operations



Preserving capital value

Maintenance

# Before Asset Management - reflections

Working with Operation and Maintenance - "**as we used to do**" - means typically a risk of focus on individual assets or asset groups:

- Could result in a **fragmented effort**
- Risk of **sub-optimization, lack of overview** of maintenance needs and budgets

An **unclear picture** (not transparent) of the total needs is **difficult to provide to the Ministry of Transport and Ministry of Finance**

**Risk for build-up a maintenance backlog!**

# Asset Management - reflections

Asset Management **focus on the performance** of the state road network:

- **Common approach → Clear common goals → Decisions to be based on data and facts**

**Minimize the total costs** for Operation and Maintenance for the entire portfolio in the long run:

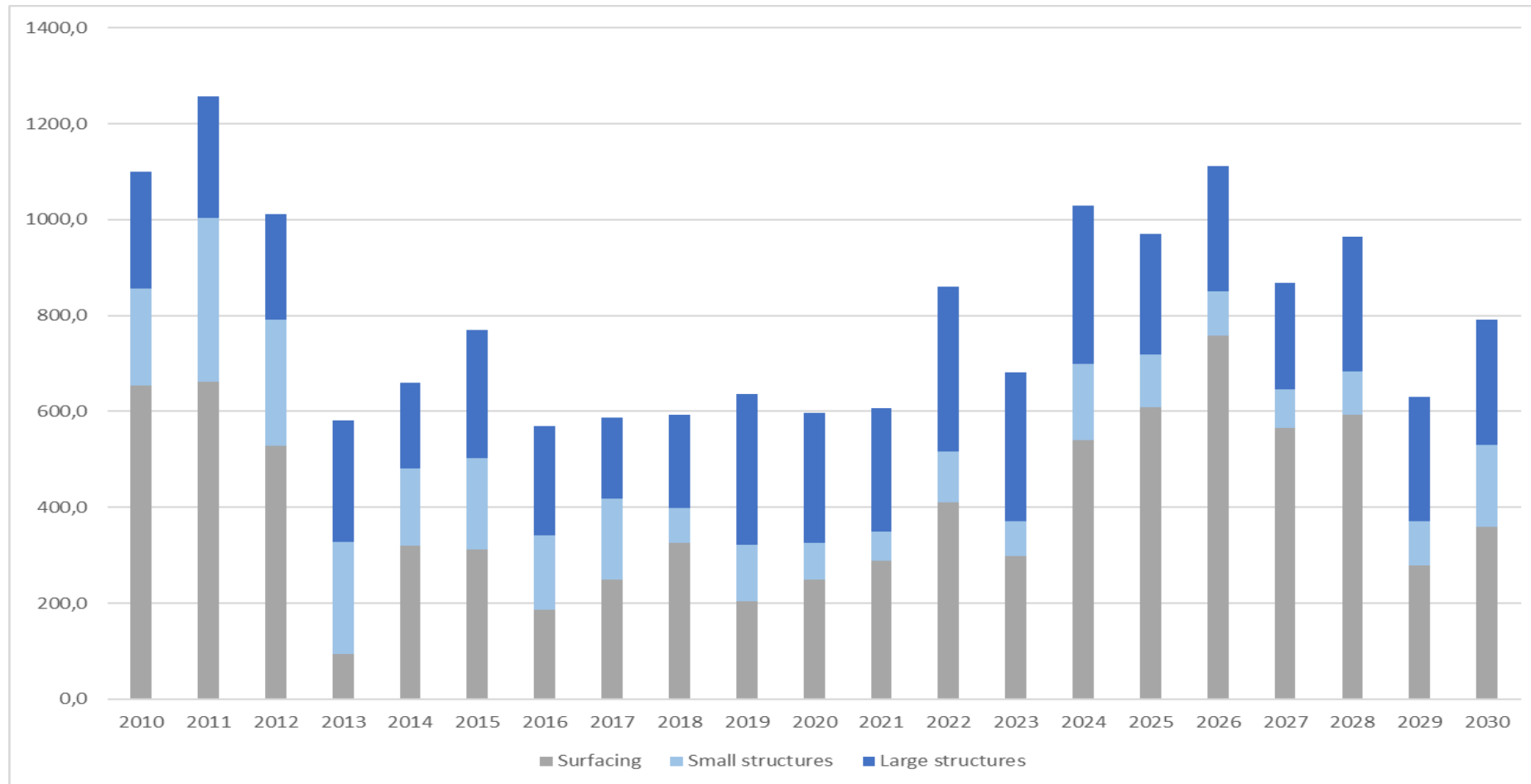
- **Condition + Degradation → Timely maintenance → Consequences** of postponing maintenance work

**Planning and prioritization** of Operation and Maintenance:

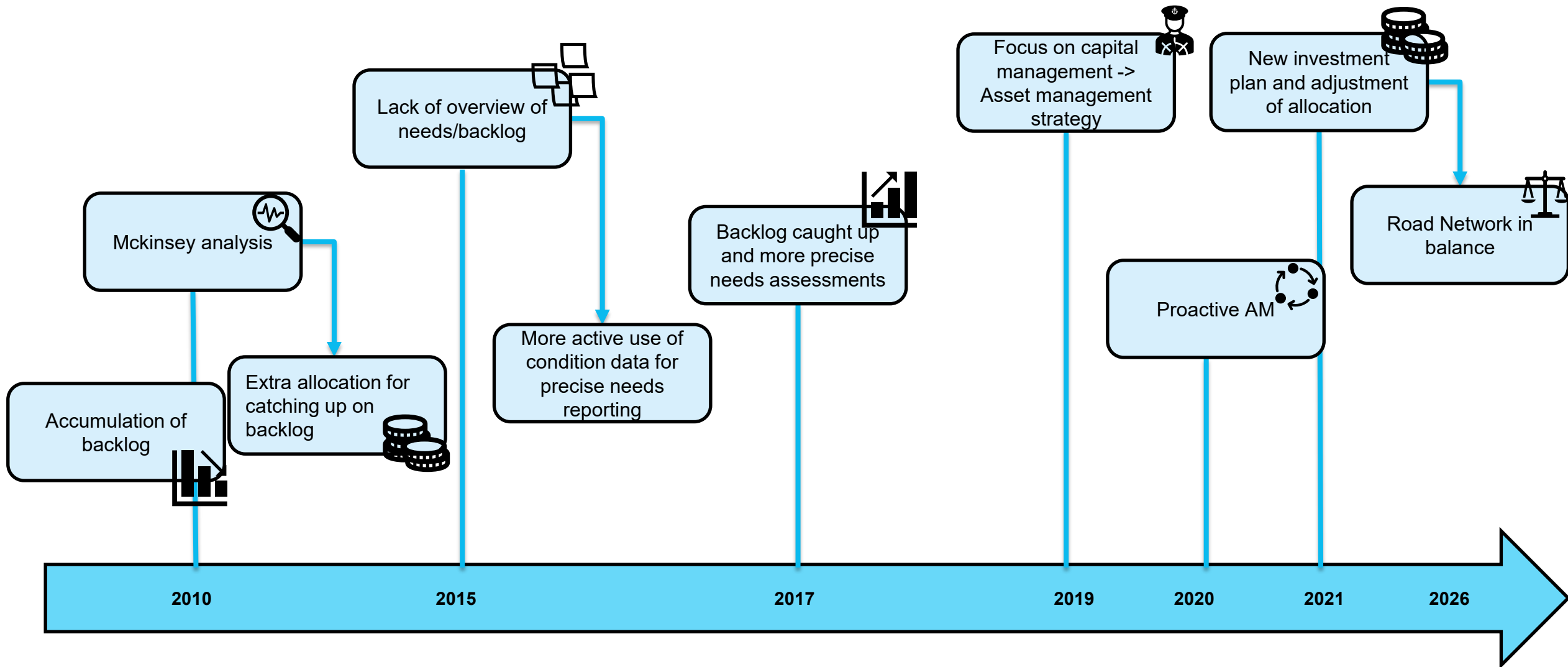
- **Total asset portfolio → Clear criteria across assets → Both technical expertise and capital management**

# Variable maintenance needs

## – viewed over a 20-year period, 2010-2030



# The Asset Management timeline, DRD



# Asset Management ambition



The goal within the given framework is to:

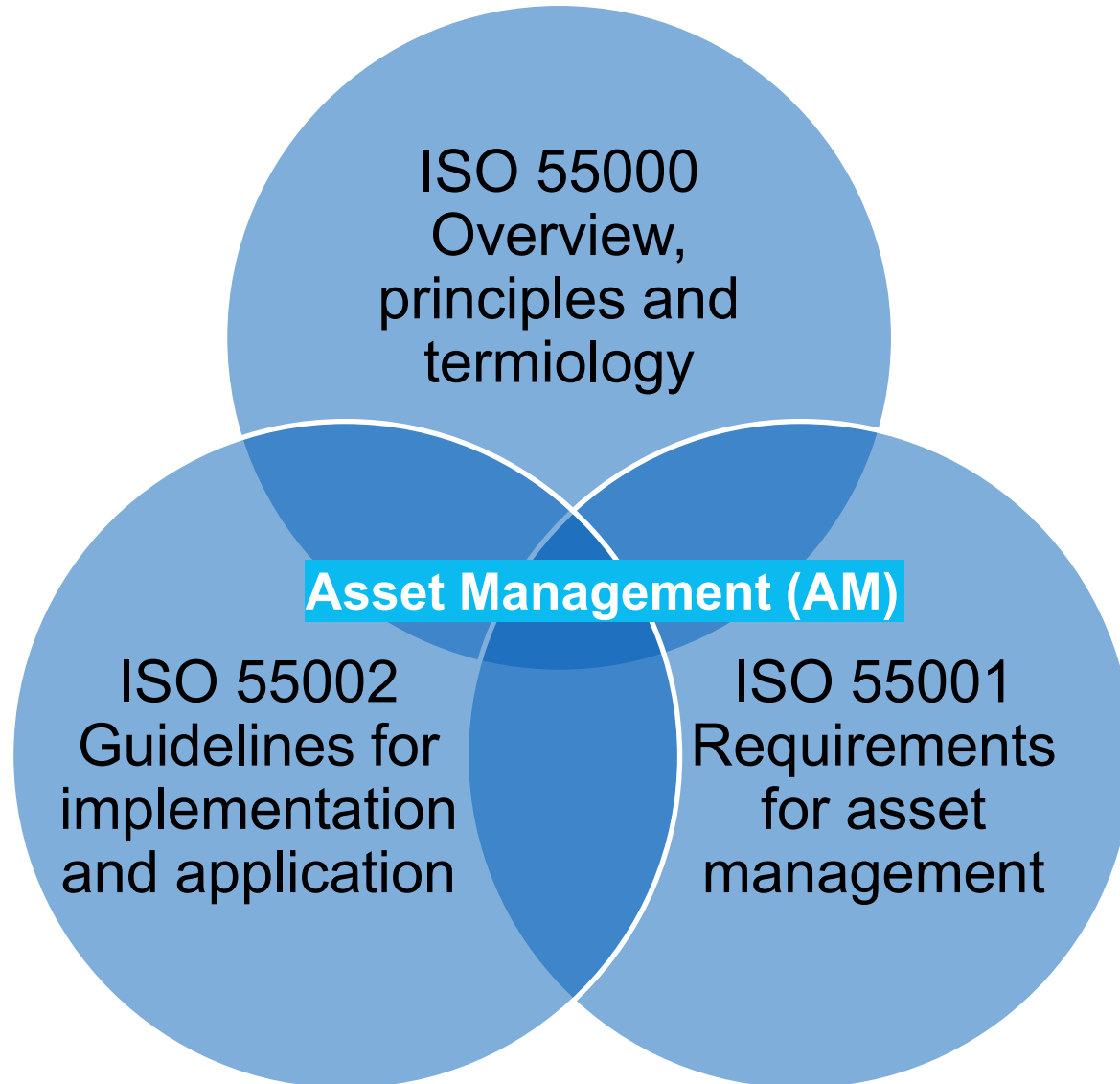
- Ensure **safety**, **function**, and **agreed service level**
- **Minimize the operation and maintenance costs** of the road network
- Consider **sustainability** and the road's **neighbors and surroundings**

We want to **achieved these goals** with **high quality and transparency** in:

- **Data used** - including data-driven Asset Management
- **Decisions** - including transparency in the decision-making process (needs assessment and production plan)
- **Execution** - including agreed control procedures
- **Reporting** - including agreed results and documented deviations (change log)



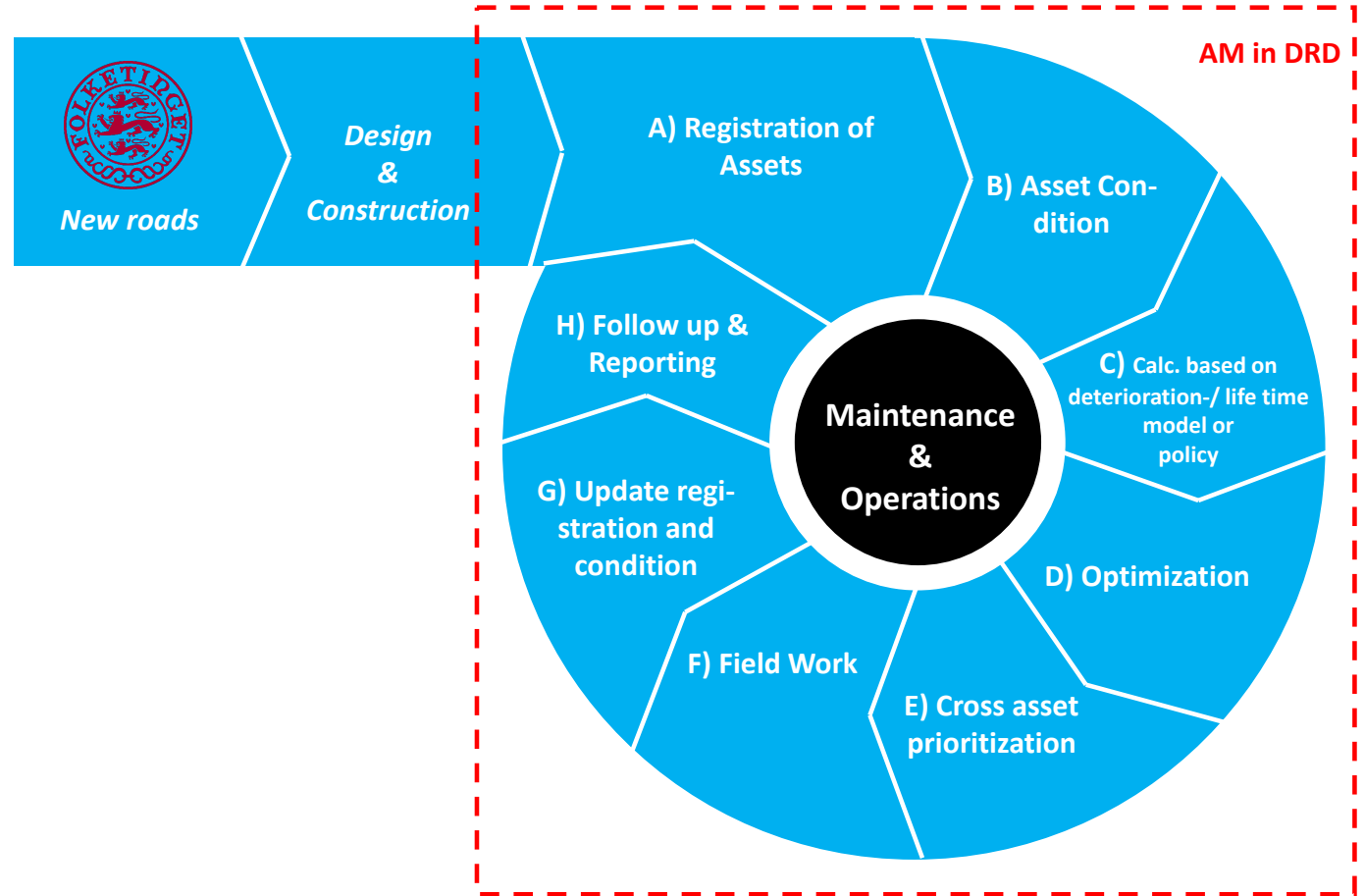
# Standard for Asset Management



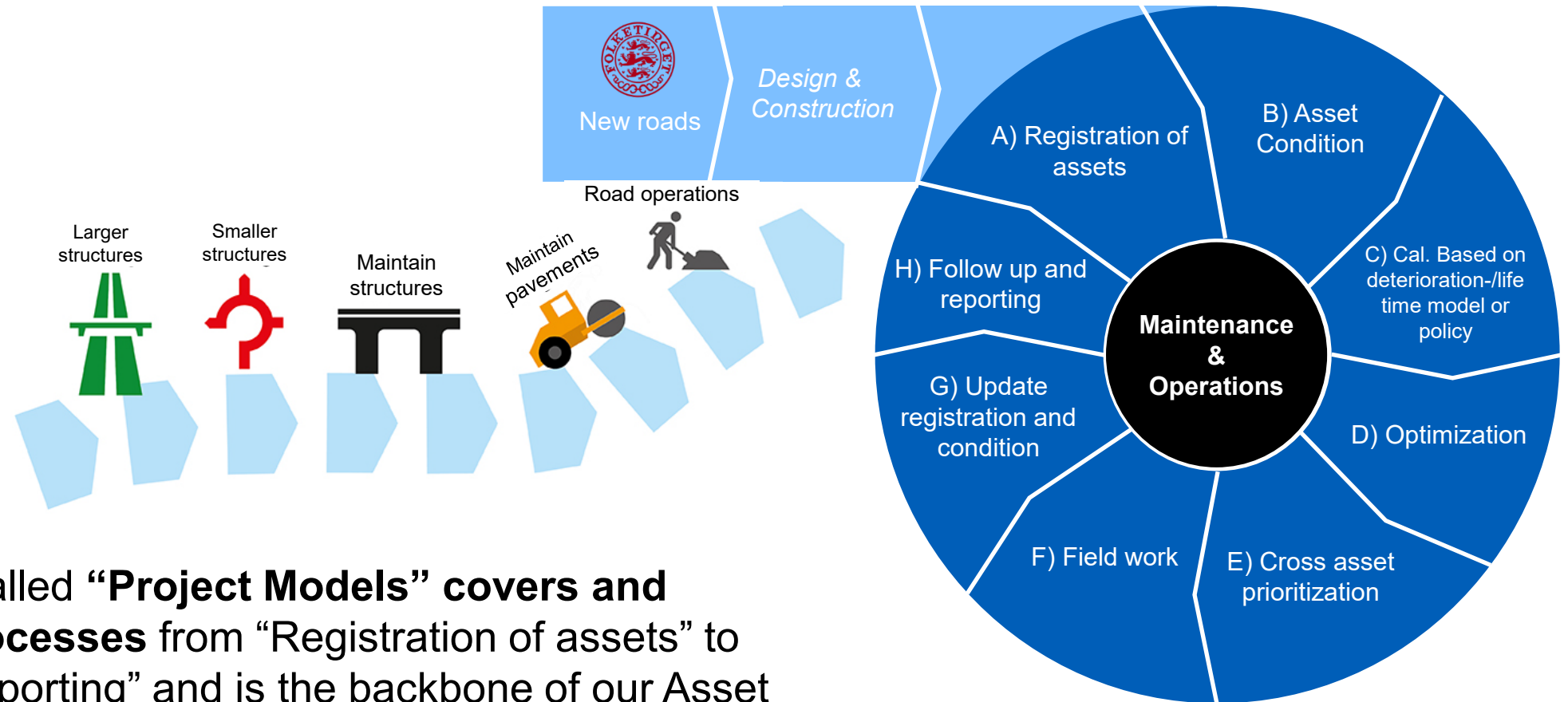
- ISO 55000 is an international standard for Asset Management
- The realization of **DRD's ambition and strategy is inspired by ISO 55000:**
  - Concepts, “language” and definitions are adopted

# The Main Asset Management process

- The Asset Management process focuses on **maintenance and operations of the existing State Road Network**
- When building new roads (or widening existing roads) **maintenance and operations is included** in the Design & Construction phase to optimize choice of solutions:
  - Cost efficiency
  - Easy of handling
  - Environment efficiency



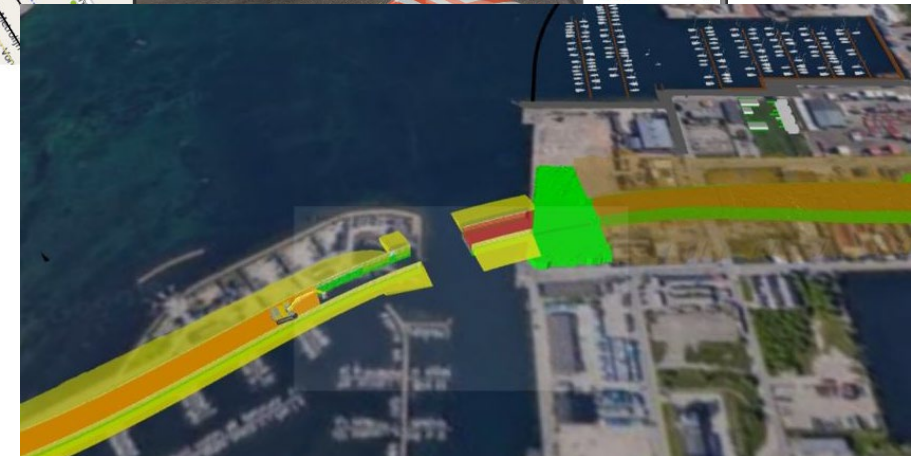
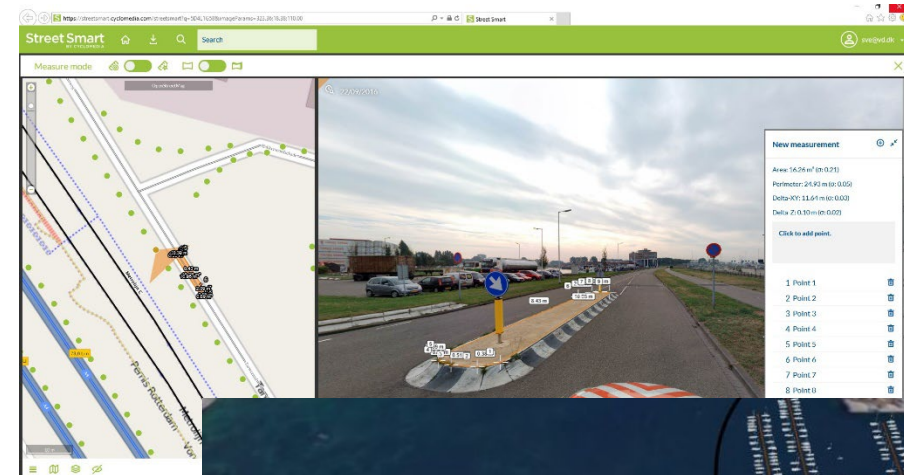
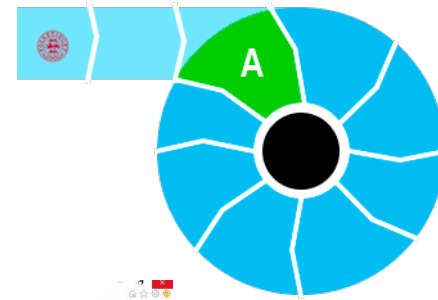
# Project Models support Asset Management



The framework called “**Project Models**” covers and describes all processes from “Registration of assets” to “Follow up and reporting” and is the backbone of our Asset Management System

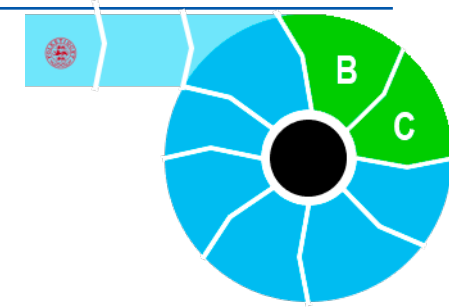
# Asset registration

- For existing roads, we already have a substantial amount of data, but far from alle
- Many of the missing data for existing roads must be collected or updated via **3D mobile mapping**.
- The LER projects collects data on underground utilities
- For new roads, much of the data will come from **BIM**
- For the many different assets or asset groups, **management data** are linked, such as age, conditions, deterioration, rate, service life and costs associated with replacement, repair or renewal.



# Asset conditions and lifetime

## – critical for ensuring timely maintenance!



**Knowledge of asset condition and degradation** must be collected and documented systematically

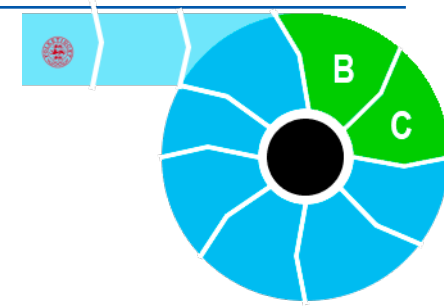
– providing an overview of the condition of each individual asset as well as the entire asset portfolio



**Condition assessments** via drone inspections, sensors and/or visual inspections.

**Lifetime assesment** using advanced degradation models and/or more simplified service-life evaluations.

# “Objective data” and automated data collection

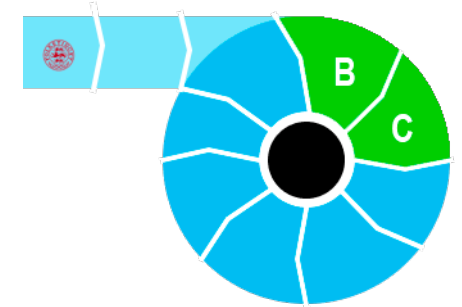


Transparent decisions means **objective measurements and automated data collection**:

- **Automated measurements** of pavement conditions with advanced vehicles
- **Lasers scanning** the road shoulders
- **Drone inspection** of bridges
- Internet of things, **IoT**, especially in M&E assets

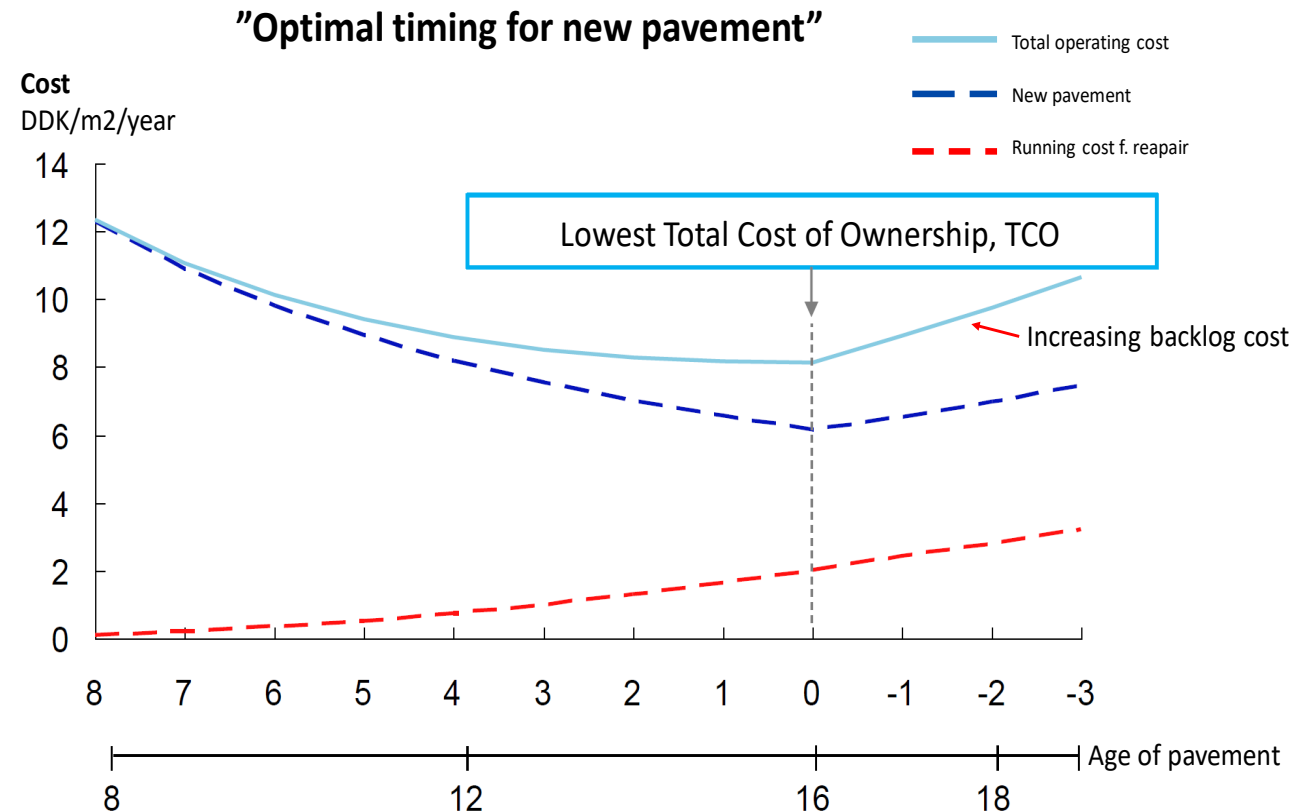


# Transparent and data driven decisions



Maintenance and repairs must be done at the **right time to avoid backlog** and extra costs!

Getting the founding allocated at the right time is dependent on a transparent and well documented **basis for decision – data and reliable forecasts!**

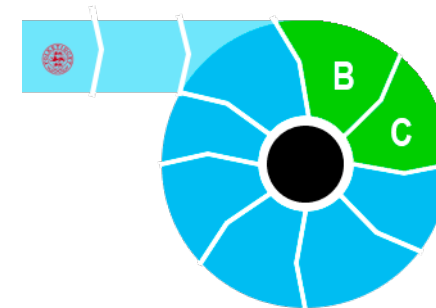
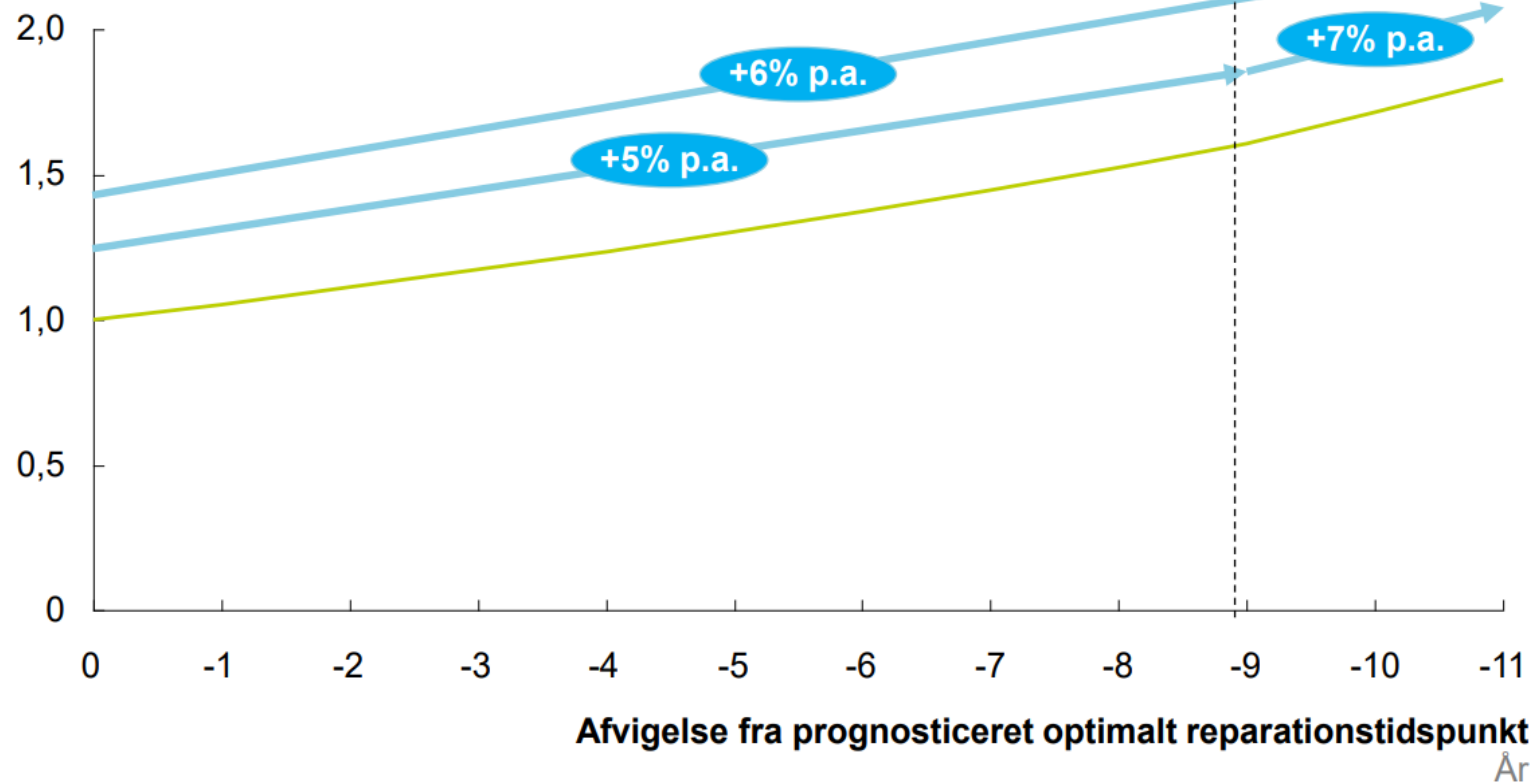


# Timely maintenance - minimize costs!

## Udskydelsesomkostning som funktion af optimalt udskiftnings år

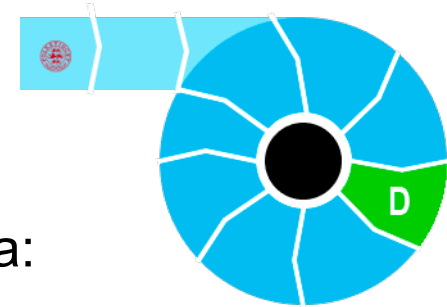
Udskydelsesfaktor, vægtet gennemsnit af beton med AKR og beton uden AKR

### Udskydelsesfaktor



| eret af Vejdirektoratet             |                                       |                                                                                       |                                          |                                                                               |                                                       |
|-------------------------------------|---------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------|
| mmuleret økonomisk inose værende år | Akkumuleret BO bevilling til eksterne | Del af akkumuleret prognose, der ikke dækkes af akkumuleret BO bevilling <sup>2</sup> | Meromkostninger som følge af udskydelser | Udskydelses-omkostninger - totale beløb det vil koste at indhente udskydelser | Meromkostninger som andel af udskydelses-omkostninger |
| 447,0                               | 263,6                                 | 183,5                                                                                 | 10,1                                     | 193,6                                                                         | 5,2%                                                  |
| 807,7                               | 471,8                                 | 335,9                                                                                 | 27,8                                     | 363,7                                                                         | 7,7%                                                  |
| 1.135,8                             | 680,0                                 | 455,8                                                                                 | 53,5                                     | 509,3                                                                         | 10,5%                                                 |
| 1.326,7                             | 894,9                                 | 431,8                                                                                 | 79,5                                     | 511,3                                                                         | 15,5%                                                 |
| 1.815,1                             | 1.102,8                               | 712,3                                                                                 | 121,8                                    | 834,1                                                                         | 14,6%                                                 |
| 2.068,4                             | 1.322,3                               | 746,1                                                                                 | 167,9                                    | 914,0                                                                         | 18,4%                                                 |
| 2.563,2                             | 1.530,9                               | 1.032,3                                                                               | 231,8                                    | 1.264,1                                                                       | 18,3%                                                 |
| 2.702,7                             | 1.741,2                               | 1.285,5                                                                               | 313,2                                    | 1.598,7                                                                       | 19,6%                                                 |
| 2.919,9                             | 1.960,9                               | 1.331,0                                                                               | 401,1                                    | 1.732,1                                                                       | 23,2%                                                 |
| 3.638,9                             | 2.176,6                               | 1.462,3                                                                               | 501,7                                    | 1.963,9                                                                       | 25,5%                                                 |

# Needs assessments and optimization

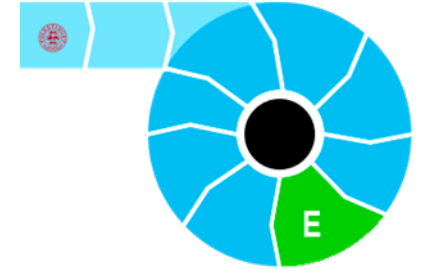


The **needs for maintenance in each asset class** is determined based on the criteria:

- **Safety, functionality, agreed service level -> road performance**
- **Timely maintenance -> minimizing costs**
- The **results are needs assessments**, detailed for the **coming year and forecasts** for the upcoming **10-year period**.

| Prognose, behov              | Regnskab 2018-24 |              |              |              |              |              |                | 4-årig prognose 2025-28 |                |                |                | Sigtelinje 2029-34 |                |                |                |                |                |                | Sum             |
|------------------------------|------------------|--------------|--------------|--------------|--------------|--------------|----------------|-------------------------|----------------|----------------|----------------|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
|                              | 2018             | 2019         | 2020         | 2021         | 2022         | 2023         | 2024           | 2025                    | 2026           | 2027           | 2028           | 2029               | 2030           | 2031           | 2032           | 2033           | 2034           | 2035           | 2025-34         |
| Belægninger                  | 326,5            | 203,8        | 249,0        | 287,5        | 410,6        | 309,7        | 527,3          | <b>676,7</b>            | 954,5          | 799,4          | 550,9          | 288,2              | 468,3          | 502,6          | 335,4          | 333,5          | 613,3          | 582,7          | 5522,6          |
| Almindelige bygværker        | 71,9             | 117,5        | 76,4         | 64,1         | 104,8        | 73,3         | 152,2          | <b>124,3</b>            | 142,7          | 124,9          | 281,5          | 108,4              | 201,6          | 142,3          | 346,4          | 251,9          | 331,6          | 232,7          | 2055,6          |
| Specielle bygværker          | 195,0            | 314,5        | 271,9        | 258,7        | 343,7        | 311,0        | 312,3          | <b>273,7</b>            | 281,6          | 232,5          | 247,4          | 192,3              | 328,1          | 370,8          | 316,2          | 271,2          | 183,8          | 206,6          | 2697,5          |
| Øvrige mindre assets, DT     |                  |              |              |              |              | 80,8         | 147,0          | <b>126,8</b>            | 164,5          | 145,0          | 149,1          | 152,0              | 153,0          | 153,0          | 153,0          | 154,0          | 155,0          | 156,1          | 1505,6          |
| Øvrige mindre assets, TPD    |                  |              |              |              |              | 33,8         | 39,9           | <b>43,0</b>             | 30,9           | 23,6           | 22,9           | 39,3               | 25,5           | 21,6           | 24,0           | 22,1           | 40,7           | 27,4           | 293,8           |
| <b>Prognose, behov i alt</b> | <b>593,4</b>     | <b>635,7</b> | <b>597,3</b> | <b>610,3</b> | <b>859,2</b> | <b>808,5</b> | <b>1.178,7</b> | <b>1.244,5</b>          | <b>1.574,1</b> | <b>1.325,4</b> | <b>1.251,8</b> | <b>780,3</b>       | <b>1.176,5</b> | <b>1.190,2</b> | <b>1.175,0</b> | <b>1.032,8</b> | <b>1.324,4</b> | <b>1.205,6</b> | <b>12.075,1</b> |
| <b>Gennemsnit</b>            |                  |              |              |              |              |              |                |                         | 1349,0         |                |                |                    | 1113,2         |                |                |                |                |                |                 |

# Prioritization and optimization Guidelines



Mio. kr., 2024-priser

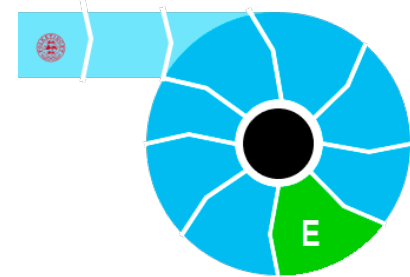
| Bevilling og midler til rådighed i 2024          |         | Kr. |
|--------------------------------------------------|---------|-----|
| FL-bevilling                                     | 551,3   | .   |
| Infrastrukturplan 2035, Nye midler               | 309,6   | .   |
| Indeksring fra 2023-pl til 2024-pl               | 255,0   | .   |
| Reduktion og udskydelse af bevilling i 2023      | 85,0    | .   |
| Indeksring af udskydelse fra 2023-pl til 2024-pl | 11,8    | .   |
| Bevilling til rådighed i alt                     | 1.212,7 | .   |
| Videreførsel fra 2023 til 2024                   | 15,4    | .   |
| Midler til rådighed i alt                        | 1.228,1 | .   |

If the “**optimal**” work exceeds the budget, the work has to be **prioritized** – and we are looking for the entire portfolio!

The main guidelines for prioritization and optimization:

1. All aspects regarding **Safety** ranks highest when looking at the portfolio of maintenance tasks. This could be repairing a pothole
2. Second highest rank tasks related to “**The function**” of the asset. This could be lubrication of the movable parts in a bridge
3. Third rank in the prioritization is “**Minimizing the overall operation and maintenance cost**” in order to preserve the road capital at lowest cost possible
4. Practical and logistical considerations

# Production Plan and Forecasting



## Samlet prognose, 2024-33

### Prognose, Behov

| Prognose, behov           | Regnskab 2018-23 |       |       |       |       |         | 4-årig prognose 2024-27 |         |         |         |       | Sigtelinje 2028-33 |         |         |       |       | Sum<br>2024-33 |
|---------------------------|------------------|-------|-------|-------|-------|---------|-------------------------|---------|---------|---------|-------|--------------------|---------|---------|-------|-------|----------------|
|                           | 2018             | 2019  | 2020  | 2021  | 2022  | 2023    | 2024                    | 2025    | 2026    | 2027    | 2028  | 2029               | 2030    | 2031    | 2032  | 2033  |                |
| Belægninger               | 326,5            | 203,8 | 249,0 | 287,5 | 410,6 | 410,9   | 572,7                   | 613,9   | 791,1   | 695,0   | 435,5 | 198,3              | 430,9   | 380,9   | 278,3 | 376,5 | 4773,2         |
| Almindelige bygværker     | 71,9             | 117,5 | 76,4  | 64,1  | 104,8 | 109,3   | 142,0                   | 128,9   | 94,9    | 83,6    | 92,9  | 93,5               | 174,4   | 137,1   | 167,3 | 112,1 | 1226,9         |
| Specielle bygværker       | 195,0            | 314,5 | 271,9 | 258,7 | 343,7 | 376,4   | 384,3                   | 232,6   | 260,5   | 222,5   | 279,8 | 260,3              | 261,2   | 322,8   | 277,4 | 190,7 | 2660,1         |
| Øvrige mindre assets, DT  |                  |       |       |       |       | 121,3   | 120,1                   | 124,4   | 120,3   | 120,8   | 121,3 | 121,8              | 126,0   | 122,8   | 120,0 | 120,0 | 1217,4         |
| Øvrige mindre assets, TPD |                  |       |       |       |       | 38,3    | 50,0                    | 42,0    | 31,5    | 26,0    | 30,8  | 44,9               | 62,2    | 50,2    | 40,0  | 40,0  | 417,5          |
| Prognose, behov i alt     | 593,4            | 635,7 | 597,3 | 610,3 | 859,2 | 1.056,2 | 1.269,2                 | 1.141,7 | 1.298,3 | 1.147,9 | 960,3 | 718,8              | 1.054,7 | 1.013,8 | 883,0 | 839,3 | 10.327,1       |
| Gennemsnit                |                  |       |       |       |       |         | 1214,3                  |         |         |         |       | 911,7              |         |         |       |       |                |

### Prognose, FL-tilpasset

| Prognose, FL-tilpasset       | Regnskab 2018-23 |       |       |       |       |       | 4-årig prognose 2024-27 |         |         |       |         | Sigtelinje 2028-33 |         |       |       |       | Sum      |
|------------------------------|------------------|-------|-------|-------|-------|-------|-------------------------|---------|---------|-------|---------|--------------------|---------|-------|-------|-------|----------|
|                              | 2018             | 2019  | 2020  | 2021  | 2022  | 2023  | 2024                    | 2025    | 2026    | 2027  | 2028    | 2029               | 2030    | 2031  | 2032  | 2033  | 2024-33  |
| Belægninger                  | 326,5            | 203,8 | 249,0 | 287,5 | 410,6 | 288,8 | 540,2                   | 609,3   | 758,6   | 565,2 | 593,4   | 279,4              | 358,2   | 359,9 | 290,3 | 432,3 | 4786,6   |
| Almindelige bygværker        | 71,9             | 117,5 | 76,4  | 64,1  | 104,8 | 85,4  | 158,2                   | 108,8   | 92,0    | 80,7  | 90,0    | 90,6               | 171,5   | 134,2 | 164,4 | 109,2 | 1199,6   |
| Specielle bygværker          | 195,0            | 314,5 | 271,9 | 258,7 | 343,7 | 324,1 | 330,5                   | 252,7   | 260,7   | 222,7 | 279,9   | 260,5              | 261,4   | 322,9 | 277,5 | 190,7 | 2659,6   |
| Øvrige mindre assets, DT     |                  |       |       |       |       | 121,3 | 125,0                   | 124,4   | 120,3   | 102,9 | 206,0   | 265,3              | 159,4   | 10,3  | 0,0   | 0,0   | 1113,7   |
| Øvrige mindre assets, TPD    |                  |       |       |       |       | 38,3  | 49,2                    | 42,0    | 31,5    | 26,0  | 30,8    | 44,9               | 60,9    | 11,2  | 0,0   | 0,0   | 296,5    |
| Prognose, FL-tilpasset i alt | 593,4            | 635,7 | 597,3 | 610,3 | 859,2 | 857,9 | 1.203,1                 | 1.137,1 | 1.263,1 | 997,5 | 1.200,1 | 940,6              | 1.011,4 | 838,6 | 732,2 | 732,2 | 10.056,1 |
| Gennemsnit                   |                  |       |       |       |       |       | 1150,2                  |         |         |       |         |                    | 909,2   |       |       |       |          |

Forskel mellem midler til rådighed og FL-tilpasset behov i 2024: 1.228,1-1.203,1 = 25 mio. kr.

### Opmærksomhedspunkter:

- Udsvingsordning på 30.10 udgår fra 2024. Der budgetteres derfor fra årets start med en reserve på 25 mio. kr. Evt. mindre-forbrug kan videreføres til 2025.
- Alle opgaver i 2024 gennemføres i henhold til det opgjorte behov, dog levetidsforlænges belægninger på anlægsstrækninger og trafikkanter vil opleve nedsat komfort på disse del-strækninger i anlægsperioden.
- Da bevillingen i 2024 er større end det samlede vedligeholdelsesbehov, fremrykkes belægningsarbejder fra 2025 til 2024 for 52 mio. kr. Dette vil tage presset af det stigende behov for belægningsarbejder de kommende år.
- Det har været nødvendigt, at udskyde mindre arbejder til 2025 (to belægningsarbejder og et bygværksarbejde, dels pga. sammenfald med anlægsarbejder og dels pga. lang myndighedsbehandling på fredet stenbro).
- Det FL-tilpassede beløb til vedligehold af ITS på M3 i 2024 er p.t. usikkert, afklares på efterfølgende møde.

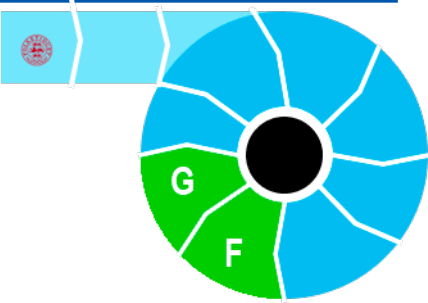
Gennemførelse af produktionsplanen vil medføre at vejnettet fortsat vil være i vedligeholdelsesmæssigt balance ved udgangen af 2024.

Kolonnen med 'FL-tilpasset 2024' viser årets overordnede produktionsplan. I løbet af året vil der kunne ske omprioritering af midler mellem de forskellige assets-grupper, for at sikre den samlede omsætning / bevillingsmæssige afløb.

Asset Management is done with 3 perspectives:

1. The next year budget – the production plan
2. The budget frame period – typically a 4 years period
3. Long term, a 10 years line of sight

# Field work and as-built data



All tasks in the production plan are **designed** and **put out for tender and contracting**

- Focus on competition for the tasks is essential to achieve the "right" prices

**The tasks are carried out in the field** – an essential part of the management is **recording changes** in the 'change log' so that the changes can be tracked in relation to the starting point and **clearly explained when reporting**



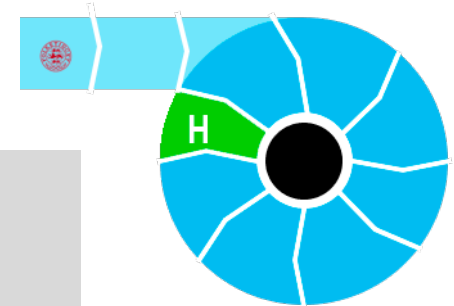
| Registrering - Bygværker |                   |              |                                  |               |             |        |
|--------------------------|-------------------|--------------|----------------------------------|---------------|-------------|--------|
| Bygværk                  | 000-0171-0-003.00 |              | UF af P-VANDL, Grødby Å, Skovbro |               |             |        |
| Strækning                | 000-0171-0        |              |                                  |               |             |        |
| Administrative data      |                   | Beliggenhed  | Interessenter                    | Tekniske data | Passagedata | F      |
| Generelle                |                   | Fritrumsdata | Bæreevnedata                     |               |             |        |
| Broklasse                |                   |              |                                  |               |             |        |
|                          | Nr                | OUA          | Strækning                        | Normal        | Betinget 1  | Beting |
| ▶                        | 1                 | 0            | 000-0171-0                       | 100           | 100         |        |

**All as-built data must be updated** in the databases and asset management systems to ensure knowledge about the updated asset condition

# Follow-up and reporting

## Goal- and Result-Plan

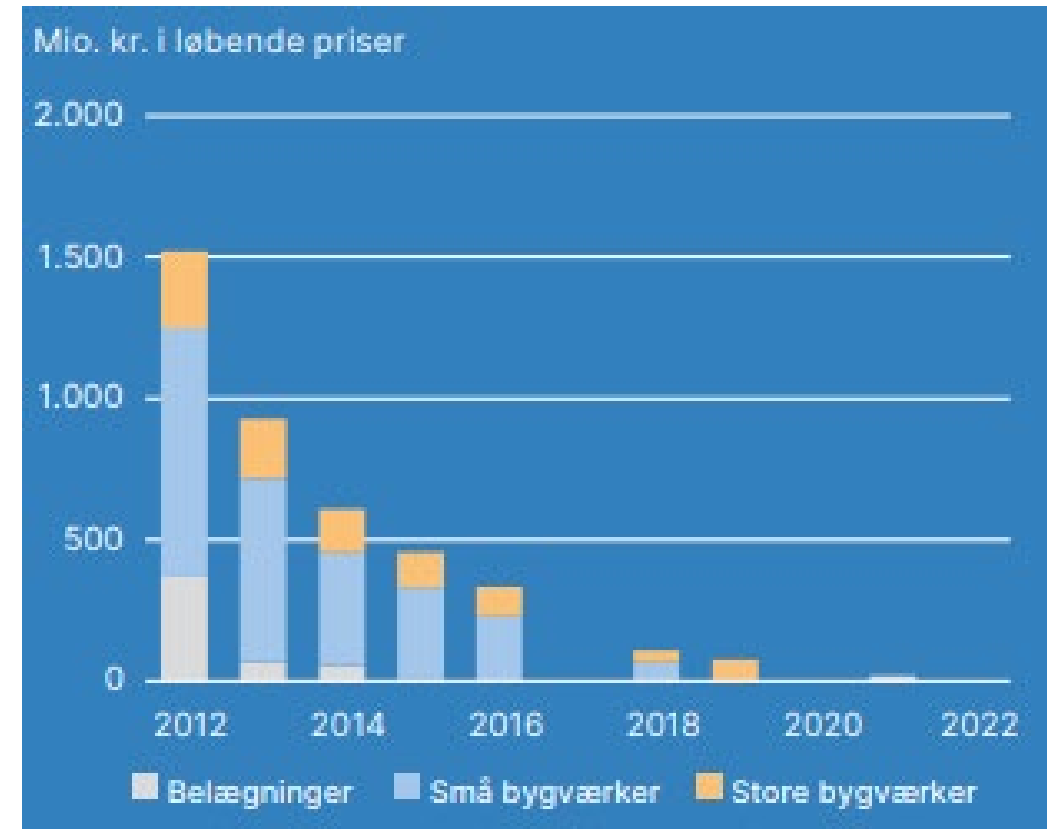
- **Goal 5 capital-preserving maintenance -> backlog or maintenance balance?**
  - Overall "asset accounting"
- **Goal 6 Agreed service level -> safety, function, trafficflow -> road performance**
- **Do we achieve our goals** - agreed condition and service level in accordance with our financial framework?



# Decreasing Backlog in maintenance

A state road network in maintenance balance – without backlog!

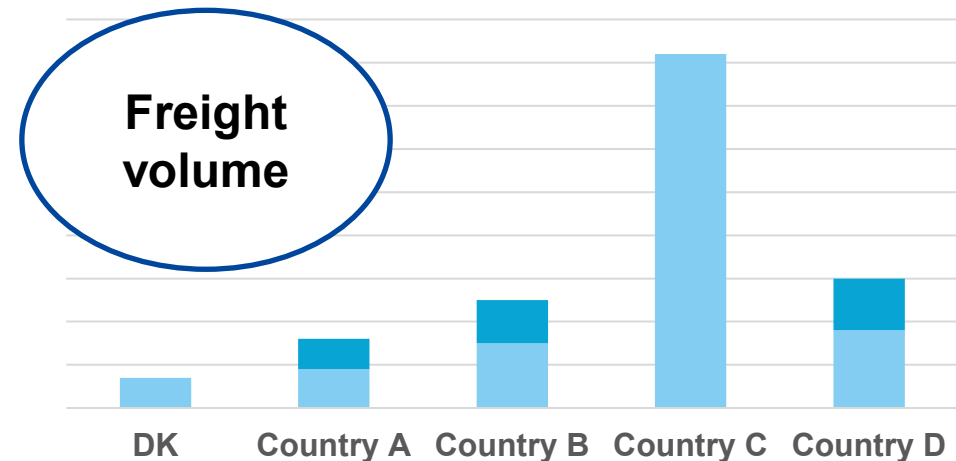
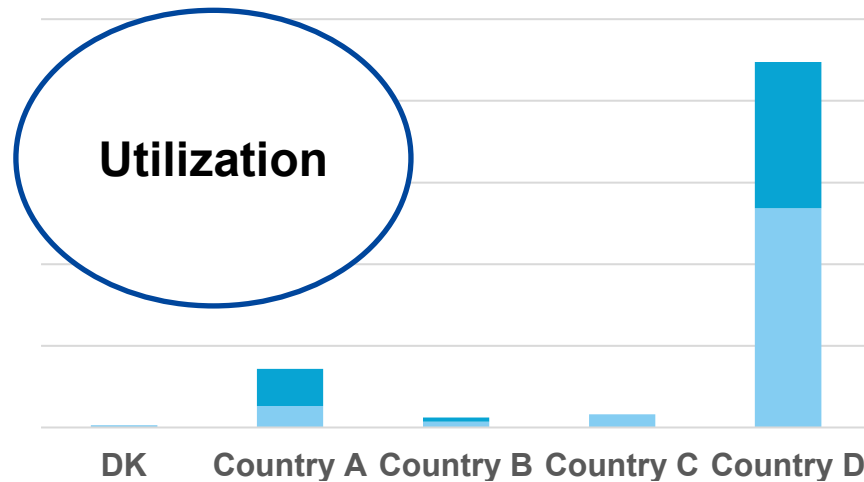
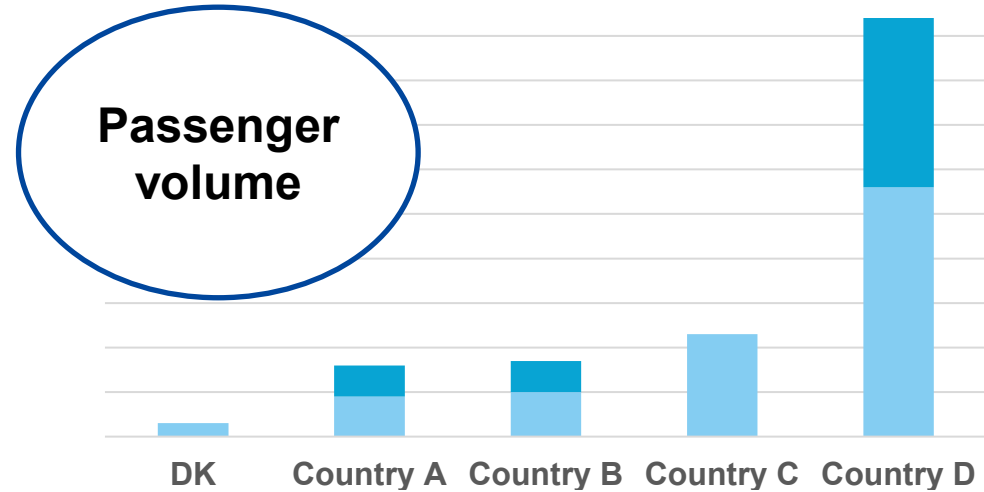
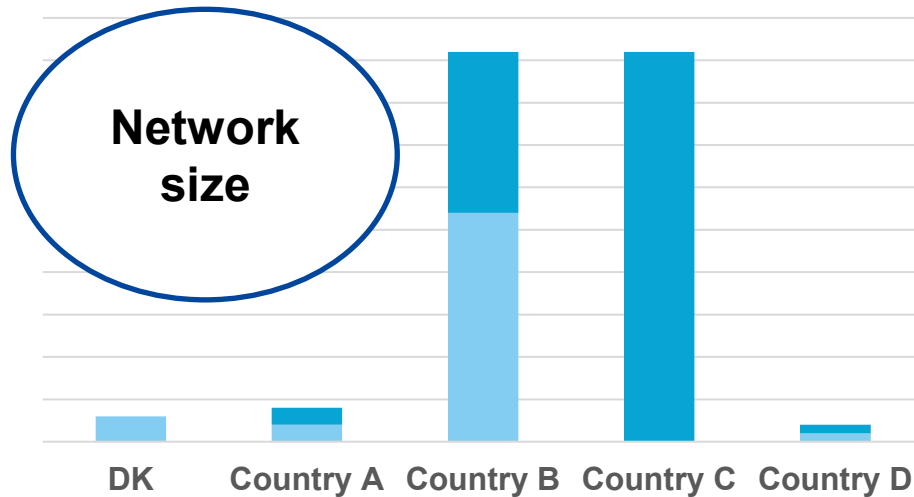
- Decreasing since 2012
- Brought into balance in 2017
- Consistently remained close to zero!



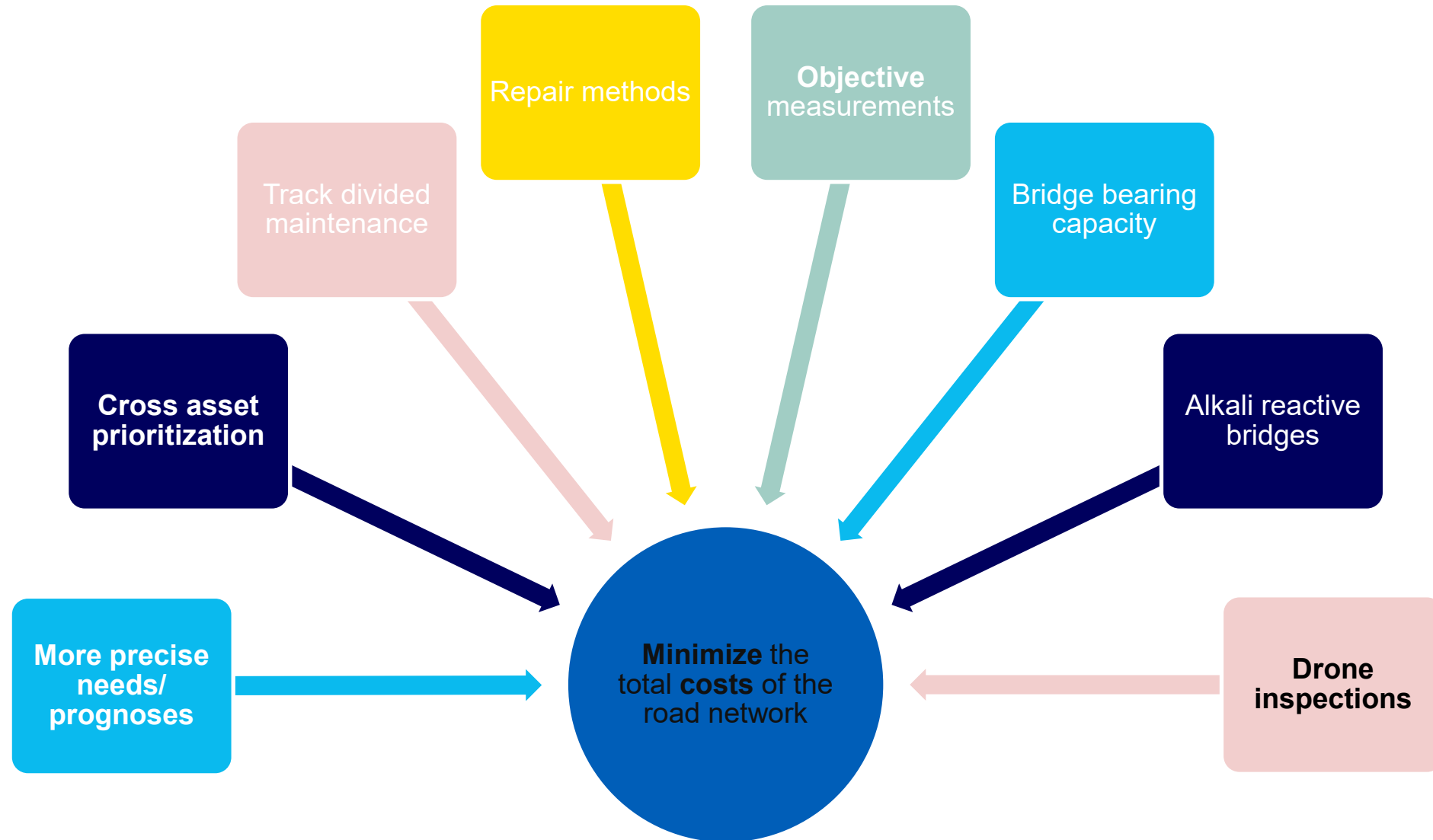
6.2. Status of backlog

# Focus on benchmark

- average cost per year in relation to



# Focus on progress and development



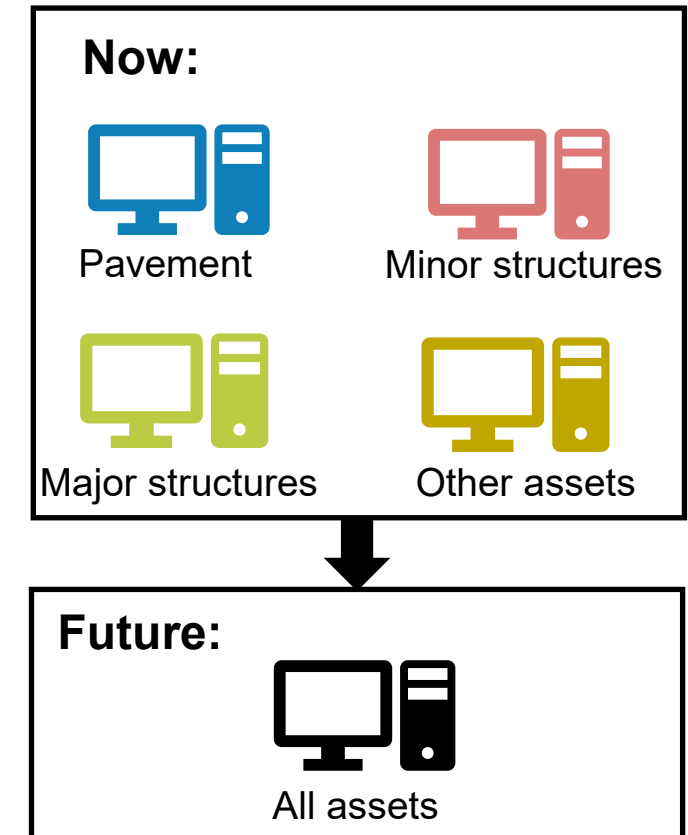
# IT-Tools – digitization and automation

To handle data there is a need for a **high degree of digitizing and automation**.

Many IT systems to handle Asset Management. They are not integrated, do not follow the same processes, costly to develop and maintain.

IT ambition:

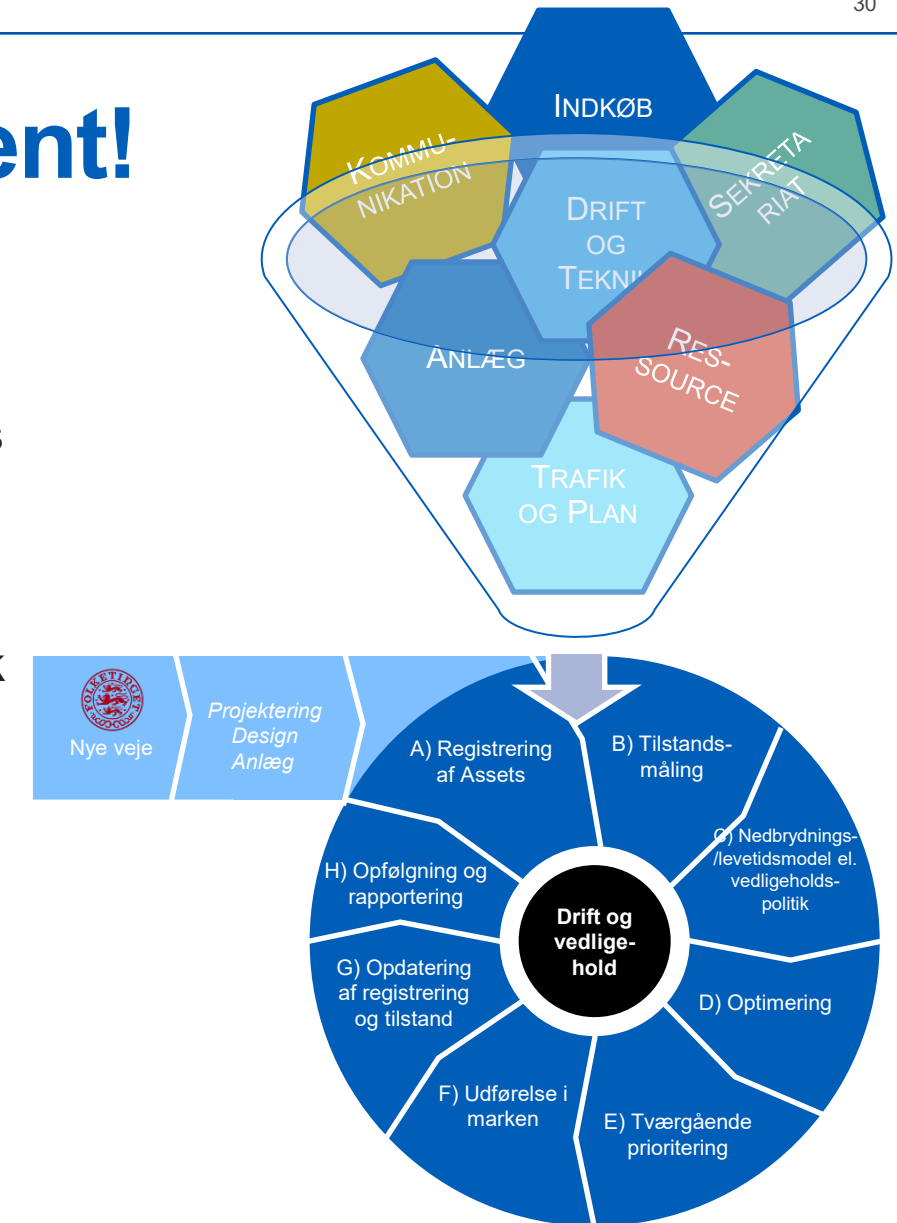
- **All assets in one system**
- **Cross asset prioritization**
- **Uniform processes for all assets**
- **Decision-making support**
- **More efficient processes**



**DRD experience: Implementation new AM it-system is difficult!**

# Together about Asset Management!

- Many skills must be involved
  - Expert **knowledge** in relation to the different types of assets is the **foundation for optimal Asset Management**
  - All **relevant skills** - technical and professional as well as financial - across the **road industry are important** in the work with Asset Management
- **Need to cooperate across the road sector ☺**



# Take aways

Asset Management focuses on the **performance of the state road network based on the entire portfolio** of assets:

- *Common approach with clear goals*
- *Decisions to be based on data and facts*
- *Key is timely maintenance based on condition data*
- *Transparency in needs and budget - forecast on the long run*



# Thank you for your attention!

