

SPiRiT

Towards an Interactive Tool for Performing Predictive Asset Management of Sewer Systems

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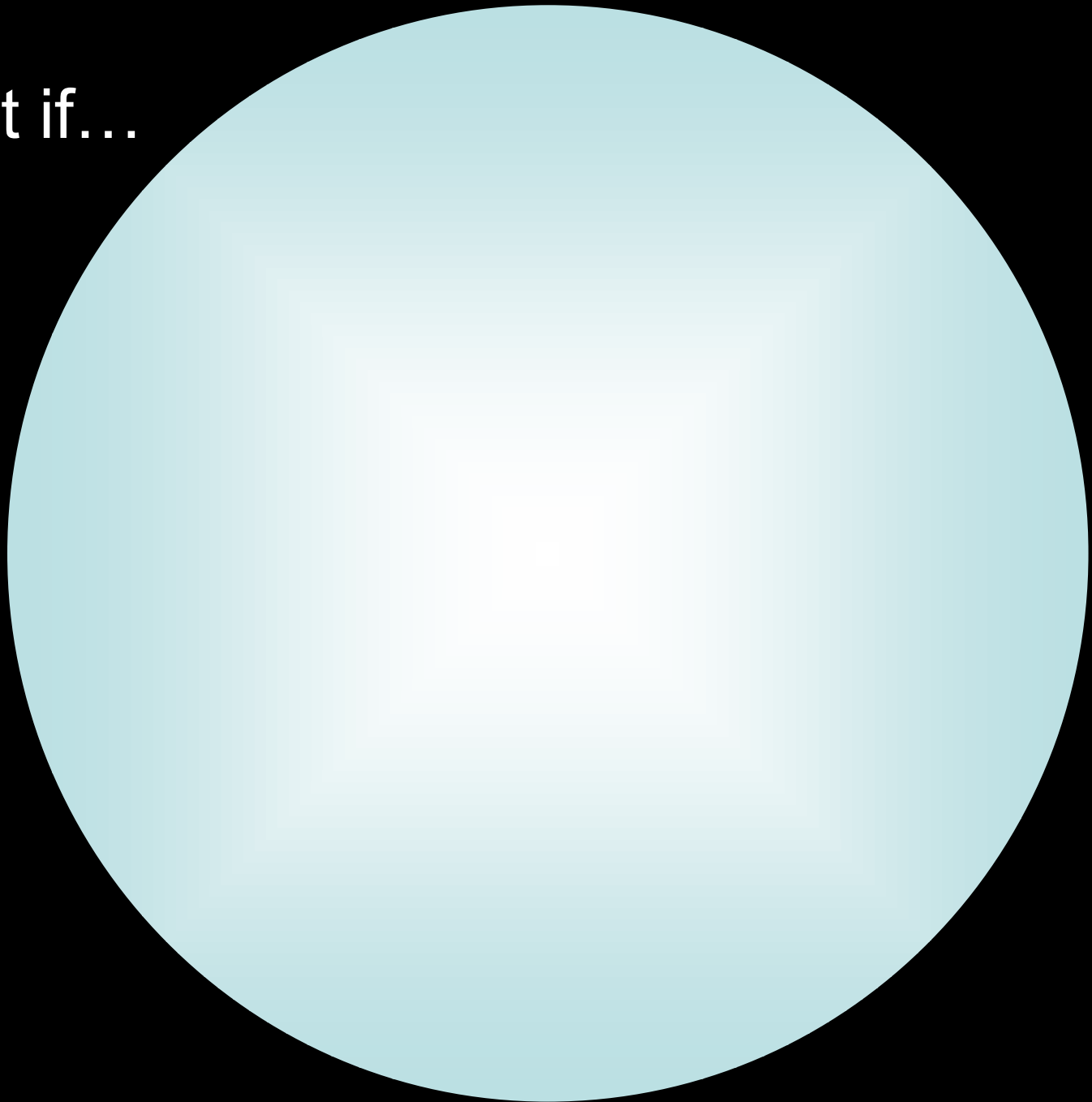
Hans Vis - Delta Pi

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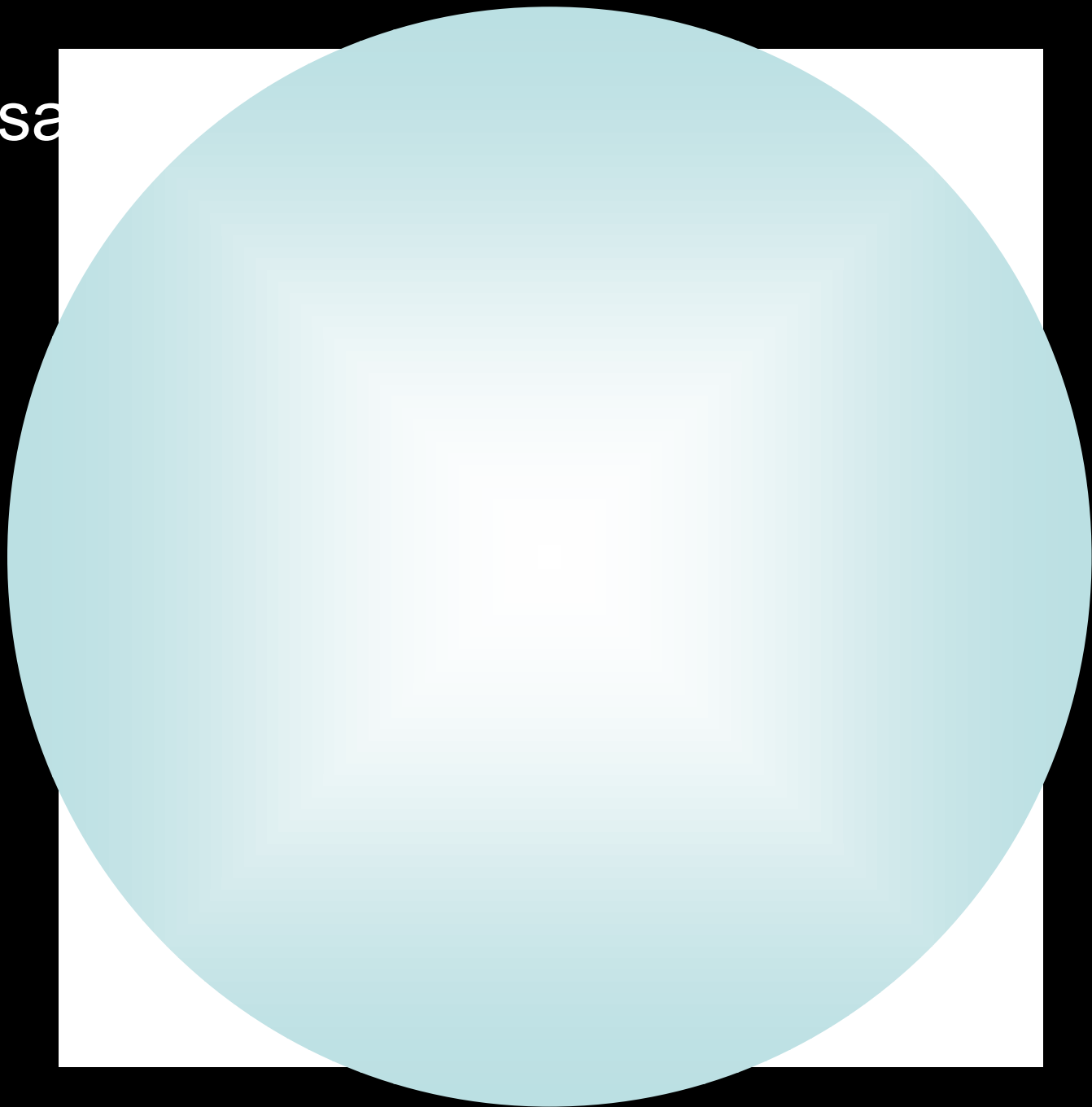
Outline

- Why SPIRIT
- How does it work
- Outlook
- Conclusions

What if...



Sim sa



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Introduction

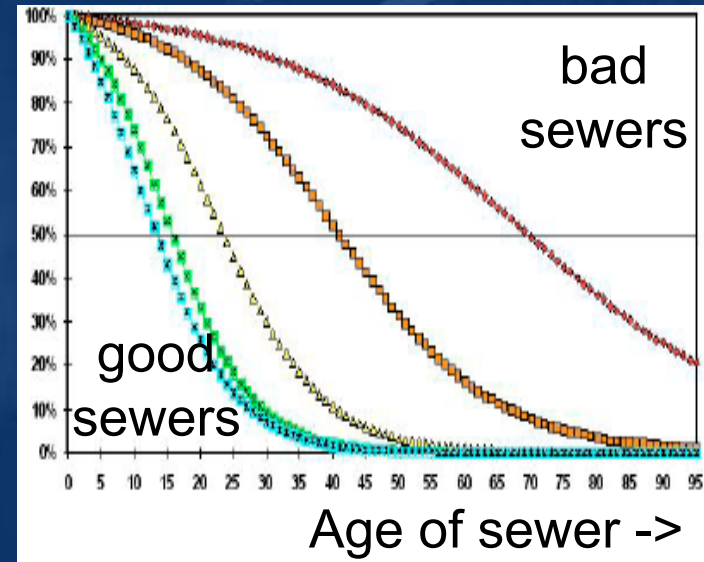
- **SPIRIT:**
 - Software Plug-In for Interactive Prediction of Sewer Conditions
 - A step closer to predictive asset management
- **Predictive asset management**
 - Planning the right thing at the right time
 - More time for co-ordination
 - Reduce costs and provide better service

Problem

- Lack of data for local trend analysis
 - CCTV inspections are expensive
 - Older data poorly digitised
- Sewer management software packages
 - Only rough and long term assessments
 - Every package different prediction

Why SPIRIT

- **Known solutions**
 - Transition curves
 - Degradation in time



- **Shortcomings**
 - Data collection is laborious
 - Models not well fitted in working routine

Aims of SPIRIT

- **No expert system**
 - Only reliable prediction of the state of sewers
 - Indicating the accuracy of the prediction
- **Ready to use**
 - No extensive input needed
 - Data at hand
- **Self learning model**
 - Starting with most common situations
 - Improving when used by gathering more data

Input

- **Inspection results**
 - 18 conditional aspects
 - leakage
 - surface damage
 - obstructions
 -
 - Standardised exchange format

Input

8 Critical factors

- Age in classes of 10 years
- Type of traffic load
- Type of soil
- Depth of sewer
- Type of joints
- Type of sewer
- Groundwater level
- Chance on anaerobic conditions

Calculation

- Statistics to transform input to output
- Based on expert opinions

Predicted distribution



Calculation

- **12,000 combinations**
 - Specific condition aspect
 - Classification
 - Typical set of values for the critical factors
- **Missing expert opinions**
 - Non available prediction curve is interpolated

Output

- **Prediction for 18 conditional aspects**
 - Section of sewers
 - 5 or 10 years after inspection
 - Indication of the accuracy

The SPIRIT Concept



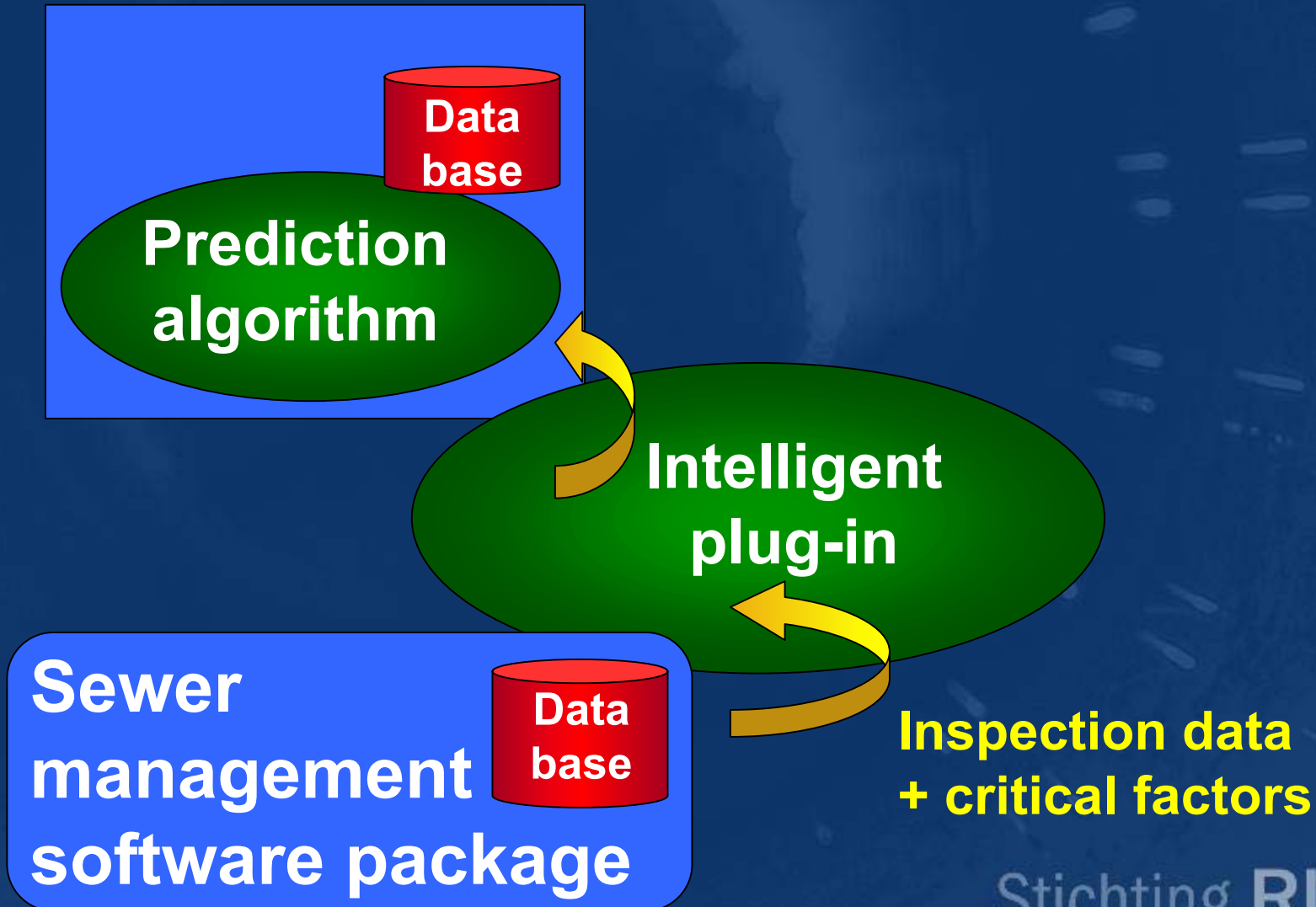
The diagram illustrates the SPIRIT Concept. It features a central green oval labeled "Intelligent plug-in". Below this oval is a blue rounded rectangle labeled "Sewer management software package". Inside the blue rectangle, on the right side, is a red cylinder icon labeled "Data base".

Intelligent
plug-in

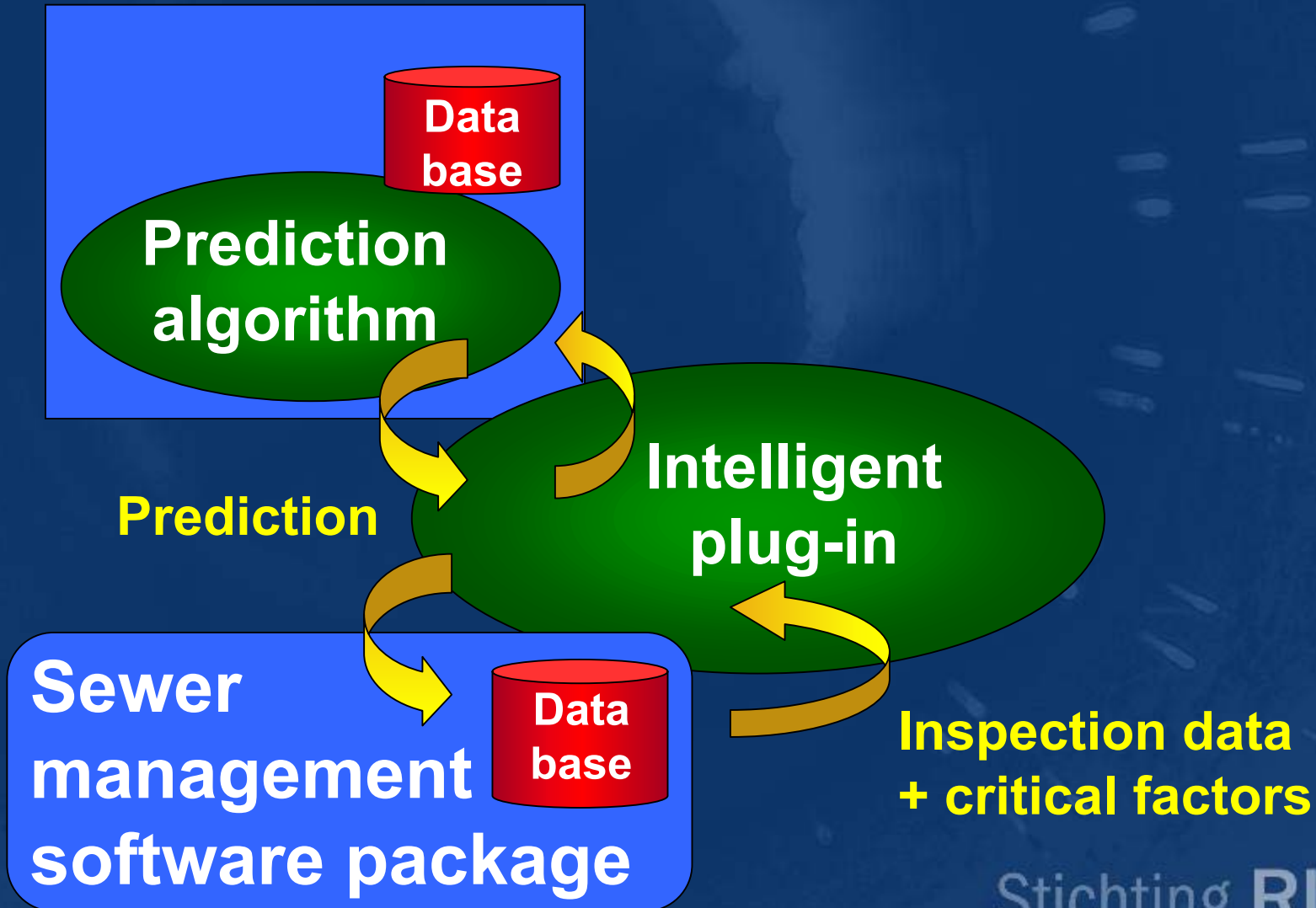
Sewer
management
software package

Data
base

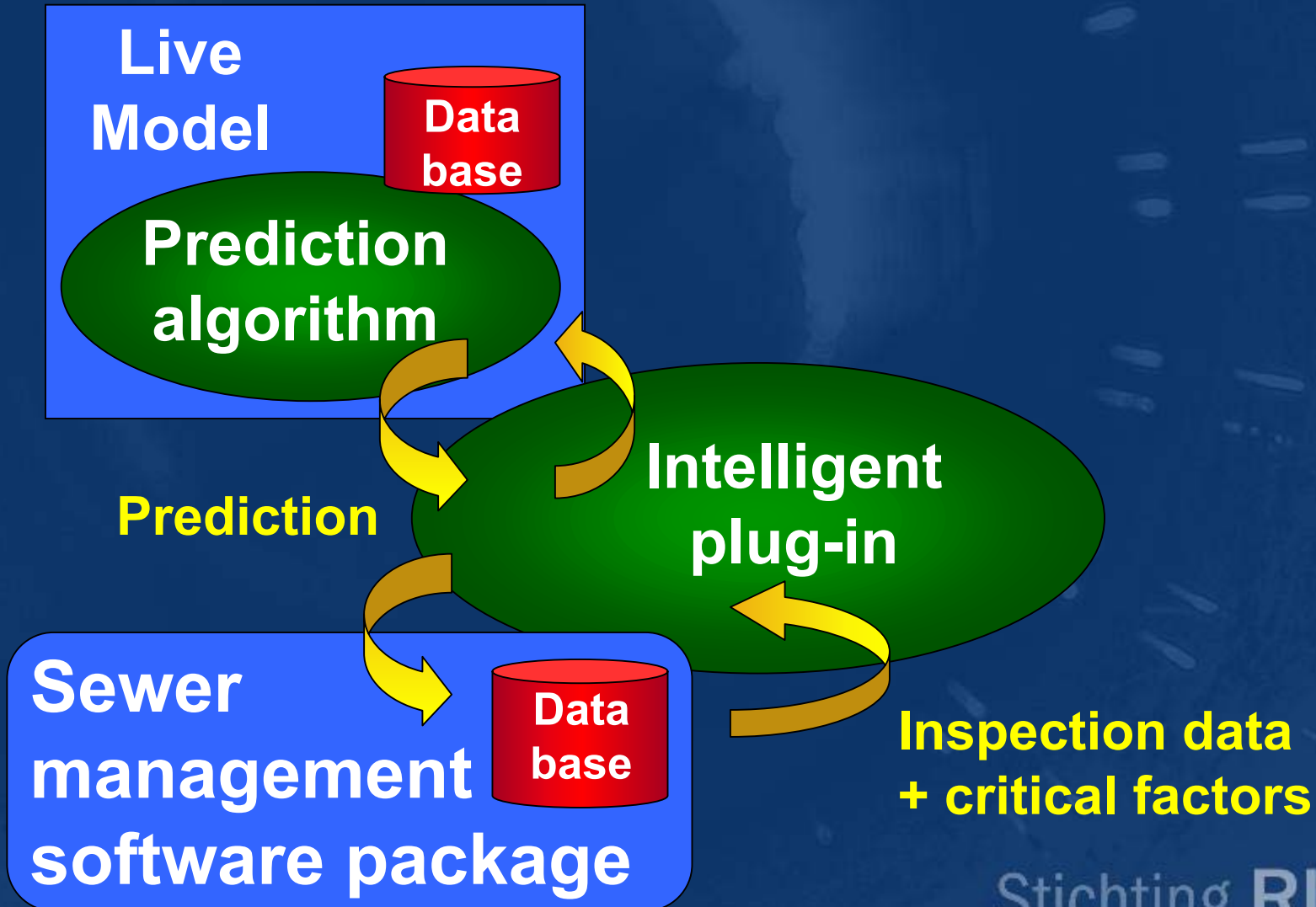
The SPIRIT Concept



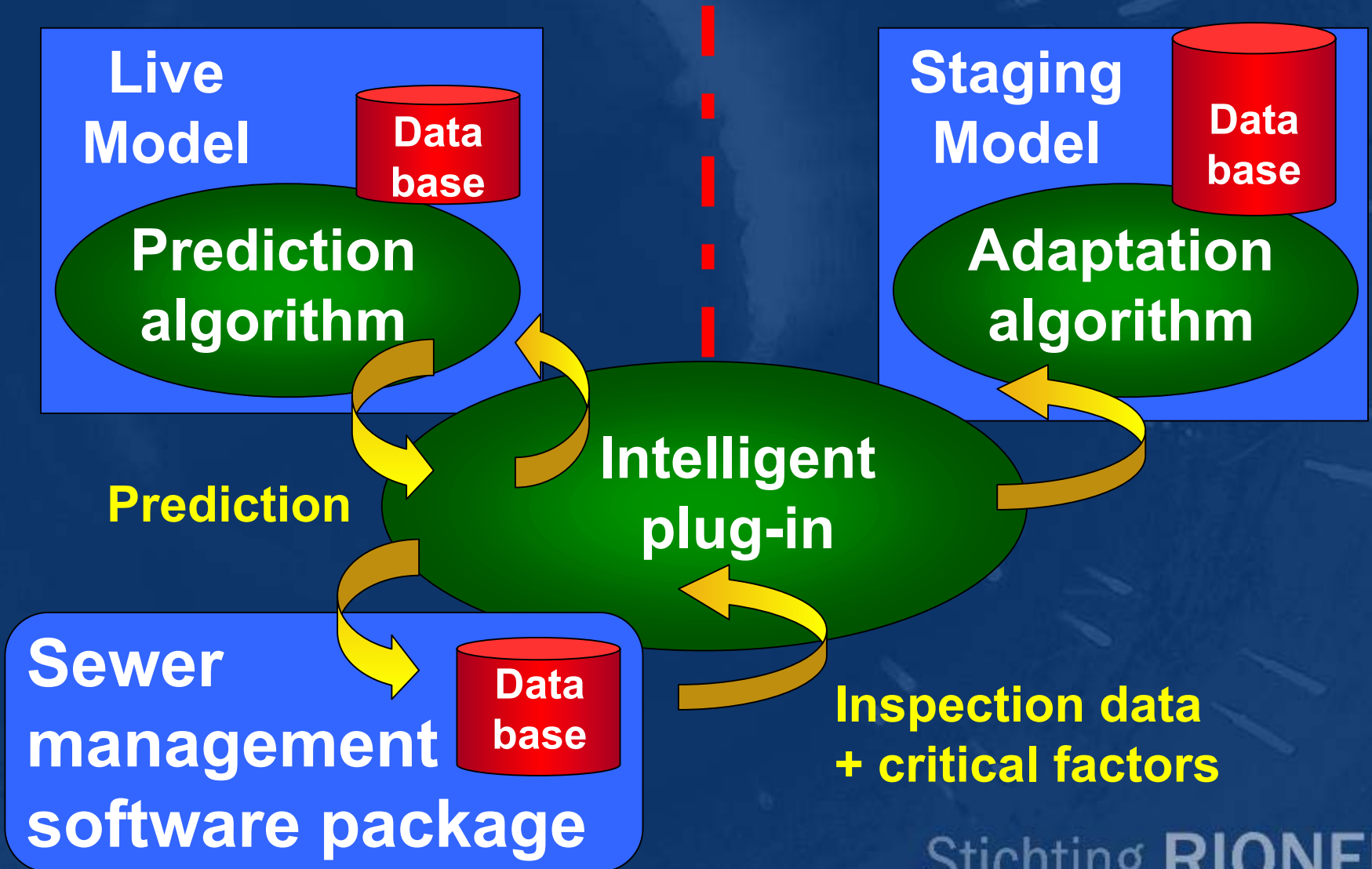
The SPIRIT Concept



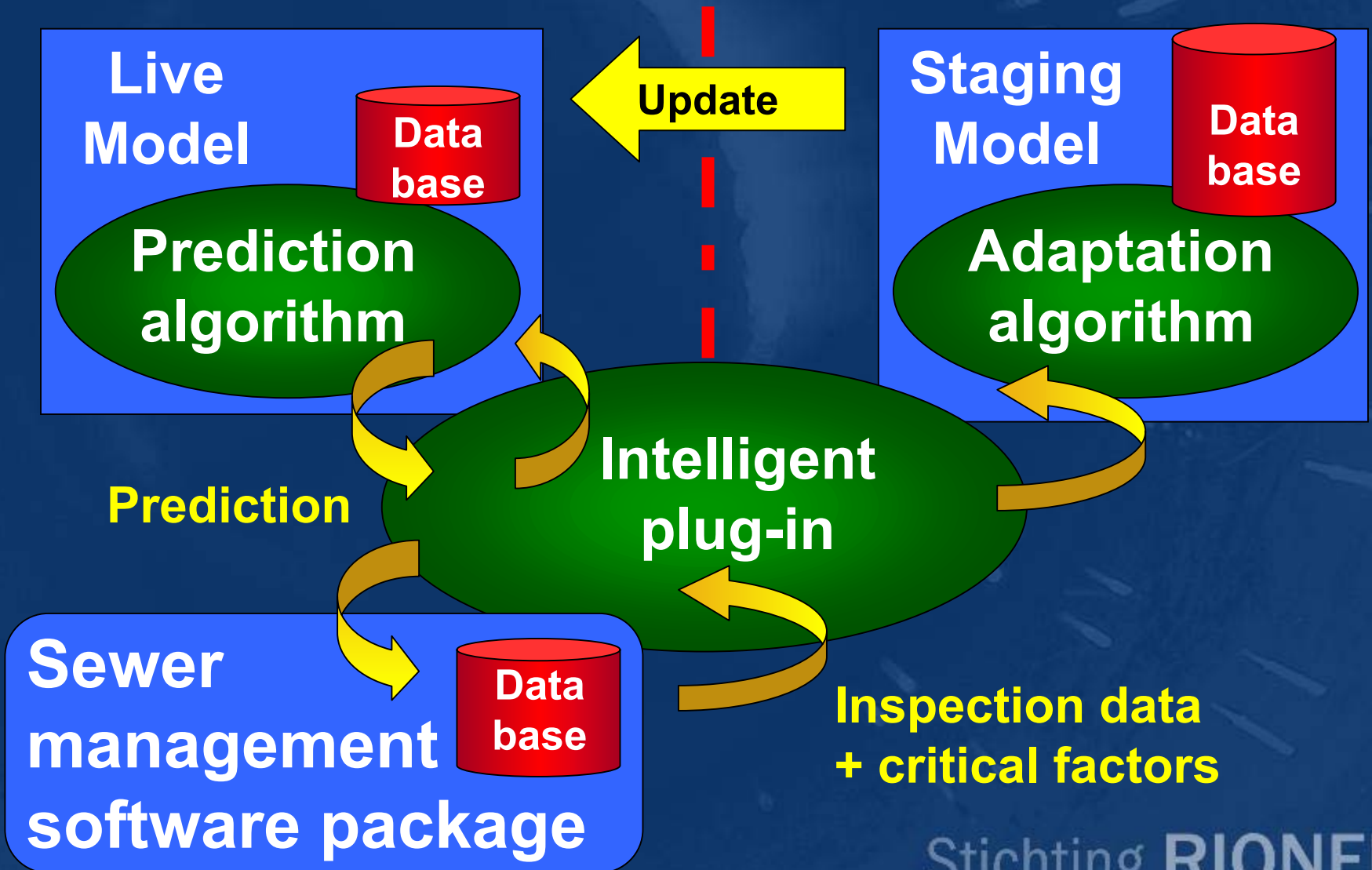
The SPIRIT Concept



The SPIRIT Concept



The SPIRIT Concept



Results

- **Prototype**

- Opinions on 10% of possible combinations
- Validated with double inspections
- 70 - 80 % accurate
- Rather insensitive to uncertainty in input-data

Roadmap

- Extending database
 - More expert opinions
 - Field data of double inspected sewer sections
- Sensitivity analysis on critical factors
 - Influence of missing data in critical factors

Roadmap

- SPIRIT version 1.0 available spring 2006
- Testing by sewer management software suppliers
- 2007 in sewer management software packages
- 2008 evaluation and possible first update

Outlook

- **Updates**
 - Long term predictions
 - Narrowing reliability bandwidth
- **Analysing Database**
 - Weighing up critical factors
 - National assessment on state of sewers

Outlook

- **International co-operation**
 - Filling each others information gaps by data exchange
 - New international working group on predictive asset management of sewer systems ?

Conclusions

- **Better planning of maintenance**
 - Lacks prediction of rate of sewer deterioration
 - Currently used models needs lot of data input
- **SPIRIT combines expert opinions and field data**
 - providing more reliable predictions

Conclusions

- **Interactive extension of Database**
 - Self learning model
 - Long term predictions
- **Analysing Database**
 - Most critical factors for sewer deterioration
 - State of sewer systems on national scale

Conclusions

- **(International) co-operation**
 - opportunity to fill each others information gaps

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