Route Optimization Workshop

Nienke Jansen

15-12-2025

ORTEC

Agenda

01 Introduction

02 Problem & complexity

03 Solution methods

04 Projects and challenges

05 AI and the future

ORTEC

01

Introduction

What we do as ORTEC

ORTEC

Operations **R**esearch **TEC**hnology

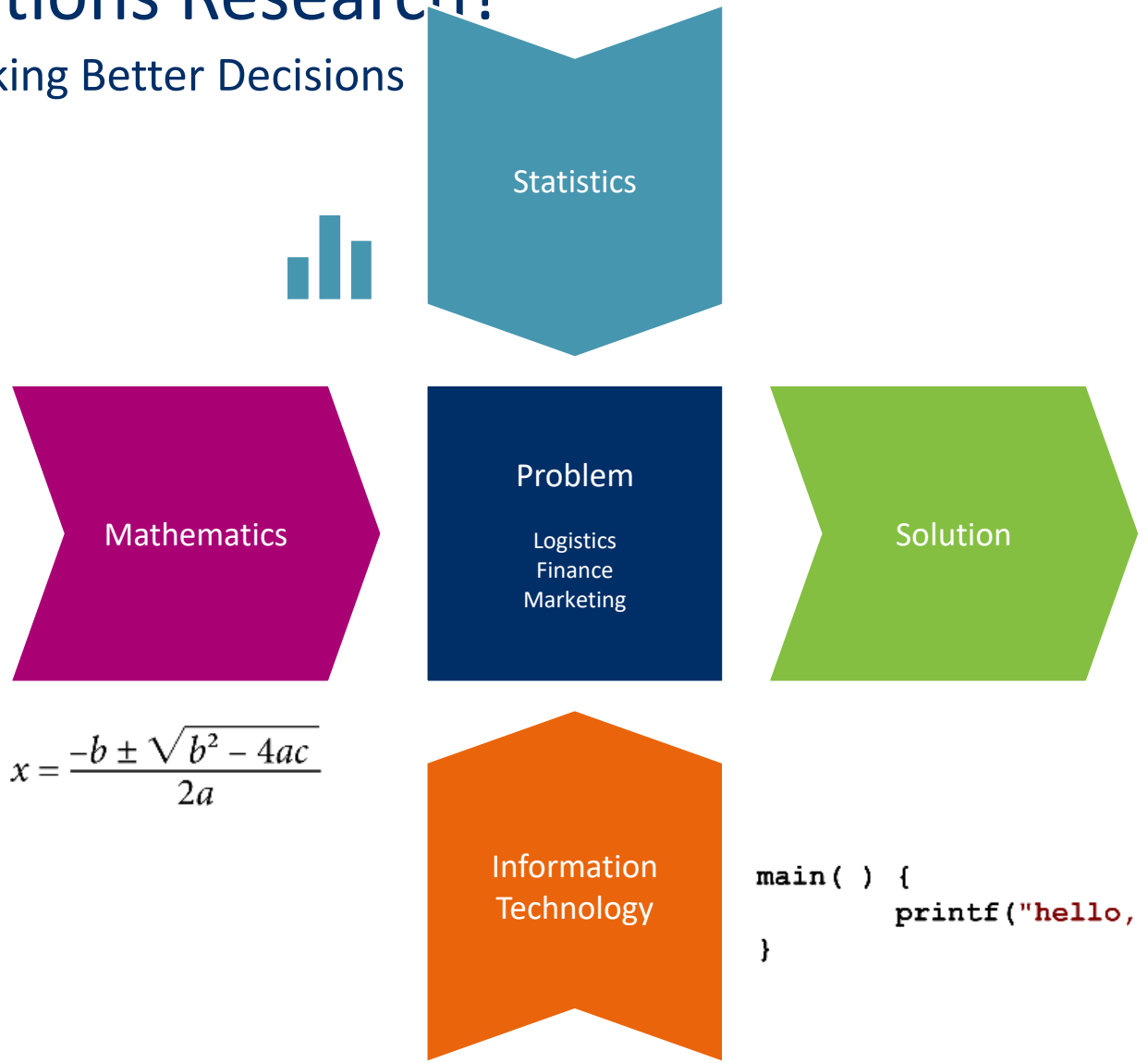
Optimize Your World

About ORTEC

- Founded in 1981
- Offices in 13 countries
- 1.200 customers
- > 1.000 employees

What is Operations Research?

Science and Art of Making Better Decisions



$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

```
main( ) {
        printf("hello, world");
}
```


ORTEC

What is Operations Research used for?

Decision-making in real world problems

Scheduling: hospital patients, classes, buses, planes, sporting events
Marketing: store layout, advertising, social media, online ad placement, recommendations on a website
Product development: product features, pricing sales forecasts
Inventory: how many to build; how many touchpads store should have in stock
Organizations: business management, cross-cultural issues, social networks
Queueing: waiting lines at amusement parks, banks, movie theatres; traffic

ORTEC

Optimize Your World

Supply chain planning
Route planning

Route Optimization
Pallet and Load Building
Warehousing

Workforce management
Personeelsplanning

Capacity & Resource Planning
Workforce optimization

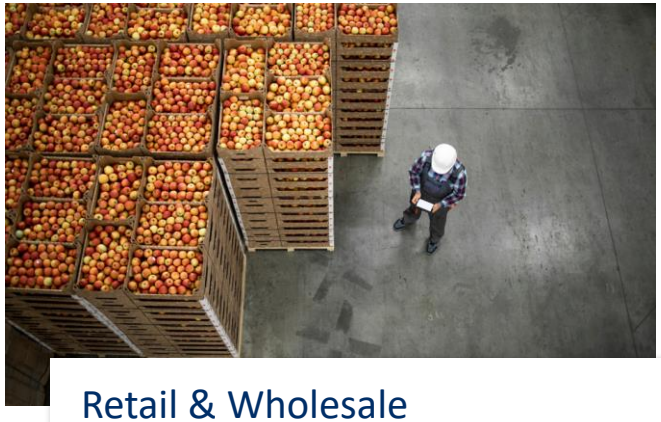
Data Science and Consulting

Big Data
Marketing & e-Commerce
Dynamic Pricing & Revenue Management
Demand Forecasting
Cost Estimating

ORTEC

Industries

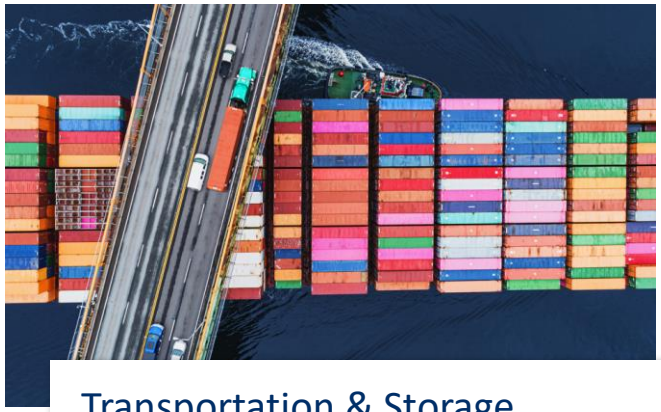
Manufacturing



Retail & Wholesale

Energy

Professional & Technical Services



Transportation & Storage

Healthcare

Optimize Your World

Supply chain planning
Route planning

Route Optimization
Pallet and Load Building
Warehousing

Workforce management

Capacity & Resource Planning
Workforce optimization

Data Science and Consulting

Big Data
Marketing & e-Commerce
Dynamic Pricing & Revenue Management
Demand Forecasting
Cost Estimating

ORTEC

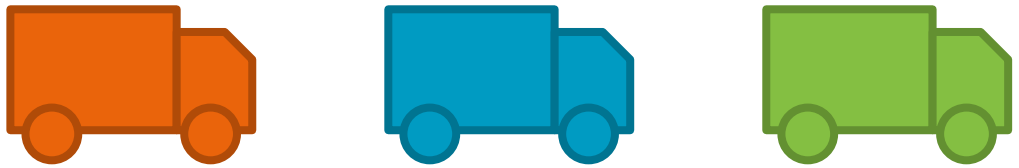
02

Problem

Vehicle routing

Vehicle Routing Problem (VRP)

Vehicles

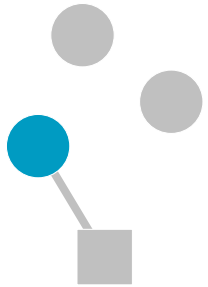


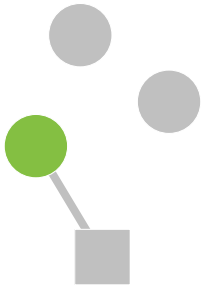
Depot

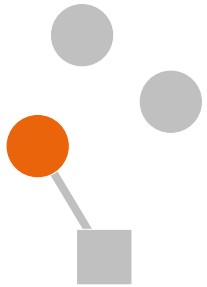
Customers

ORTEC

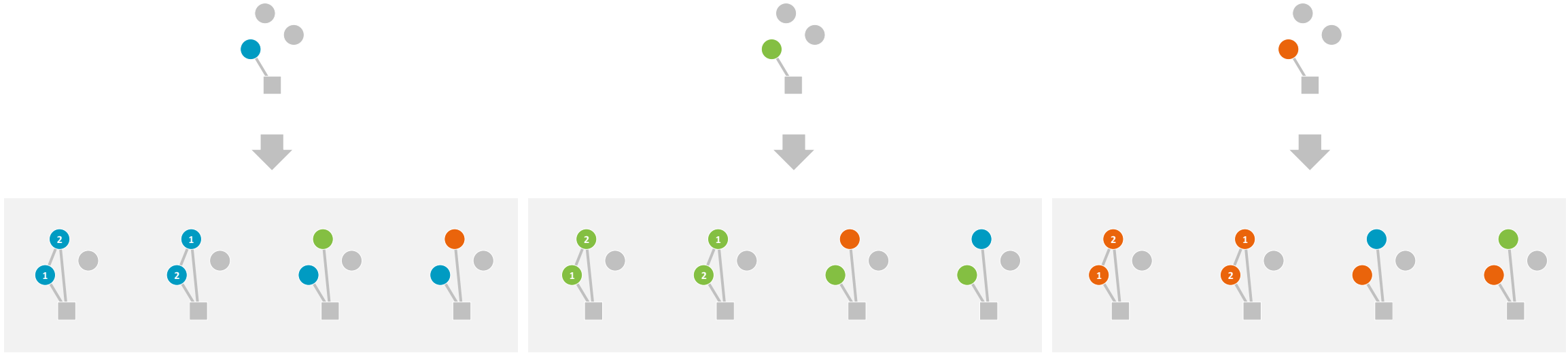
Plan Customer 1



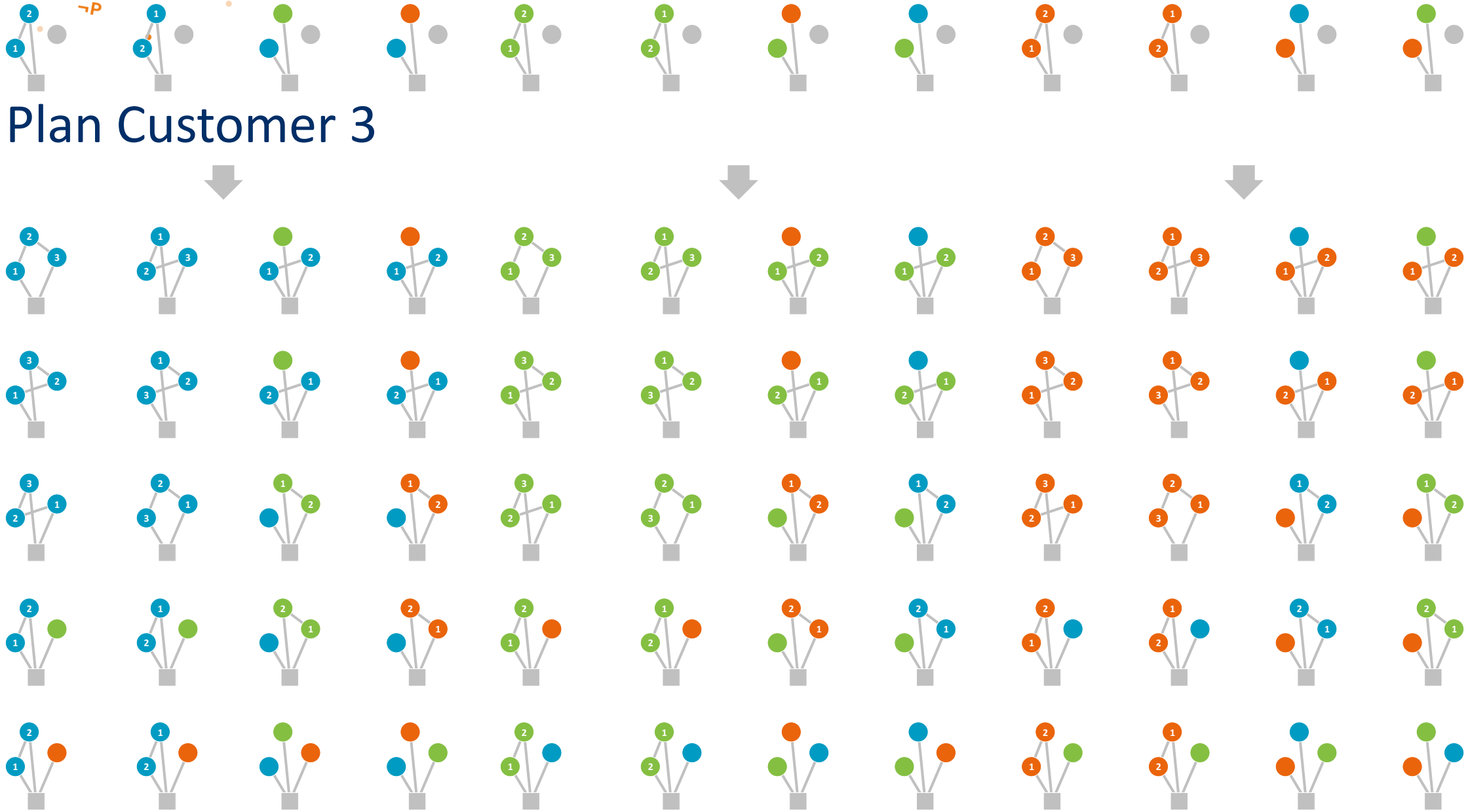




Plan Customer 2



Plan Customer 3



Optimization Complexity

$$Number\ of\ Solutions = \frac{(Vehicles + Customers - 1)!}{(Vehicles - 1)!}$$

Optimization Complexity

Vehicles	Customers	Formula	Solutions
3	3	3 x 4 x 5	60
3	6	3 x 4 x 5 x 6 x 7 x 8	20,160
3	9	3 x 4 x 5 x 6 x 7 x 8 x 9 x 10 x 11	19,958,400
5	25	5 x 6 x 7 x 8 x 9 x 10 x 11 x 12 x 13 x 14 x 15 x 16 x 17 x 18 x 19 x 20 x 21 x 22 x 23 x 24 x 25 x 26 x 27 x 28 x 29	368,406,749,739,154,000,000,000,000,000 = 368×10^{27}
m	*n*	*m x (m + 1) x … x (m + n - 1)*	

"Freshful has handled over 3000 customers in a single day in peak season"

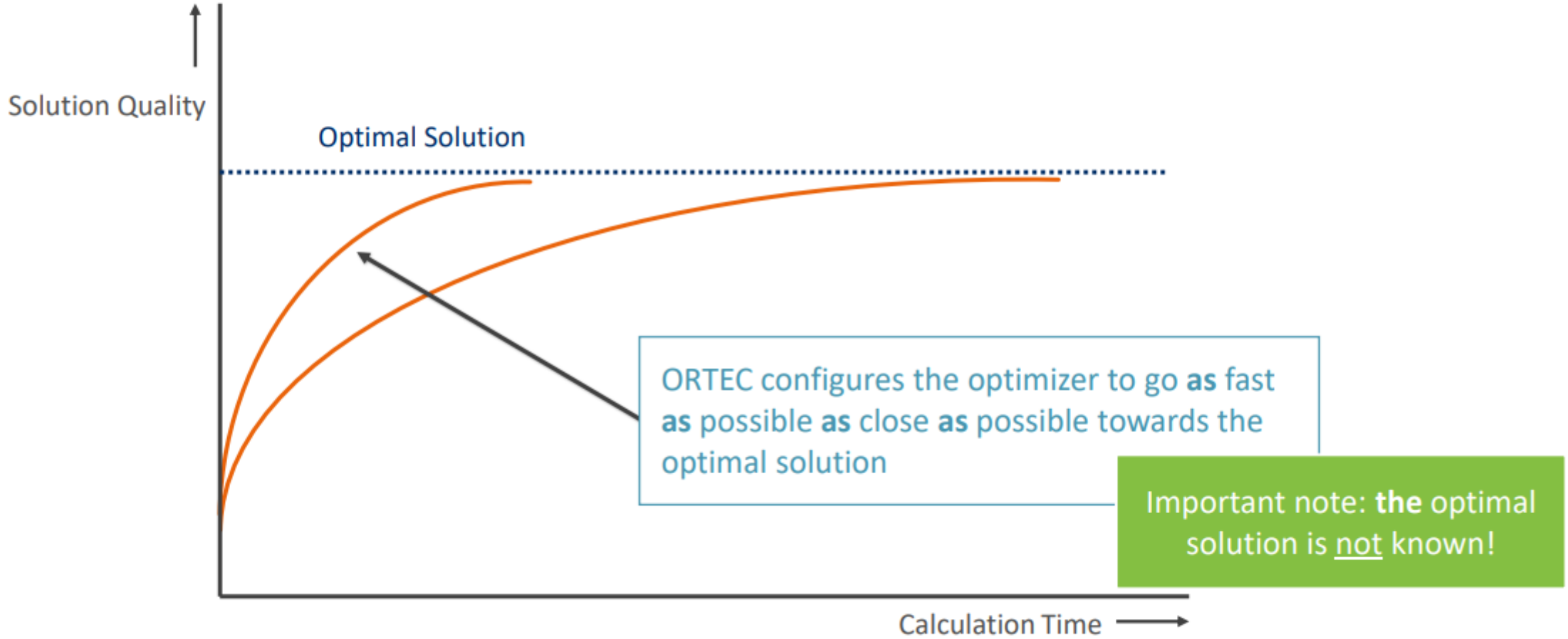
For 5 vehicles and 25 customers → more than 10 trillion years calculation time

Moore's law: speed doubles every few years

ORTEC

Theory

Heuristics choose from many possibilities



ORTEC

Optimization Complexity

Exact Methods

- Small problem instances
- Examine all solutions

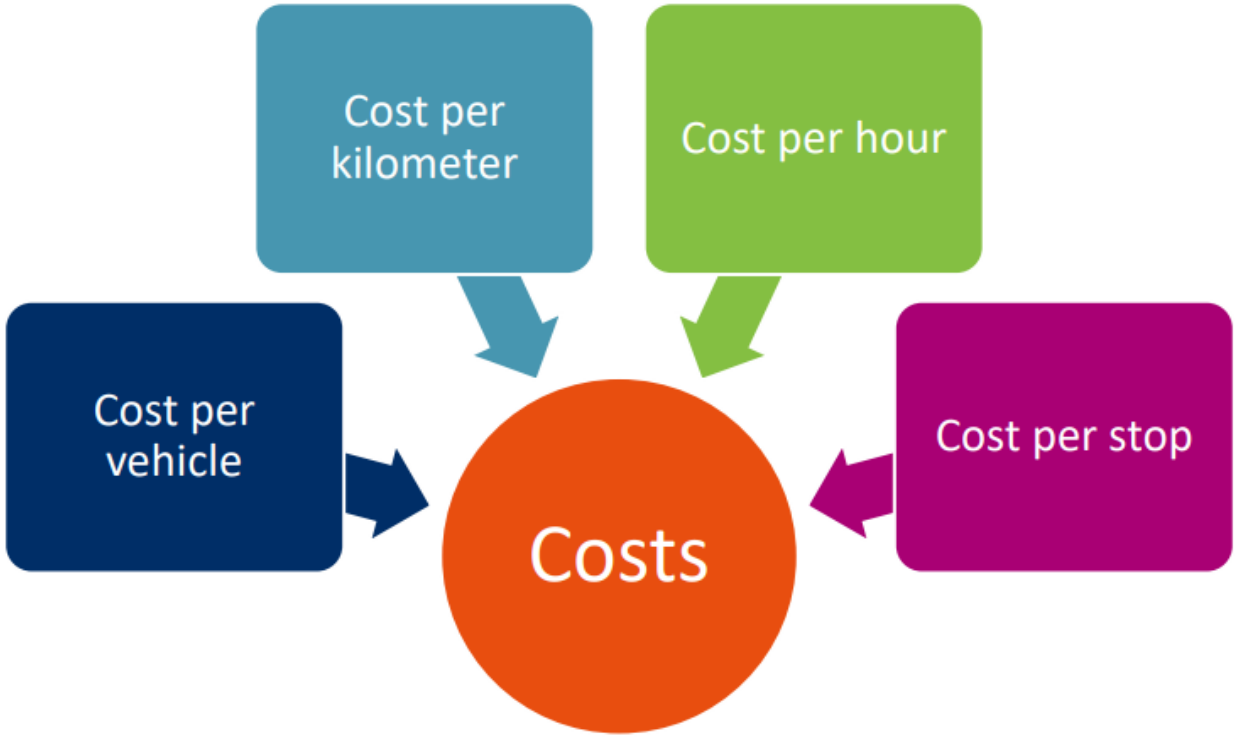
Approximation Methods

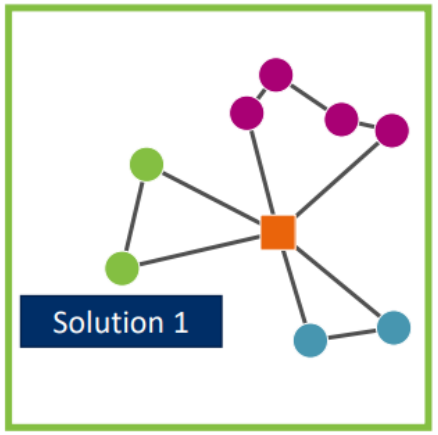
- Small to large problem instances
- Optimization strategy modeled based on data, business rules, and objectives
- Heuristics
- Metaheuristics

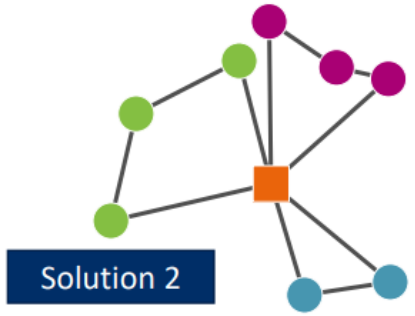
ORTEC

Best solution

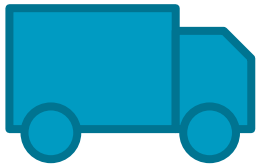
- Number of customers served
- Costs







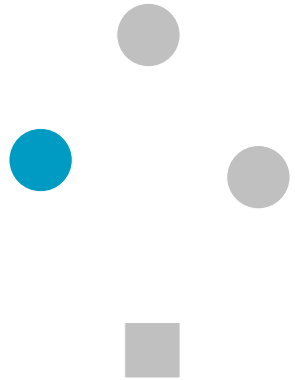
Cost per vehicle

- Salary of a driver
- Buying vehicle
- Maintaining vehicle
- Less km -> less gas

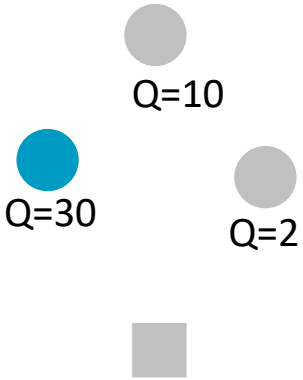
- More orders
- More business & profit

Constraints



ORTEC

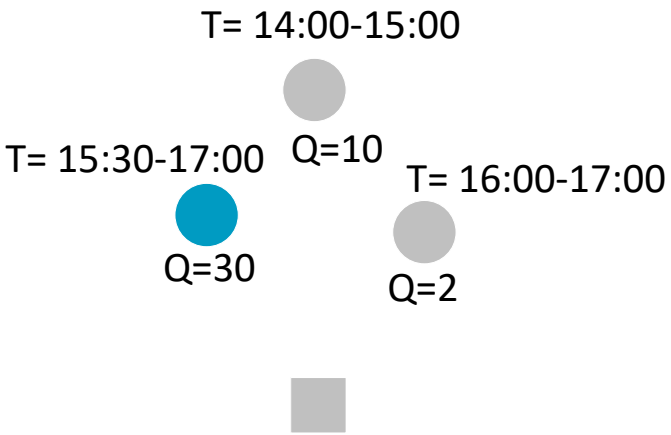
Constraints



Quantities

- Kg
- Volume

Constraints



Quantities

- Kg
- Volume

Times

- Order times
- Driving times
- Working times
- Service times

03

Solution methods

How to solve an unsolvable problem

ORTEC

Optimization Complexity

Exact Methods

- Small problem instances
- Examine all solutions

Approximation Methods

- Small to large problem instances
- Optimization strategy modeled based on data, business rules, and objectives
- Heuristics
- Metaheuristics

ORTEC

Optimization Technology

Solution Approach

Construction

- Rule based & geographical based strategy to build initial routes
- Plan as many orders as possible (or the ones with most profit)
- Initial focus on 'difficult orders'

Local Search

- Heuristics that search 'locally' to minimize cost: reduce km/miles, reduce hours, reduce overtime, reduce routes, etc.

Ruin and Recreate

- Metaheuristics that search on both a 'local' and 'global' scale for improvements:

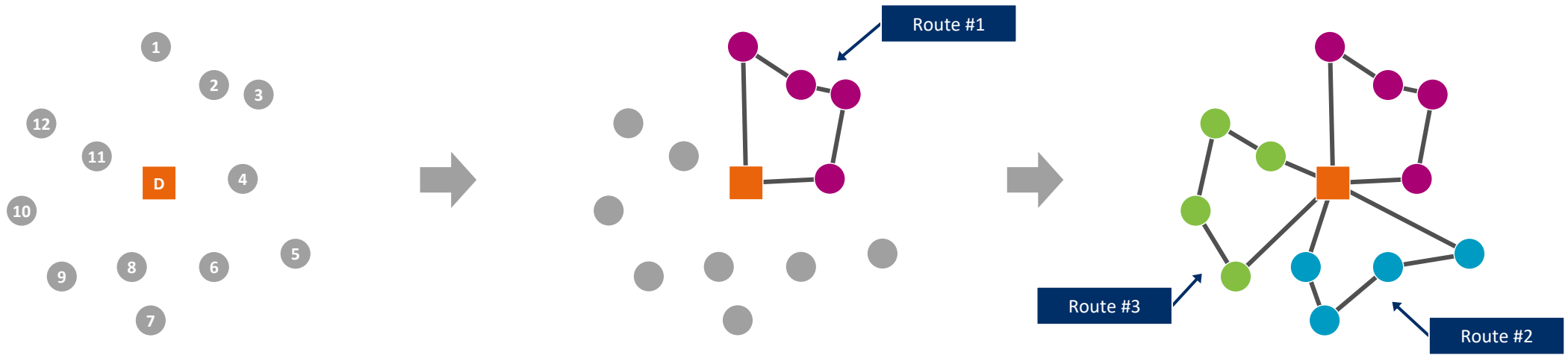
  Ruin and Recreate

ORTEC

Phase 1 · Build Routes

Sequential Insertion – Route per route
Parallel Insertion – all routes simultaneously

Taking into account the business rules



Unplanned Stops

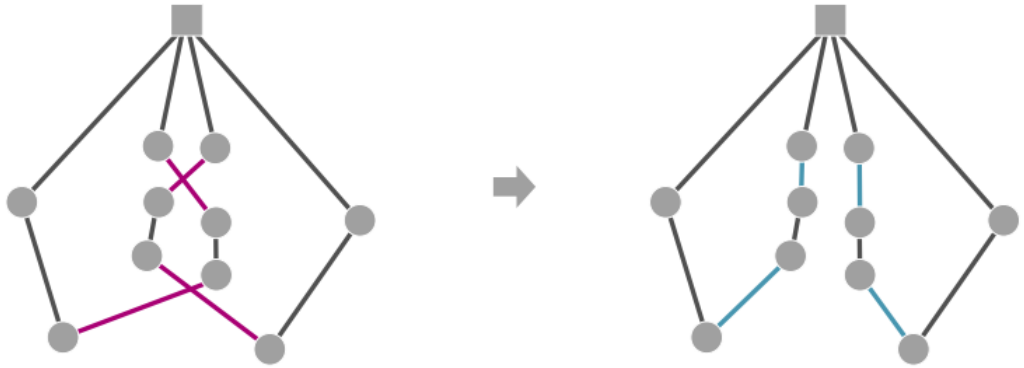
Build Route #1

Build Route #2 and #3

Phase 2 – Local Improvements

2-opt – redirect two travels

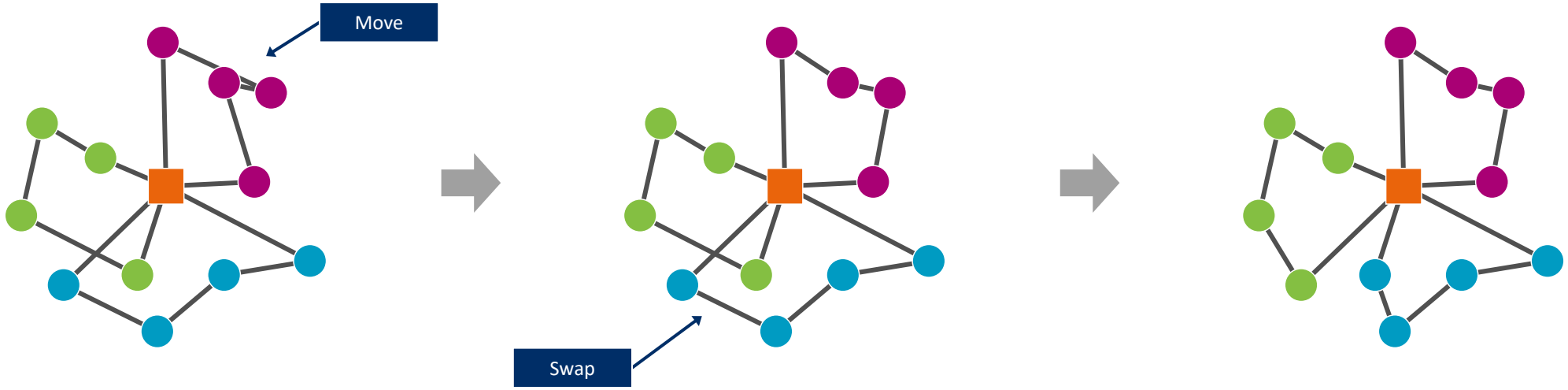
Cross Exchange – redirect 4 travels



ORTEC

Phase 2 · Local Improvements

Move – Move an order to another place in the solution
Swap – Swap two orders in the solution



Start Situation

Move Stop

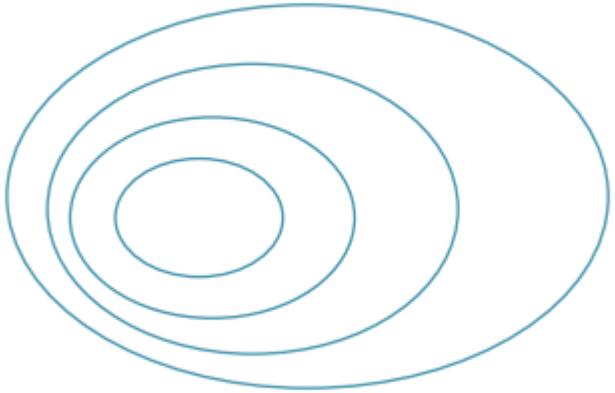
Swap Stops

ORTEC

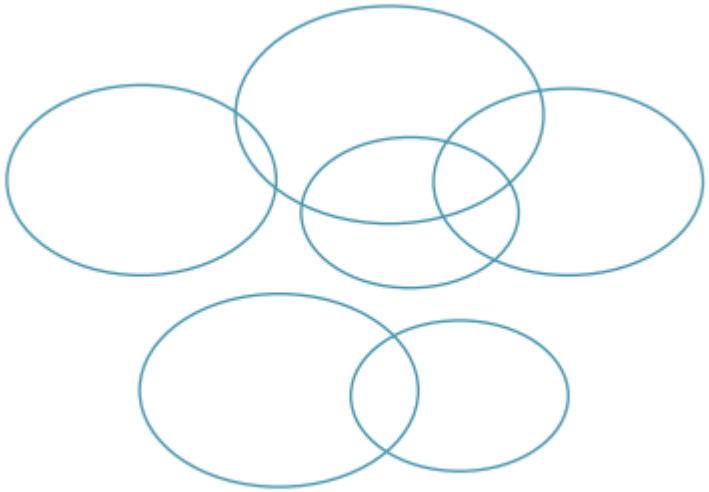
Theory

Intensification and Diversification

- Intensification implies searching for solutions near good solutions that are already found
- Diversification implies exploring parts of the solution space that are known or not yet visited



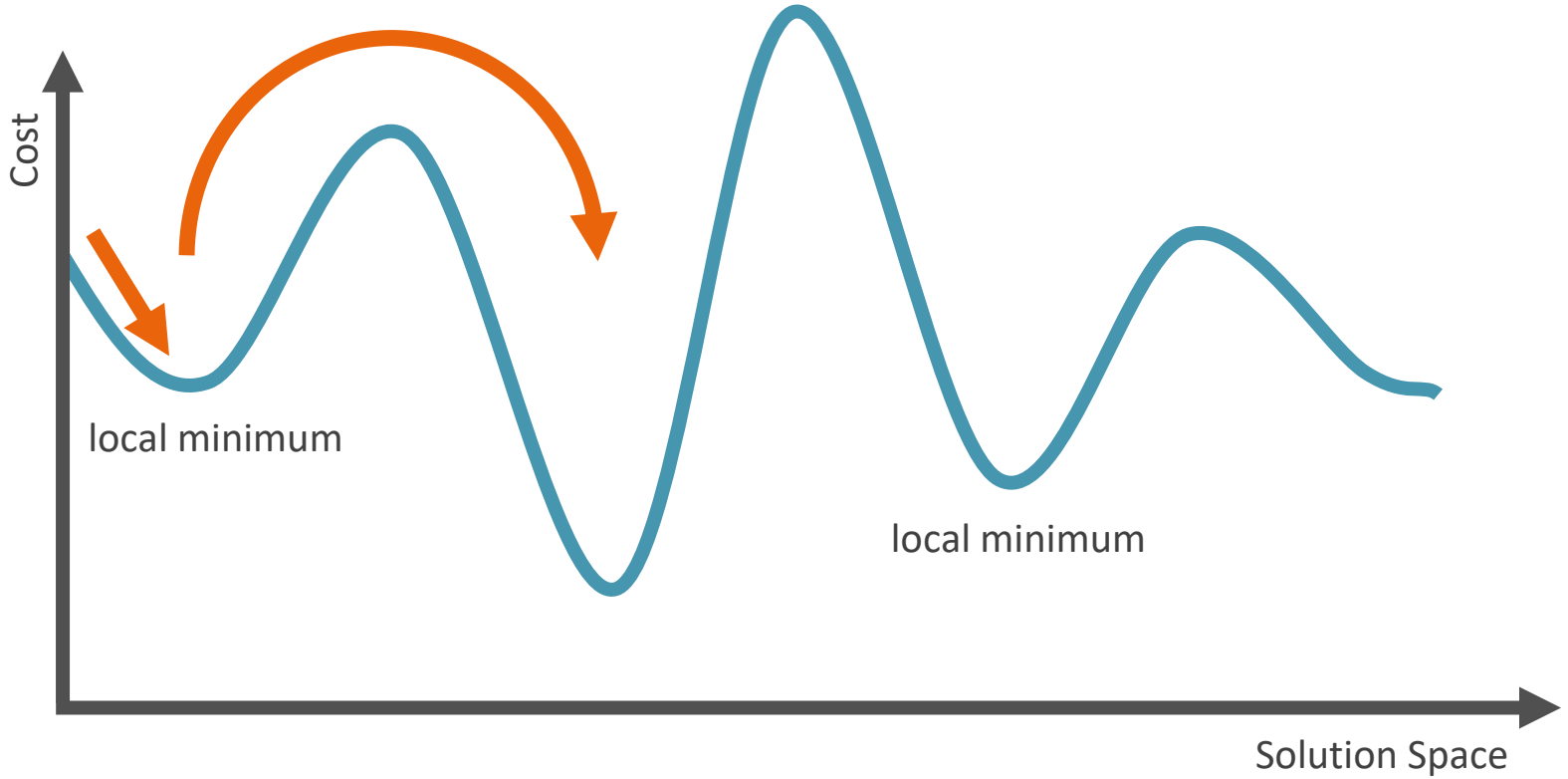
Intensification



Diversification

Phase 3 · Global Improvements

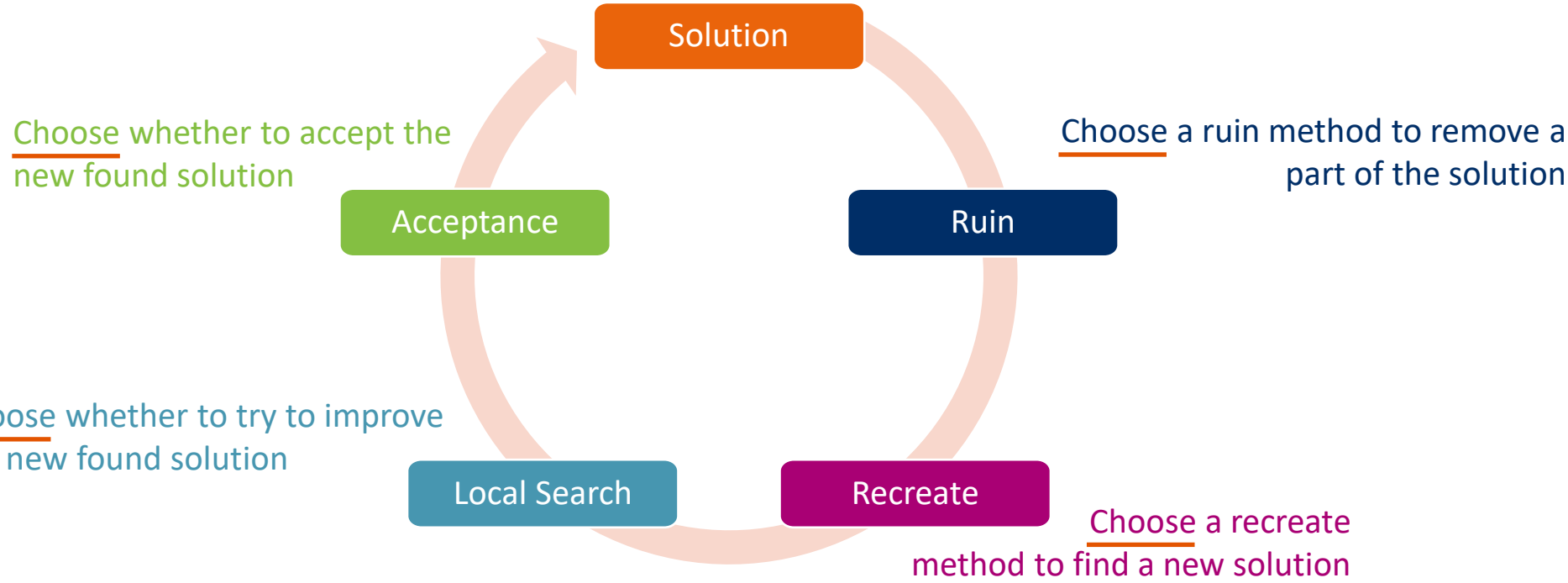
Optimize by making global changes



ORTEC

Phase 3 · Global Improvements

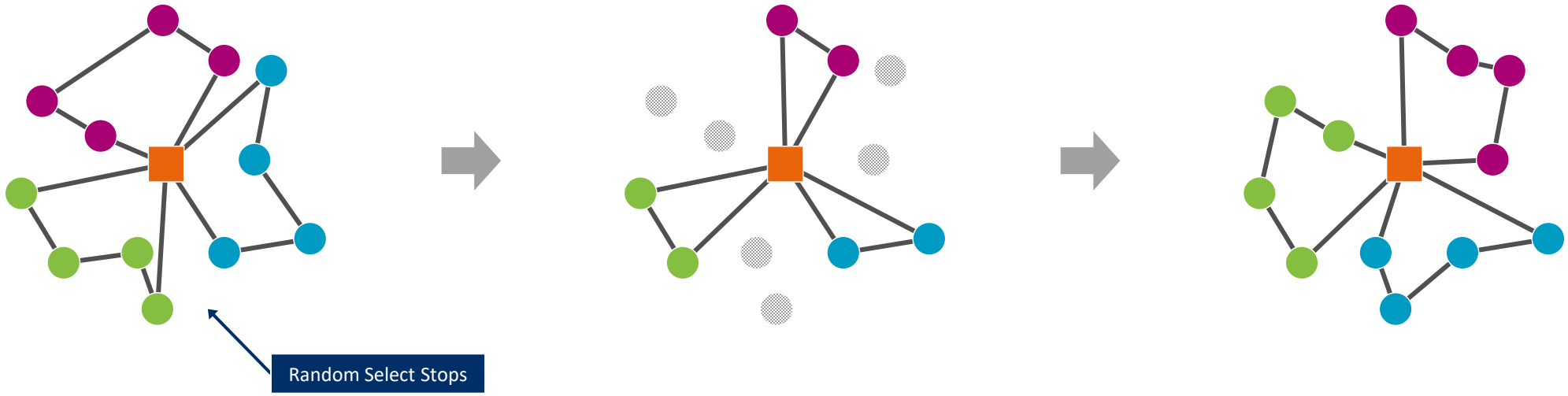
Ruin and Recreate



ORTEC

Phase 3 · Global Improvements

Ruin and Recreate



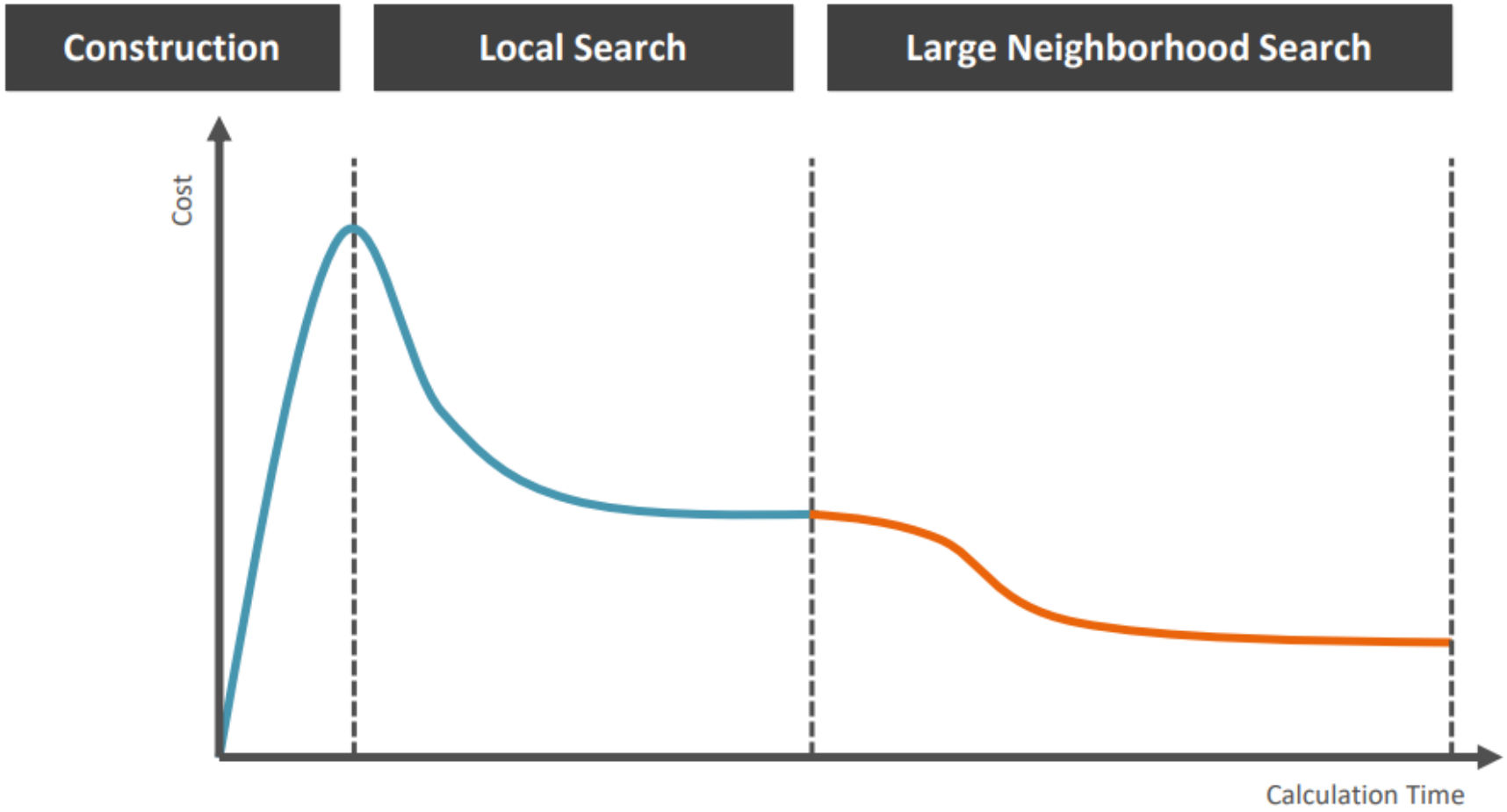
Start Situation

Remove Stops

Re-insert Stops

ORTEC

Overview of optimization flow



ORTEC

04

Projects & challenges

How to implement a workable solution

Optimization Framework

Business Analysis and Design

Via business analysis the Customer's business needs are translated into the optimization design.

This creates a mutual understanding of the scope and details of the project.

Baseline and Business Rules Validation

The baseline, which serves as a basis for evaluating the optimization, is created and validated in the system.

The data quality is assessed, and the business rules are validated.

What is a baseline?

- A baseline is today's route planning of a set of agreed representative cases, in the ORTEC system.

Purpose of a Baseline

?

- Validate Data
- Validate Business Rules
- Measure improvements by optimization and compare to the success criteria

ORTEC

Optimization Framework

Business Analysis and Design

Via business analysis the Customer's business needs are translated into the optimization design.

This creates a mutual understanding of the scope and details of the project.

Baseline and Business Rules Validation

The baseline, which serves as a basis for evaluating the optimization, is created and validated in the system.

The data quality is assessed, and the business rules are validated.

Modeling and Validation

The optimization modeling is performed, evaluated, and validated against the baseline.

Based on the feedback on the optimization results the model is iteratively enhanced.

Optimization Configuration

ORTEC

Optimization Framework

Business Analysis and Design

Via business analysis the Customer's business needs are translated into the optimization design.

This creates a mutual understanding of the scope and details of the project.

Baseline and Business Rules Validation

The baseline, which serves as a basis for evaluating the optimization, is created and validated in the system.

The data quality is assessed, and the business rules are validated.

Modeling and Validation

The optimization modeling is performed, evaluated, and validated against the baseline.

Based on the feedback on the optimization results the model is iteratively enhanced.

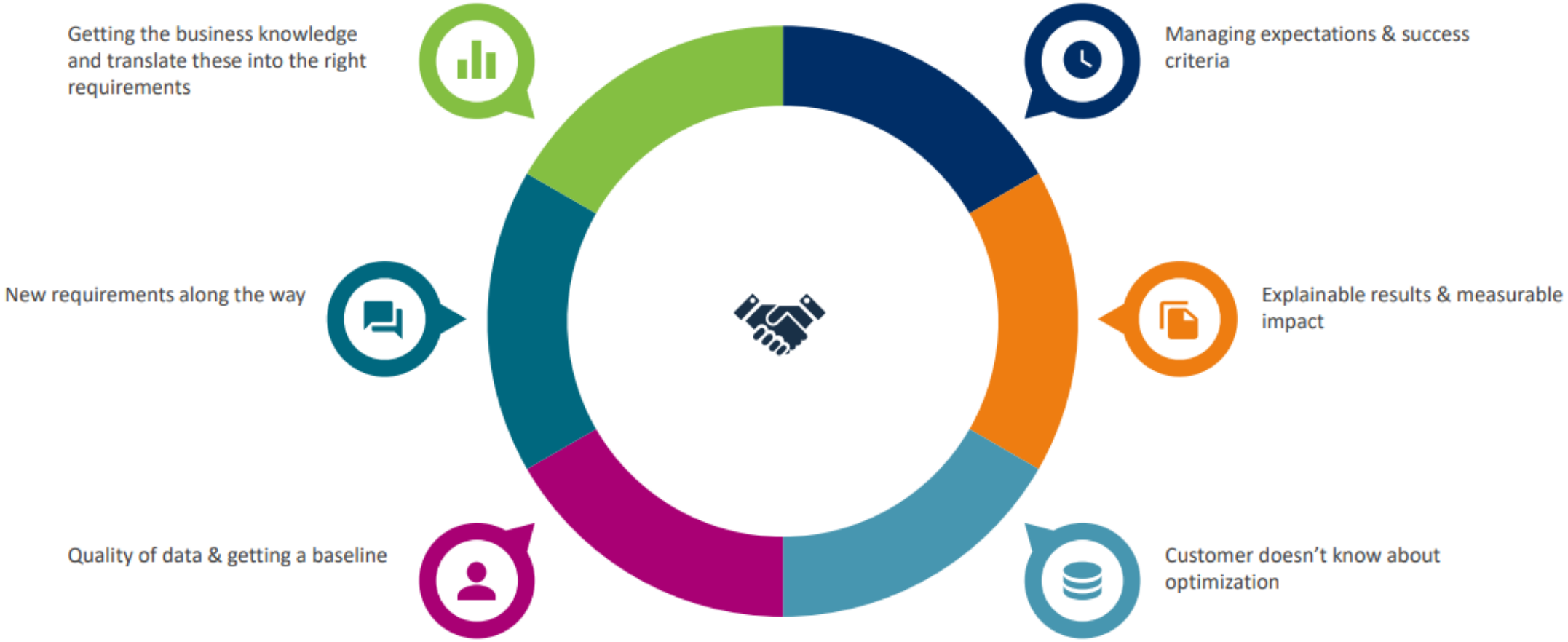
Delivery and Support

The solution is delivered, and all use cases are tested.

Optimization is embedded in the daily work of the Planners.

ORTEC

Challenges when running projects (with Optimization involved)



04

AI and the future

Try and feel the complexity yourself

ORTEC

AI

- Historic data
- Machine learning models & predictions
  - Customer demand
  - Driving times

What does the future look like?

Questions?

ORTEC

ORTEC