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Are we ready for SAE Level 4 (on) Motorways? (PPT)

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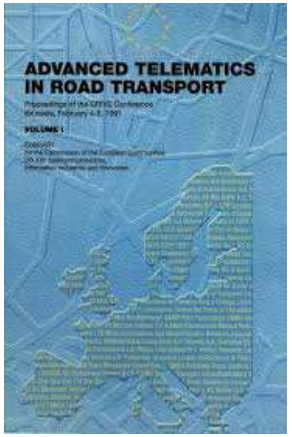
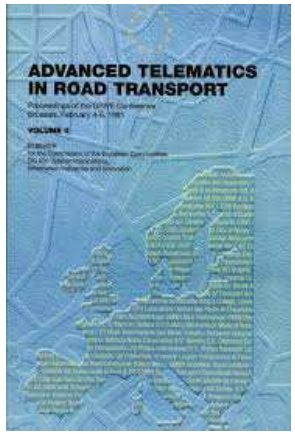
Are we ready for SAE Level 4 (on) Motorways?

Bart van Arem

How I met Frans…





AMSTERDAM GROUP

Get It In On The Road, Get It In the Vehicle.

Declaration of Amsterdam

Cooperation in the field of connected and automated driving

14-15 April 2016

High expectations rest on Automated Driving

Automated cars can improve traffic efficiency and safety

Netherlands to facilitate large scale testing of automated cars

Dealing with 50 shades of automation….

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

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Automated driving

Driver assistance/
Partial automation

Driver needs to be able to intervene at all times

Automated parking, autocruise

Conditional/ High automation

Vehicle in control in special conditions

Taxibots, platooning, automated highways

Comfort, efficiency, safety, costs

Mode choice, location choice, urban and transport planning

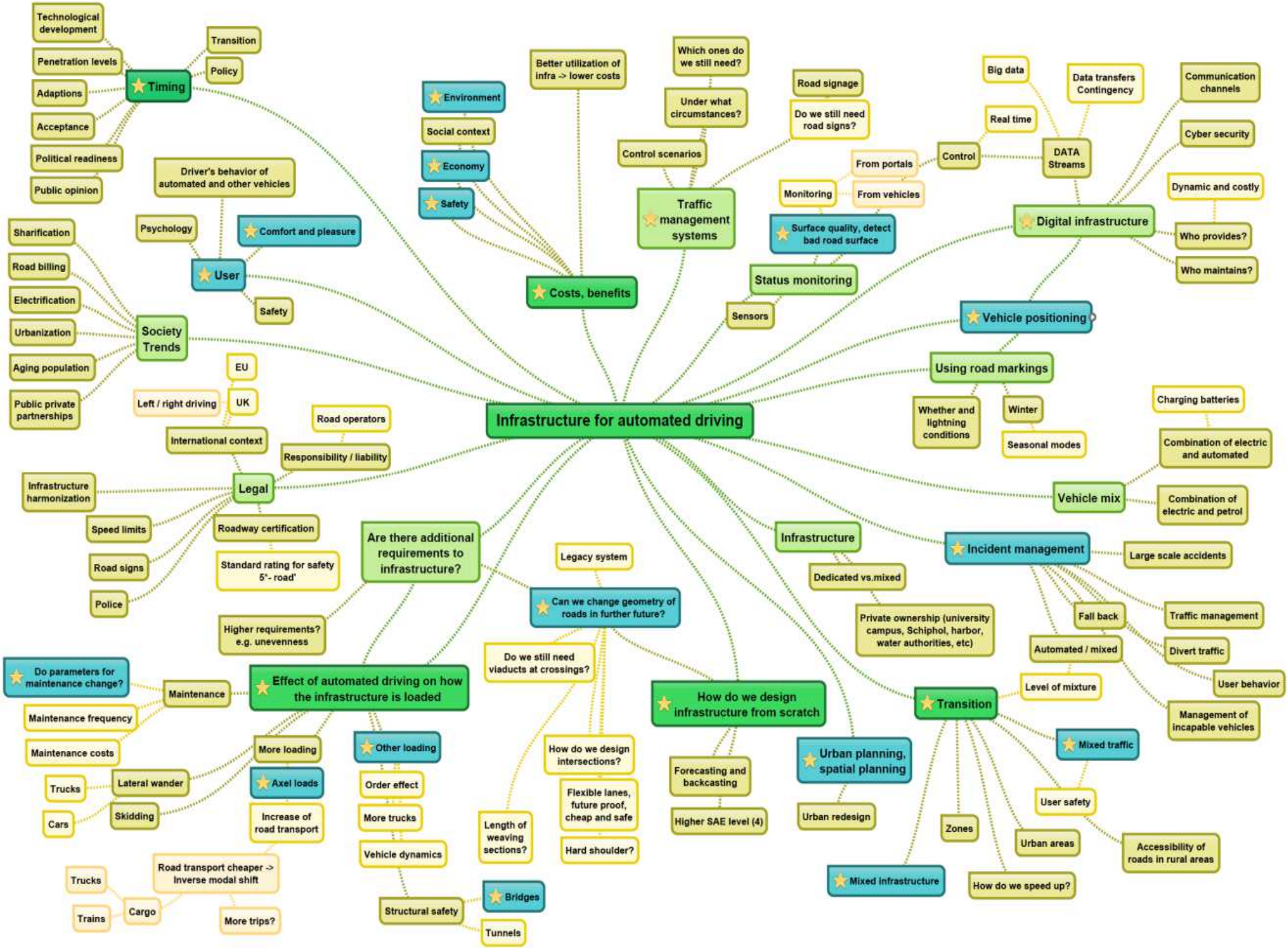
What is it like to ‘drive’ in high automation?

What does a highly automated road look like?

Call in the experts!

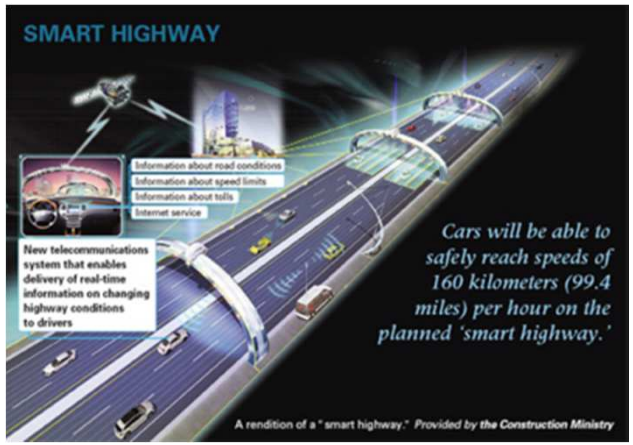
TrafficQuest
CENTRE FOR EXPERTISE ON TRAFFIC MANAGEMENT

InfraQuest
COMPETENCE CENTRE FOR ROADS & STRUCTURES


Infrastructure for automated driving
Timing
Technological development
Penetration levels
Adaptions
Acceptance
Political readiness
Public opinion
Transition
Policy
User
Driver's behavior of automated and other vehicles
Psychology
Comfort and pleasure
Safety
Society Trends
Sharification
Road billing
Electrification
Urbanization
Aging population
Public private partnerships
Legal
EU
UK
Left / right driving
International context
Road operators
Responsibility / liability
Infrastructure harmonization
Speed limits
Road signs
Police
Roadway certification
Standard rating for safety 5*- road'
Costs, benefits
Environment
Social context
Economy
Safety
Better utilization of infra -> lower costs
Traffic management systems
Which ones do we still need?
Under what circumstances?
Control scenarios
Road signage
Do we still need road signs?
Status monitoring
Sensors
Surface quality, detect bad road surface
Monitoring
From portals
From vehicles
Digital infrastructure
Control
Real time
Big data
DATA Streams
Data transfers Contingency
Communication channels
Cyber security
Dynamic and costly
Who provides?
Who maintains?
Vehicle positioning
Using road markings
Whether and lightning conditions
Winter
Seasonal modes
Vehicle mix
Charging batteries
Combination of electric and automated
Combination of electric and petrol
Incident management
Large scale accidents
Fall back
Traffic management
Automated / mixed
Divert traffic
User behavior
Management of incapable vehicles
Transition
Level of mixture
Mixed traffic
User safety
Accessibility of roads in rural areas
Urban areas
Zones
How do we speed up?
Mixed infrastructure
Urban planning, spatial planning
Urban redesign
How do we design infrastructure from scratch
Forecasting and backcasting
Higher SAE level (4)
Infrastructure
Dedicated vs.mixed
Private ownership (university campus, Schiphol, harbor, water authorities, etc)
Are there additional requirements to infrastructure?
Higher requirements? e.g. unevenness
Legacy system
Can we change geometry of roads in further future?
Do we still need viaducts at crossings?
Length of weaving sections?
How do we design intersections?
Flexible lanes, future proof, cheap and safe
Hard shoulder?
Effect of automated driving on how the infrastructure is loaded
Maintenance
Do parameters for maintenance change?
Maintenance frequency
Maintenance costs
More loading
Lateral wander
Trucks
Cars
Skidding
Axel loads
Increase of road transport
Other loading
Order effect
More trucks
Vehicle dynamics
Structural safety
Bridges
Tunnels
Road transport cheaper -> Inverse modal shift
Cargo
Trucks
Trains
More trips?

Automated roads?

- Implication of changes in traffic load? Platoons, bridges, rutting?
- Automated driving under adverse roadway and weather conditions?
- Implications for traffic management? Opportunity or thread?
- eHorizon: automated driving cloud for real-time positioning, manoevering and safety?
- Level 4 certified roads?
- Geometric design, transition zones?
- Who is responsible?



Potential impacts on traffic

Solve traffic jams by increased outflow

Prevent traffic jams by better stability

Better distribution of traffic over network

Less congestion delay

Decreased throughput by larger headways

Decreased stability by lack of anticipation

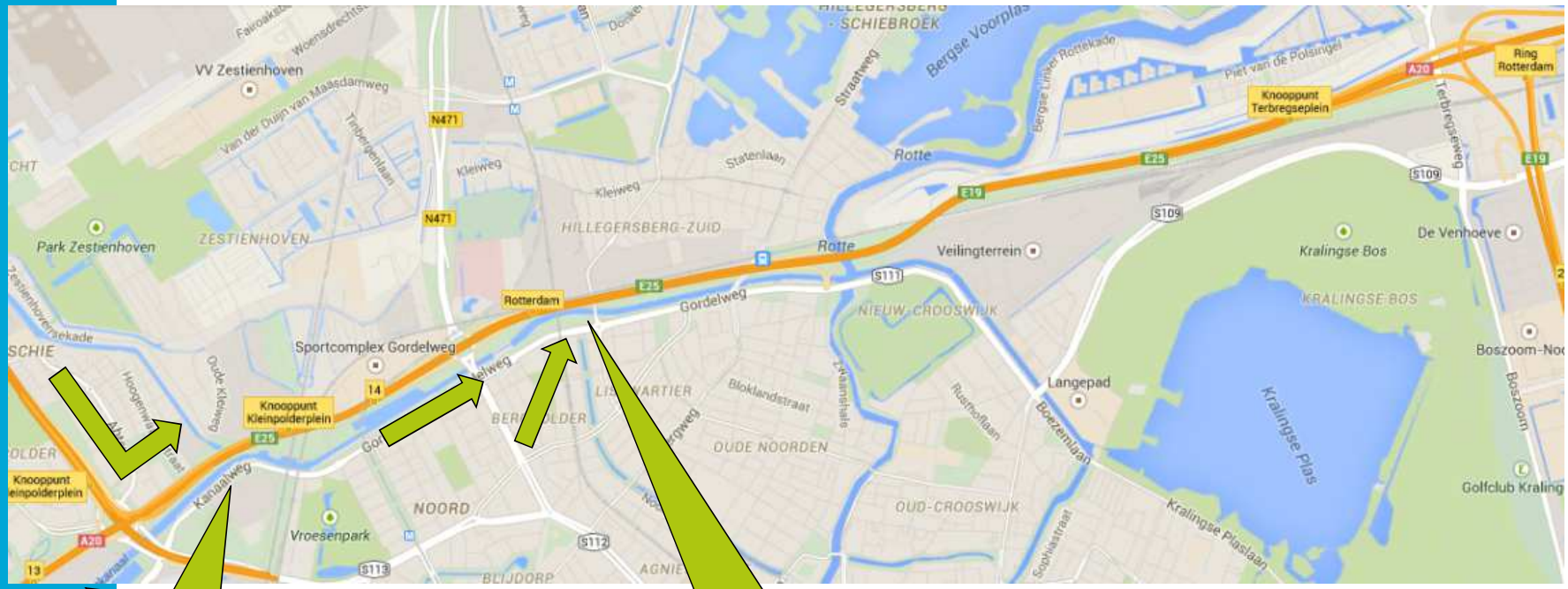
Increased risk of congestion

Non connected
Large penetration

TUDelft

DAVI ONTHEROAD

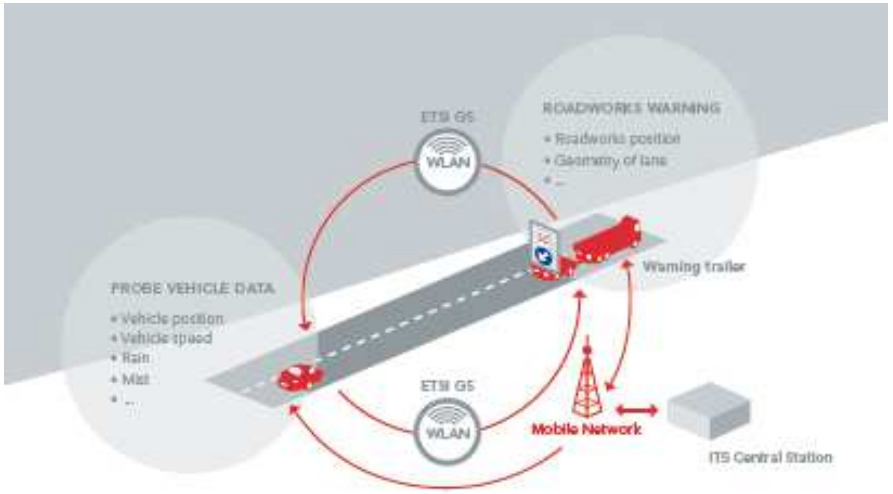
Imagine yourself an automated vehicle!



3+2 cross weaving

Short on-ramp

How can AVs relieve congestion here?



Cooperative ITS Corridor

Joint deployment

V2V	I2V/V2I
Hazardous location warning	Road works warning
Slow vehicle warning	In-vehicle signage
Traffic Jam ahead warning	Signal phase and time
Stationary vehicle warning	Probe Vehicle Data
Emergency Brake light	
Emergency vehicle warning	
Motorcycle approaching indication	

(Very rough) Exploration using LMS

Automated Autonomous

5% capacity decrease on primary road network

	Index km travelled
Train	100.3
Car driver	99.8
Car passenger	99.7
Bus, tram, metro	100.2
Cycling	100.1
Walking	100.1
Total	99.98

Index congestion 115.7

Automated Cooperative

15% capacity increase primary road network
10% capacity increase secondary road network
10% decrease value of time commuting and business car trips

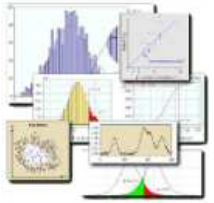
	Index km travelled
Train	98.8
Car driver	100.8
Car passenger	101.4
Bus, tram, metro	99.2
Cycling	99.3
Walking	99.4
Total	100.10

Index congestion 69.1

From demonstration to research and deployment!

Develope efficient and reliable technology

Collect, analyse and publish large scale real-world experience



Study spatial, transport and societal impacts

Regulations, type approval

Awareness, ambitions, expectations, reality checks

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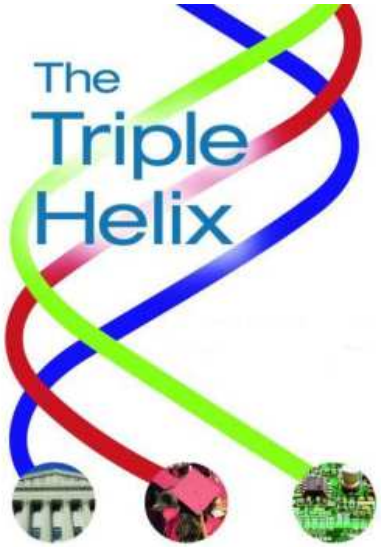
TUDelft

What we can learn from Frans