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Dutch leading journal  
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March 2018  
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# magazine

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iCentre programme in the Netherlands

# Smarter, more efficient control centre operation

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## Colophon

NM Magazine is published three to four times a year in Dutch. Special English edition, March 2018.

### About this magazine

NM Magazine is a (Dutch) specialist journal about network management and intelligent transport systems. The aim is to offer an independent platform for the further development of these fields, by informing readers about new developments and by facilitating discussions. Views and opinions expressed by interviewees and (external) authors do not necessarily reflect the views of the publisher.

### Publisher

Stichting NM Magazine  
PO Box 61639  
2506 AP The Hague  
The Netherlands

### Board

Jos van Kleef (*Goudappel Coffeng*)  
Prof. Serge Hoogendoorn  
(*Delft University of Technology*)  
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### Production

Essencia Communicatie, The Hague

### Contributors

Ropp Schouten (*design*)  
Arjan Doelman (*design*)  
Louis Haagman (*photography*)  
Eunice Driesprong (*traffic*)  
Steffart Buijs (*traffic*)  
Coline Lugassy (*proof reading*)

### Printing

Platform P, Rotterdam

### Subscriptions

NM Magazine is distributed free of charge to the target group. Applications for or changes to a subscription can be made via [abonnementen@nm-magazine.nl](mailto:abonnementen@nm-magazine.nl).

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ISSN 1875-2179







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## EDITORS' REMARKS

This is a special edition of NM Magazine, an international edition devoted entirely to the iCentre programme. It is the first time that we have published our Dutch journal in English, and for good reason. In our previous (regular) edition, we already paid a lot of attention to the iCentre but that magazine has only been distributed in the Netherlands and Flanders, Belgium. In the meantime, the parties involved have successfully progressed with the smart organization of operation control centres – and we think the time has come to spread the news to a wider audience.

In itself, iCentre could be considered a 'typical Dutch' project. The programme is a good example of the Dutch drive for collaboration and consensus. Six local authorities and thirteen private parties are working in iCentre to structure operation control centres more efficiently for traffic management, city management, tunnel management and bridge and lock operation. A province or municipality could implement such an improvement process much faster alone, and end up with a few useful efficiencies along the way, but in the small country we call the Netherlands, we tend to want something bigger. We see economies of scale, new business models, win-win opportunities, leaps of innovation and extra savings, and so strike up national alliances.

While all this may take extra time, there is often really more to be gained. The efforts in the iCentre programme have, in any case, led to some very interesting concepts, products and services. Moreover, the first analyses of regional cases show that these concepts, products and services actually do the job: they are cost-saving and improve traffic flow. And to say that we only need it in the Netherlands would be a huge understatement. That is why we planned an international NM Magazine.

We sincerely hope that through this knowledge sharing, you – road authority or service provider in Germany, Denmark, Great Britain, Japan, the United States or wherever – will get ideas.

Enjoy your read!

The editors  
[redactie@nm-magazine.nl](mailto:redactie@nm-magazine.nl)

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## Field test: 24/7 traffic management by subscription



In the autumn of 2017, a number of public-private parties of the iCentre programme carried out a successful live field test with the iService 'Traffic management in evening hours and at weekends'.

The iService field test shows that operation over large distances between control centres is possible through smart integration and deployment of multidomain operators. As a result, traffic management is no longer dependent on capacity at one location and one domain: the live field test has shown that municipalities and provinces can easily conduct 24/7 traffic management at low cost on the basis of a subscription.

### Taking over each other's work

During the field test, an incident was simulated in the Waterwolf Tunnel of the province of Noord-Holland whereby the operator in the operation control centre in Hoofddorp had to give priority to tunnel management and was, therefore, temporarily unable to take care of his traffic management (TM) tasks. As there was a major event in the Amsterdam Metropolitan Area at the same time, this meant the prospect of considerable traffic jams for road users in the region. In this live test situation, a (private) operation control centre in Schiedam took on the TM tasks. The overall network coordination tasks were delivered by a network coordinator from another (private) operation control centre in Utrecht.

### iService for evening, weekend and peak

This live field test shows that 24/7 traffic management can be facilitated by cleverly combining and integrating domains, using multidomain operators and facilitating (private) remote control. Municipalities and provinces do not have to man their control centres unnecessarily, but can purchase iServices instead. As a result, service to drivers is also guaranteed during evening hours, at weekends and peak times, while the costs are lower.

## European tender awarded for operation control centre according to multidomain iServices

In January 2018, the province of Noord-Holland awarded the tender for the implementation of multidomain operation in the Hoofddorp operation control centre, with the existing control centres for the tunnels, traffic management and bridges and locks being combined using 'products' developed in the iCentre programme. The province of Noord-Holland is thus a launching customer for these iServices.

The tender was awarded to a consortium of Trigion, Enai and Be-Mobile. Together, these companies have all the necessary expertise. They have indicated that they will deliver the requested functionalities within time and specifications.

### More synergy and smart combinations with existing systems

By awarding this tender, the province wants to achieve more synergy by cleverly combining and integrating tunnel and bridge operation and traffic management from the existing control centre in Hoofddorp. The aim is to achieve better multimodal network performance, to provide better service to road users, residents and companies, and to reduce integrated (operating) costs.

### Launching customer for products from the iCentre programme

The province of Noord-Holland acts as a launching customer by implementing developments and products from the iCentre programme in its own existing operation control centres. In order to be able to use the learning experiences (content, process, purchasing) that are acquired nationally for the benefit of other local authorities, the province has made it a requirement that the system to be delivered must be capable of being expanded and scaled up to all six domains of the iCentre programme. The system to be delivered must also be usable, open and scalable for other local authorities.



## First KPI-controlled tunnel management centre in the Netherlands

The province of Noord-Holland launched the first fully KPI-controlled tunnel management control centre in the Netherlands in 2017.

In November 2017, the province of Noord-Holland gave private operators the responsibility for implementing the province's tunnel

and traffic management. In order to be able to manage well in terms of the policy objectives for tunnel operation and monitoring, the province had selected 'hard' performance indicators – KPIs – for this domain, such as the maximum time between the occurrence of an incident and the confirmation of an incident by an operator. See also the box on page 13.

## New national CROW standards ready



In early 2018, the Dutch technology platform CROW offered three national standards from the iCentre programme to the Ministry of Infrastructure and Water Management, including a blueprint for the technology of an iCentre.

Working with the so-called iServices can only work well if the authorities and companies apply the same standards. Therefore, the iCentre programme developed several products that can be used on a national scale.

All products in the iCentre programme are made by experts from the authorities and companies. In order to convert these into CROW products and national standards, CROW also involves external public and private experts from across the country for reviews and adoption.

National standards that have appeared from the iCentre and CROW programmes in early 2018 are a *blueprint* for (the architecture of) the technology of an iCentre, *interfaces* for the uniform linking of control centre systems, and *service level agreements* and *key performance indicators* for the SMART recording of performance agreements.

## First iServices presented at national summit



In November 2017, the partners in the iCentre programme presented over twenty iServices for mobility, safety and control centres at the summit entitled 'Mobility, Safety and Smart Centres as a Service'.

By smartly integrating and combining tasks for multiple domains and multiple authorities, the partners of the iCentre programme have developed various multidomain iServices. These services will help municipalities and provinces to improve their performance in the area of city and road management, to serve passengers better and to achieve significant cost reductions.

The directors of the participating private parties jointly presented the first basic versions of the iServices they developed in a public-private partnership at an iCentre Summit on 3 November 2017. The iServices, varying from an iGenerator for an up-to-date multidomain overview to a managing agent that can support the organization of the service, were enthusiastically received by the local authorities. In 2018, these first versions will be developed into fully fledged iServices that provinces and municipalities with, and certainly also *without*, their own operation control centres can purchase based on subscriptions and performance agreements.

**Nationwide iCentre programme**

**Smarter, more efficient  
control centre operation**





By organizing work in the control centres for bridge and lock operations, tunnel monitoring, traffic management, parking management, city access and crowd management in a smarter way, municipal and provincial authorities can make significant savings on their annual operating costs. However, much more can be gained by taking an even broader approach to smart organization, through cooperation and the implementation of national standards and services. The national iCentre programme is a driver of developments and supports the provincial and municipal authorities.

The authorities in the Netherlands together have around 150 different control centres for the management of roads and waterways, tunnels and public spaces, most of which were developed and set up separately to serve a single domain. As a result, many provincial and larger municipal authorities have several control centres. For example, a control centre for bridge and lock operation was once established, adding a traffic management centre at a later stage, followed by a city control centre, and so on.

The overall costs of all of these control centres are substantial, amounting to an estimated annual total of 200,000,000 euros for the whole of the Netherlands, covering the costs of accommodation, systems and applications as well as personnel.

These control centres perform well enough but the reality is also that many operators tend to work on standby. European legislation, for instance, stipulates that tunnels must be monitored 24/7 just to be safe, although, fortunately, emergencies rarely occur.

So the conclusion seems justified that operating tasks could and should be organized **more cost-efficiently**. What would be the best way to achieve this?

### iCentre

That is a good question. To prevent every local authority from having to reinvent an efficiency wheel of its own, in 2016, the provinces of Flevoland, Noord-Holland and Utrecht, along with the municipalities of Almere, The Hague and Rotterdam, came together to explore the options for greater cost efficiency and work out the details. With the support of the Ministry of Infrastructure and the Environment (as it was then known), they set up the **iCentre programme** to this end and invited **private parties** to cooperate on the basis of a nationwide pre-qualification. Thirteen parties signed up: Arcadis, Be-Mobile, Cruxin, DAT.mobility, Dynniq, Goudappel, MAPtm, Siemens, Sweco, Trafficlink, Trigion, Technolution and Vialis. Their participation is not free of obligation: all parties are expected to invest time and resources.\*

### Transitions

The iCentre partners have identified three transitions to enable more efficient structuring of city and road management tasks. One option is for a municipality or province to find a smart solution to combine and integrate its individual, single domain-specific control centres into **one control centre to serve multiple domains**. This will bring loca-

tions for traffic management and the operation of tunnels, bridges and locks, for example, literally under one roof, which saves the organization costs of accommodation, systems and personnel. A second efficiency boost would involve **the joint use of control centres**. Instead of having separate control centres for each municipality or province, there would be one single control centre serving several local authorities. This also saves on costs of accommodation, systems and personnel. A third transition is that the government no longer undertakes everything itself but that (part of) **the work is purchased as a service** from specialist companies. Expectations are that specialized companies are able to leverage economies of scale (doing the same work for several clients) and specialization (being specifically set up for the task) to reduce fees. This transition is also seamlessly aligned with the current trends of 'bringing more to the market' and 'as a service'.\*\*

Besides these transitions, the iCentre is an interesting programme for several other reasons. There is nothing new to control centres serving multiple domains, authorities cooperating on a regional level or the purchase of private services, but what the iCentre adds to this is nationwide **innovation** for and the structured **facilitation** of the transitions. Put simply, a shop is being created with **products and (private) services** that local authorities can purchase as required in order to improve their efficiency gradually. It is even possible – which is interesting for smaller authorities – to purchase control centre operation as a service without the need for local investments.

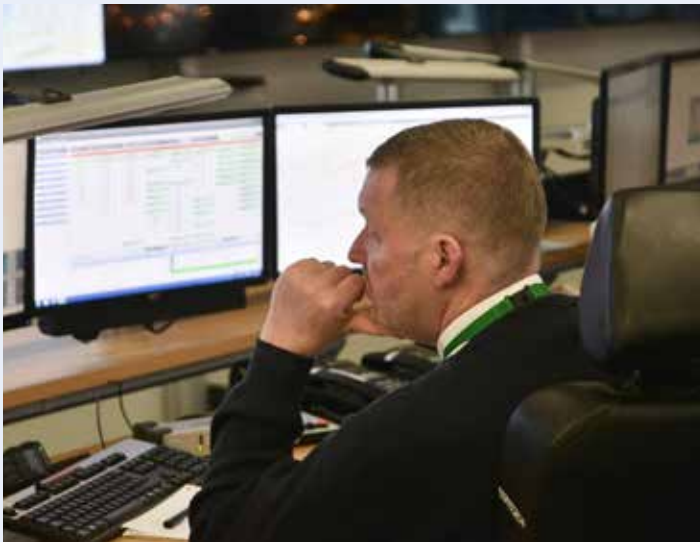
The growing range of services of this iCentre shop is by no means random: they are all part of a well-thought-out and **future-proof structure**, one that is based on a **clear vision** of a smartly integrated operation control centre.

### Vision and structure

The vision of an iCentre, the final picture, is as follows. The 'ideal operation control centre' is suitable for **multidomain operation**. All relevant **information** on the different domains is available and the operators are adequately **trained** to serve multiple domains. To be able to manage the workplace properly and efficiently, there are **key performance indicators** and thresholds that are very realistic as the operators are supported by intelligent applications, with **smart software** taking over an important part of the monitoring and even control tasks. Only where a situation deviates from the norm is the workplace alerted (**trigger-based operation**).

\*The local authorities, private parties and the Ministry of Infrastructure and Water Management communicate about the iCentre via the website [maasandmore.com](http://maasandmore.com).

\*\*The iCentre programme does not advocate any specific transition but leaves it up to the individual provinces and municipalities to decide to what extent they want to pursue any of the transitions.



This final picture did not yet exist at the time, and even today, the details have not yet been agreed upon, but the structure is in place and was designed to ensure that the picture does not need to be complete to offer added value. Important components of the structure include a **step-by-step plan** that helps authorities to introduce performance-based operation – [see the article on pages 12 and 13](#). This plan includes model requests and contracts for the procurement of services on the basis of performance agreements.

An **operation control philosophy** has been defined, including an allocation of roles and a specification of the requisite knowledge and skill competences. [This is addressed in the article on pages 14 and 15](#). In addition, the partners in the programme have created a **blueprint** for the technical structure of an iCentre – [please refer to pages 18 and 19](#) – that uses existing and de facto standards and interfaces that enable existing systems to be reused. Furthermore, the blueprint is subdivided into logical, functional components, allowing several (even smaller) parties to work on them simultaneously. An additional benefit is that this prevents vendor lock-in, as the purchaser of a control centre service can always exchange a component independent of the supplier.

### iServices

Next, we will discuss the services proper, called iServices in the programme. Twenty of them are currently available as initial **basic versions**. That is, regional and local authorities can purchase them but they still require further development. In fact, the first to purchase such a service will enter the development process as the practical experiences gained will be incorporated into the service.

A large number of such real-life cases have already been carried out, together with municipalities and provinces. Below is a brief summary of these live applications:

- **Event Management as a Service (EMaaS)**. During the TT in Assen in June 2017, a ‘pop-up iCentre’ deployed various iServices for traffic, crowd and parking management. [See the box on page 17](#).
- **Multidomain operation training**. This concerns the traffic management training for operators and control centre staff to enable them to perform traffic management in addition to their regular tasks. In June 2017, the first operators received their ‘multidomain’ certificate.
- **Night and weekend traffic management services**. Traffic management by local authorities can be remotely performed by (private) operation control centres during peak periods or incidents. This solution will also provide relief at night and in weekends.

Early in September 2017, private parties developed this service in a real-life situation, using their own control centres in Schiedam and Utrecht.

- **KPI-controlled traffic management control centre**. Eighteen key performance indicators are now being tested live in the traffic management control centre of the province of Noord-Holland. [See the box on page 13](#).

[Page 24 contains a summary of the current set of iServices](#) covering the whole spectrum, from initial exploration to training and technical support.

The iServices were designed to enable city and road authorities to decide on the extent to which they want to pursue their transition to greater efficiency and whether or not they want to cover a larger market. To create a professional market, each iService must be offered by **several private parties**, and to create sufficient mass, it is important for more local authorities to subscribe to the developments. Local authorities, companies and the Ministry of Infrastructure and Water Management will be working together on this over the coming period.

### Benefits

With its vision, structure and services, the iCentre programme provides the right kind of orchestration to take control centres in the Netherlands to a higher level, not only in terms of cost efficiency but also in terms of performance. An initial well-founded estimate by experts suggests that the products and services of the iCentre programme can **save 10 to 20%** on the annual public operating costs without the need for high levels of investment. Equally as important is that the **network performance** can, in due course, be **improved by 5 to 15%**. A more in-depth study of the social costs and benefits was completed early in 2018 – [please refer to the article on pages 20 and 21](#).

In an era of increasing traffic jams and congested cities, that would be a real achievement: saving money while at the same time improving performance •

## National standards

A number of the products within the iCentre programme are currently being converted into national standards by CROW, a non-profit-making knowledge institute that engages industry and government experts from all over the country for reviews and conclusions. CROW presented the first national standard, the iOperation (*iBedienfilosofie*) to the Ministry of Infrastructure and Water Management and the Optimizing Use (*Beter Benutten*) programme on 3 November 2017.

Other national standards that are published early in 2018 include:

- Blueprint for iCentre technology and the uniform linking of control centre systems.
- Certified training for operational and strategic multidomain personnel.
- Functionalities of uniform multidomain control sites.
- Service level agreements and key performance indicators for the SMART adoption of performance agreements.

### The authors

*André Loos is the nationwide programme manager of iCentre.  
Marcel Westerman is the strategic advisor of MARCEL.*

**Jan Bert Dijkstra, programme director Optimizing Use:**

## **‘Better network performance in urban areas’**

‘On 13 July 2016, I signed a partnership agreement for the implementation of the **iCentre programme** on behalf of the former Ministry of Infrastructure and the Environment. The other signatories were Almere, Rotterdam, The Hague, Flevoland, Utrecht and Noord-Holland and thirteen companies. The agreement was clear: the control centres of the municipalities and provinces must be operated in a smarter and more efficient way, and we will all invest in this, both publicly and privately.

For us as a ministry, the latter was crucial. It is a programme for regional and local authorities with plenty of opportunities for the market, so **the regions and companies must see the importance of it** – they have to carry the load together. Furthermore, demonstrable contributions must be made to the network performance in urban areas while structural costs for the authorities must be reduced.

I am very confident about this. The fragmentation of over 150 control centres, usually operated by a single province or municipality and often focused on a single domain, can be quickly and significantly reduced. By working together effectively and finding smart solutions for combination and integration, they can work more effectively and efficiently, **achieving more impact at lower costs** for waterway and road users as well as for residents of and visitors to urban areas. And it can be done in a way that we see everywhere today, in the form of customized, performance-oriented services that are available to all provinces and municipalities.

The iCentre partners have recently developed various **iServices** that enable provinces and municipalities to improve the efficiency and effectiveness of their central control operations. By improving efficiency and effectiveness, I mean more than just ‘operating a single control centre that serves several domains’. This in itself would be meaningful, as particularly in urban areas, these domains are so strongly interconnected that integrated control would improve network performance as well. But to me, it also means the municipal or provincial decision to outsource central control operations. As authorities, we have a responsibility to deliver a certain level of performance and certainties to users of roads and waterways and to city residents and visitors, although not necessarily to do this ourselves. If companies can do this better and more cost-efficiently by offering their standardized services to multiple authorities, why should we do it ourselves?

The package of iServices that has now been developed caters to all needs. Even local authorities for whom centralized operation was previously too complex and too expensive can now purchase



iServices. To them, this offers the prospect of a relatively simple improvement of their network performance, while for the companies, it creates a new market.

The iServices are still initial versions that need to be further developed and tested in practice in the time ahead, by companies and governments – jointly, simultaneously and as equal partners. That is why we have **included the continuation of the iCentre programme in the Short Term Approach**.<sup>\*</sup> During a national summit of the iCentre programme on 3 November 2017, directors of municipalities and provinces volunteered to flesh out the details in the time ahead. I have accepted their offer. I wish them and the companies every success and inspiration and, above all, a lot of ambition. I look forward to seeing the joint public-private proposals.’

<sup>\*</sup>The Short Term Approach is the follow-up to the Optimizing Use (Beter Benutten) programme.



# Five steps towards a performance-based structure of control centre operation



The core responsibility of city, road and waterway authorities is to ensure safety, quality of life and accessibility. These policy objectives were translated into a set of tasks for the grass roots. The next question is: What is the optimal way to perform these tasks in order to achieve the objectives? And what is the best way to manage for good, cost-efficient results?

Using policy objectives and managing for the desired results is referred to as **performance-based operation**. It seems self-evident – after all, why would any operation not be based on performance? – but it is far from self-evident. In most cases, we see a large gap between policy objectives and operational practice. In addition, it is often difficult to see the connection between the (sub)tasks on the operational work floor and the strategic goals.

Performance-based operation is nothing more or less than designing the processes in an organization for optimal performance. **Everything that does not contribute to achieving the agreed performance is redundant.** This approach keeps the processes extremely cost-efficient.

To achieve this efficiency also in the operation control centres of city, road and waterway authorities, the public and private partners of the iCentre programme developed a **step-by-step plan** for performance-

based operation that targets not only the improvement of existing processes but also a review of the approach itself. Can, for instance, performance be boosted by smart combination and integration?

This plan is elaborated not merely as a theoretical exercise but is based on and verified by actual implementation by the province of Noord-Holland for one – see the box on page 13. Below is a brief discussion of the main steps.

## 1. Defining the ambitions

Performance-based operation begins with defining the ambitions. This requires that the organization has a real grasp of the current performance level. Subsequently, they have to ask themselves: **What is the level we want to achieve** and is our current service level to users adequate to achieve the desired level? Do we want to expand our services? Will we continue to provide the services ourselves or are we more

inclined to supervise them? What is the situation regarding the economic life of the assets or the control centre? As to our workforce, do they have the required knowledge and skills, or are changes called for? And equally important when it comes to performance-based operation: What will we gain by switching to a new approach?

## 2. A transition that is approved by the board

Once you know where you are headed, it is time to work out the best path to get there. A particularly crucial question in this respect is to what extent the organization wants to maintain control of the service supply, team up with a third party or outsource the services. **All of these options are possible** and must be translated into an initial business case based on which the board can decide which transition they want to pursue.

## 3. Defining service level and performance indicators

After the decision has been made in favour of a specific transition, it is time to formulate the performance and performance requirements. For this purpose, the iCentre programme has developed a practical method to **translate the general ambitions and policy objectives** of steps 1 and 2 **into measurable and traceable performance requirements** for the roads and waterways.

One of the goals is to decide on the desired level of commitment and responsibility in the operational execution. Suppose, for instance, that the decision was made in step 2 that parking management should be smarter and more efficient. Which tasks, performances and risks would be involved? Making targeted choices for each specific domain will provide us with clear insight into the scope of the service provision and requisite service level.

For the domains within the scope of the iCentre programme – traffic management, tunnel management, operation of bridges and locks, city supervision and management, crowd management and parking management – experts have drafted a full series of ‘standardized’ key performance indicators or **KPIs** for various service levels. Obviously, individual municipalities or provinces will have to have this set of KPIs tailored to the specific domain features of the organization.

## 4. Benchmark values and baseline

Besides the KPIs, the iCentre programme has defined the indicative **benchmark values** per KPI to measure the performance level. Likewise, the benchmark values will have to be adjusted to the specific organization concerned, as they will differ per city or road authority. To define the right benchmark values, it is important to identify the quality level of the current operational (service) tasks. A baseline or **performance check** can serve to establish the ‘benchmark’ values for the individual organization concerned. What would be feasible benchmark values for management purposes? These are necessary for the internal organization to monitor performance, but they are also very useful in terms of managing external parties, for example. The benchmark values are actually the dashboard for the performance-based operational control of the operation control centres.

## 5. Performance-based contracts

If the organization decides to have (some of) the work outsourced, unambiguous contracts will have to be drawn up. To this end, there are model requests and **contracts** for local authorities available in iCentre. These are also geared to performance and structured with an eye to benchmark values. The documents can easily be adjusted to the desired (own) services, inserting the right benchmark values according to the baseline of the previous step.

## Growth path

With the completion of step 4 and, if services are purchased, step 5, the road or waterways authority and/or city authority is ready to work in a performance-based way. That is a milestone in itself, but it is not

necessarily the final destination. Once performance-based operation has landed in the organization, the ambitions expressed in step 1 can be re-examined. Is it possible to improve effectiveness, efficiency or the service to the users? The steps above can then be taken again, and the bar for performance-based operation raised a little on the foundation of real-life experience •

# The Netherlands’ first KPI-controlled traffic management control centre

**In November 2017, the province of Noord-Holland was the first to introduce a fully KPI-controlled traffic management control centre in the Netherlands.**

As a road and waterway authority, the province has three different operation control centres: for traffic management, tunnel operation and remote bridge and lock operation. To explore the possibilities of ‘less government, more market’ in a controlled way, the provincial authority decided in 2013 to have the operation of the provincial tunnels performed by a private party, the Managing Agent. The province orchestrates and manages using key performance indicators (KPIs) for overall performance.

## Smart combination

In the autumn of 2017, the private operators were given the responsibility for performing the tunnel and traffic management for the province. In order to be able to manage properly for the policy objectives for traffic management, the province also selected ‘hard’ performance indicators in recent months for this domain, such as the maximum time between an incident occurring and an incident being confirmed by an operator.

This marked the introduction of the first KPI-controlled traffic management control centre in the Netherlands. The KPIs are currently still being tested in terms of their suitability and being modified where necessary. They will also be further refined in due course: the intention ultimately is for the performance to relate to the (intended) effect on the street. In addition to the ‘hard’ indicators, ‘soft’ indicators will be introduced, like ‘government satisfaction with the quality of the unburdening’.


## Next step

In 2018, the next step will be taken: combining tunnel management and traffic management. The operation of traffic management systems in Noord-Holland happens from the same room as the operation of tunnels. By training the tunnel operators as multidomain operators (in this case as road traffic controller) largely the same personnel capacity can be used to optimum benefit.

## The authors

**Gerben Quirijns** and **Bettinka Rakic** are the respective *Project Manager* and *Team Leader Tactics in Traffic* at Arcadis.

**Corianne Stevens** is *Senior Advisor for Smart Mobility* at Sweco.



# The human dimension of multidomain operation

What is the impact on staff of operating multiple domains and possibly serving several customers from an operation control centre? What does it take to maintain good conditions, and which technological support and automation does this require? How do you strike the right balance between too complex and too boring? The public-private partners in the iCentre programme focused on these questions and worked out an operation control philosophy.

One of the final pictures of the iCentre programme is an operation control centre that supports multiple customers and serves multiple domains. This inevitably has consequences for the staff in the control centre. How do you prevent multitasking from overstressing the abilities of the men and women on the ground? And what does that mean for the design of the centre and supporting instruments? These aspects of **multidomain operation** are worked out in the iCentre programme.


## Interchangeability

The first thing you need in order to be able to integrate the control centres of various (local and regional) authorities and of various domains is **standardization** in various forms and on several levels. For employees, this concerns the way in which the service is provided for different customers and different domains; this must be broadly the same and interchangeable.

That is why we have identified, listed and analysed all relevant operating processes – processes that are used throughout the country within the six domains. Based on the findings (what is the common denominator?), the *iOperation philosophy* was formulated: a standardized approach with supporting instruments. You will read more about this later.

## Automation

If the monitoring and operation in the control centres were to depend



entirely on the staff, you would soon reach the (human) limit in terms of scale. Automation is, therefore, essential.

Take monitoring, for instance, which is designed to determine when an intervention or operation is necessary. To a large extent, this can be automated with the help of **triggers**. This means that the system gives a warning as soon as a relevant measuring unit exceeds a critical limit. The respective employee on site does not have to monitor the current situation constantly – staring at a screen with passing cars is, therefore, a thing of the past.

Another advantage of the use of triggers is that complex combinations of data and information can be used, so that accurate and/or extra warnings are given promptly, and, in fact, more reliably than humanly possible. With the latest artificial intelligence (machine learning, deep learning, heuristics), new patterns can also be found.

This automatically brings us to the **automation of the operation**. If the triggers clearly point in one direction, human intervention is not always necessary. Parts of operating processes can then be performed automatically. In other fields, the rule of thumb is: 'If the answer to a question can be given in advance, this can be automated.' This is no different for control centre operations.

## Staff competence

The fact that the work floor is supported by triggers and automated operating processes does not mean that the task for the staff will be simpler. On the contrary, the more complex activities remain and these concern different objects in different domains. What does that imply for the human activities involved? In the framework of iCentre, we have identified the required **levels of knowledge and skills**. In addition, performance indicators have been formulated for the management of the operating staff.

## iOperation philosophy

This brings us to the iOperation philosophy. In short, it describes the future organization (roles, work processes) and design (systems, workplaces) of an iCentre. The employee is central to this; he must be able to perform the operation tasks for different domains and authorities safely and satisfactorily.

In the iOperation philosophy, we distinguish **three roles**. The **network manager** oversees the quality of the networks involved. Think of tasks such as adjusting and managing traffic flows externally (traffic manage-





ment, crowd management, city supervision and management) to maintain the flow and safety. Internally, the network manager coordinates the practical execution of the services. In the event of large-scale calamities, a network manager will take on the emergency organization. The **operator** is responsible for executing the actual tasks in an iCentre. This includes bridge and lock operation, tunnel operation, traffic control and parking management. Finally, the **account manager** is the link connecting the service providers and the customers (local authorities).

The iOperation philosophy also describes the most important characteristics of the **tasks** on the work floor. The tasks cover various domains: parking management, camera surveillance, crowd management, city supervision and management, traffic management and tunnel, bridge and lock operation. For the proper execution of these diverse tasks, the operating staff must have **sufficient competences and domain-specific knowledge**.

In a simultaneous supply of tasks, we work with **prioritization**. A task is given priority when safety is a primary concern, or (if the primary concern for both is flow, for instance) when the task delivers a greater contribution to the customer requirements as laid down in the KPIs. The statutory duties of a city and road manager always have priority. Tasks differ in terms of **mental load**. That load should not be too high for an iCentre employee, but certainly not too low either (mind-numbing). In addition, it is important to provide sufficient variation in the tasks.

Finally, we come to the description of the work processes in the iOperation philosophy. The distribution and provision of (the varied set of) tasks will be organized in an iCentre by an intelligent **distribution mechanism**, the task characteristics being decisive.

The **workplaces** are **domain-independent** in any case. From every workplace in an iCentre, you can perform all of the tasks of each domain. As soon as a task is offered, the operator or network manager is also immediately presented with the appropriate images (**situational awareness**), with all the information needed to carry out the task in an efficient and safe manner. If the relevant task involves the operation of a system, the necessary **interfaces** are **presented** in the multidomain workspace to perform the relevant operating procedures.

The requirements set out in the iOperation philosophy were the starting points for the technical development of the integrated human-machine interface, the **iHMI**, and the necessary data and information components.

### Staffing consequences

In order to get a clear picture of the consequences of this iOperation philosophy – after all, the employee should be key – we asked ourselves two questions as a check: Which domains and tasks can be integrated and combined from the point of view of the competences of staff? And what does that mean for staff training?

The question as to which combinations are promising was answered by working out the aforementioned **knowledge and skills competences** for all six domains **in relation to the tasks**. One example of the results is that for the role of operator, traffic management can easily be combined with operating and monitoring tunnels, to a certain extent with operating and monitoring bridges and locks, and easily with city supervision and management, crowd management and parking management. The complete overview is part of the results of the iCentre programme.

In addition, a complete overview has been made of the available **training courses** for the domains. Using the competence profiles and the insights into promising combinations, we identified the training requirements appropriate for multidomain operators and network managers. This shows, among other things, that multidomain operation requires the development of basic courses such as ‘Operator: Operating and monitoring tunnels’, ‘Operator traffic management’ and ‘Network manager (cross-domain)’.

Obviously, it is important for both the authorities and market parties, both within and outside the programme, to endorse these results. That is why the parties in iCentre work together with CROW and training institutes on a national **standard of required staff competences and development levels**, with corresponding training. The importance of this cannot be underestimated; in combination with the iOperation philosophy, this standard guarantees the human dimension of multidomain operation ●

### The authors

Eugène de Geus is managing director of Smartervision. He worked closely with Erik Brave from Sweco, Marieke Bijl from MAPtm, Peter Rasker from VHP Human Performance and André Smulders from Trigion within the ‘Control centre operation and personnel’ component in the iCentre programme.

# Smartly combining, integrating and interpreting data from multiple domains

The smart combination and integration of control centres from multiple domains also has a direct impact on the centre's data and information management. Data fusion and data enrichment are already indispensable, but in view of the increasingly complex future, the author believes an iCentre requires new innovations in *machine learning*.

An iCentre stands for operating multiple domains and for *trigger-based* operation, which has unmistakable consequences for the **data management** in the operation control centre. In any event, the volume and diversity of the data will increase as every domain has its specific data sets. However, the fact that the systems in the control centre must be able to 'observe' changes in the current image of these domains independently, which is the idea behind trigger-based operation, requires extremely accurate and reliable data and a good dose of artificial intelligence, including **machine learning**.

We have not yet reached that final stage of intelligence within the iCentre programme, but the path has already been mapped out. This consists of three processes: collecting multidomain data, upgrading the data to meaningful and reliable multidomain information, and interpreting that information. This last step brings us to the level of automated decision making and generating triggers.

## Collecting data

The first process of collecting data seems fairly straightforward, but appearances are deceptive. One concern is that the **'data level' of the various iCentre domains varies considerably**. The road traffic domain is doing relatively well, although new sources such as *floating car data* are needed. The insight into parking management, crowd management and tunnel, bridge and lock operation, on the other hand, is often limited and fragmentary.

With relatively new batches such as sensor data, floating device data and social media data, it may be possible to catch up on the rather meagre domains, but we still have to gain experience with the use of those data sets. Companies will also have to provide the desired data. This aspect, by the way, has a direct relationship with another Optimizing Use (Beter Benutten) programme, namely Talking Traffic. Within this programme, several *cloud providers* join forces to collect, combine, integrate and process large amounts of data from a wide variety of sources. The iCentre and Talking Traffic programmes can greatly strengthen each other in this – especially because many iCentre partners are also active in Talking Traffic.

Another aspect in the first phase is to 'harmonize' all of the data at the basic level of time and geographic location. This is a condition for being able to combine and merge the data in phase 2.

## From data to information

The data from phase 1 is not necessarily useful knowledge or information. The bar within an iCentre is high anyway. If you ever want to be able to automate monitoring tasks, you need **complete, accurate, reliable, domain-wide and, above all, real-time and predicted data**. In order to achieve this, we will have to enrich, combine and merge the data from different sources.

A nice example of what is possible in the field of **data fusion** concerns (road) traffic information. The traditional loop data are accurate, but the number of measuring points is limited, especially on the municipal and provincial road network. GSM data and floating car data are significantly less accurate and have a low(er) penetration rate, but are nationwide. None of these sources separately give the complete picture, but when we merge loop data with GSM data and/or floating car data, the data sets fill in each other's gaps, resulting in better and more reliable information.

This only concerns the merging of data within a domain. It will become even more interesting for iCentre applications if we smartly combine data from *different* domains. We can then ensure that events in one domain lead to (other) actions in another domain.

## Interpreting information

By far the most difficult phase on the path to the final stage is the step towards **automated monitoring (interpretation) of information**. In an iCentre, it will no longer be the operator or network manager who determines what is relevant; instead, it will be determined by the data software.

If we want to establish the connections and correlations between information from different sources, **artificial intelligence** is indispensable. Without having to model or understand the full complexity beforehand, smart algorithms search for patterns and recognize connec-



tions. The developments in this area are moving fast, as has also been demonstrated by developments in the area of self-driving cars. In its current form, services such as (C)ACC and Lane Assist independently recognize the relationship between the speed limit, the distance to the vehicle in front and the marking on the road.

Even more intelligent would be the application of **machine learning** in operation control centres. The algorithm will identify if-then relations and refine the underlying mathematical equations on this basis. Many online stores use this technique to offer products based on previous buying behaviour.

In the traffic domain, machine learning is not yet common, but the possibilities are considerable. We can think, for instance, of recognition of a normal daily pattern in the parking occupation of a car park, the traffic situation on a route or the scheduled opening hours of a bridge. The algorithm will then learn, for example, that opening a bridge will lead to traffic congestion on the road leading up to the bridge. This is an essential step for trigger-based operation. After all, if the self-learning algorithms recognize a normal daily pattern reliably enough, it is no longer necessary for an operator to watch the screen. Only when reality starts to deviate from the expected value (the normal course) will the algorithm send a signal, at which point the operator springs into action.

There are more options besides 'triggering', by the way. For example, if a car park nearly fills up to capacity around the same time every day, the algorithm can predict this and automatically stop directions to that car park. And if there is a correlation between a traffic slowdown in a tunnel and a jam at the tunnel exit, the algorithm can give higher priority to the traffic lights in the lane concerned. This **automated operation** significantly increases the efficiency of the work processes.

### iCentre requires new techniques

The new way of working in an iCentre has a major impact on data and information management. A path has been set out in the programme to raise the level of data sourcing and processing gradually and in a structured manner. The rapid developments in information

## The MotoGP TT Assen as a practical case

During the MotoGP TT Assen from 23 to 25 June 2017, partners of the iCentre programme used new data techniques to monitor the way traffic developed around the event.

The annual MotoGP TT Assen attracts thousands of motorcyclists and motorists. *Floating car data* were used to monitor this traffic as the road network around the circuit offers little in the way of permanent sensors.

The floating car data were converted into a graphical map display. Algorithms were used that constantly calculated the delay on predefined routes on the basis of the current data plus historical travel times. This was also shown graphically, so that the coordinator had real-time insight into the delay per route. This proved to be especially useful in assessing which routes still had residual capacity. In this way, the coordinator was better able to control the traffic flows.

technology support this path as the increasing availability of many and (almost) real-time data in combination with self-learning algorithms pave the way to fully trigger-based operation in a smart iCentre ●

### The author

Jasper Caerteling, project manager at Be-Mobile.



# The technical blueprint of a multidomain control centre

Being able to operate multiple domains in multiple operating areas from an iCentre requires an innovative design of the control centre itself. Which technical platform is needed to create a flexible 'multidomain workplace'? And what is it like to work there?

An iCentre will rely heavily on **automation and artificial intelligence** to make the multitude of tasks manageable for the operating staff. For example, monitoring in an iCentre is partly automated. The technology will even handle some of the (more routine) control centre tasks autonomously. Please also refer to the articles on the previous pages.

What will happen exactly when certain tasks require the attention of the operator or network manager? These 'trigger-based' tasks will be distributed dynamically across the available multidomain workplaces in an iCentre in such a way that neither the operators nor the network manager are overloaded and **critical work processes really receive full attention**.

The so-called integrated Human-Machine Interface, in short **iHMI**, will provide the necessary support. It will, for instance, at all times display a **common operational picture** showing the tasks to be performed: a graphical representation of the area and the dynamic traffic flows and traffic measures within the area under consideration, with which the operator has an overview of the situation.

Via the iHMI, an iCentre operator can easily accept a task, after which the monitoring and operating interface of the management system associated with the task is immediately linked to his workstation. The iHMI also supports the operator step-by-step in the execution of the task.

## Principles of technical platform design

This concept, however, requires quite a bit from the underlying technology. In organized pursuit of the final goal, the private parties Dyniq, Siemens, Technolution and Vialis have drawn up a general **blueprint** in the iCentre programme, supplemented by a set of uniform, standardized **interfaces**.

The most important elements of the blueprint are the **business logic** (data collection and processing, automation of tasks), the **presentation logic** (assigning tasks dynamically to the right people/desks) and the aforementioned **iHMI**. See the figure on the next page.

Via interfaces, these functionalities are connected to the existing video and object management systems and waterway/road network management systems. The starting point here is that these existing systems are not adapted in terms of functionality, but are only provided with an

iCentre interface. These interfaces are explicitly specified and based on official and de facto standards.

Another characteristic of the iCentre blueprint is that it is **modular**. The benefit to system suppliers is that rather than having to deliver one large system, they can focus on specialized components. The benefit to local authorities and private iCentre service providers is that they can purchase (sub)systems from several suppliers. Last but not least, the blueprint incorporates **security frameworks** ensuring that iCentres comply with the (national) security guidelines from all domains.

The blueprint, including its standards and the functional description of the modules and interfaces, is an important result of the iCentre public-private programme. These elaborations were converted into CROW (Dutch technology platform) standards and were published nationally in early 2018.

## How will it work?

What will this ultimately mean for the tasks on the work floor? This can best be explained by describing a number of activities, always with an eye to the figure on page 19.

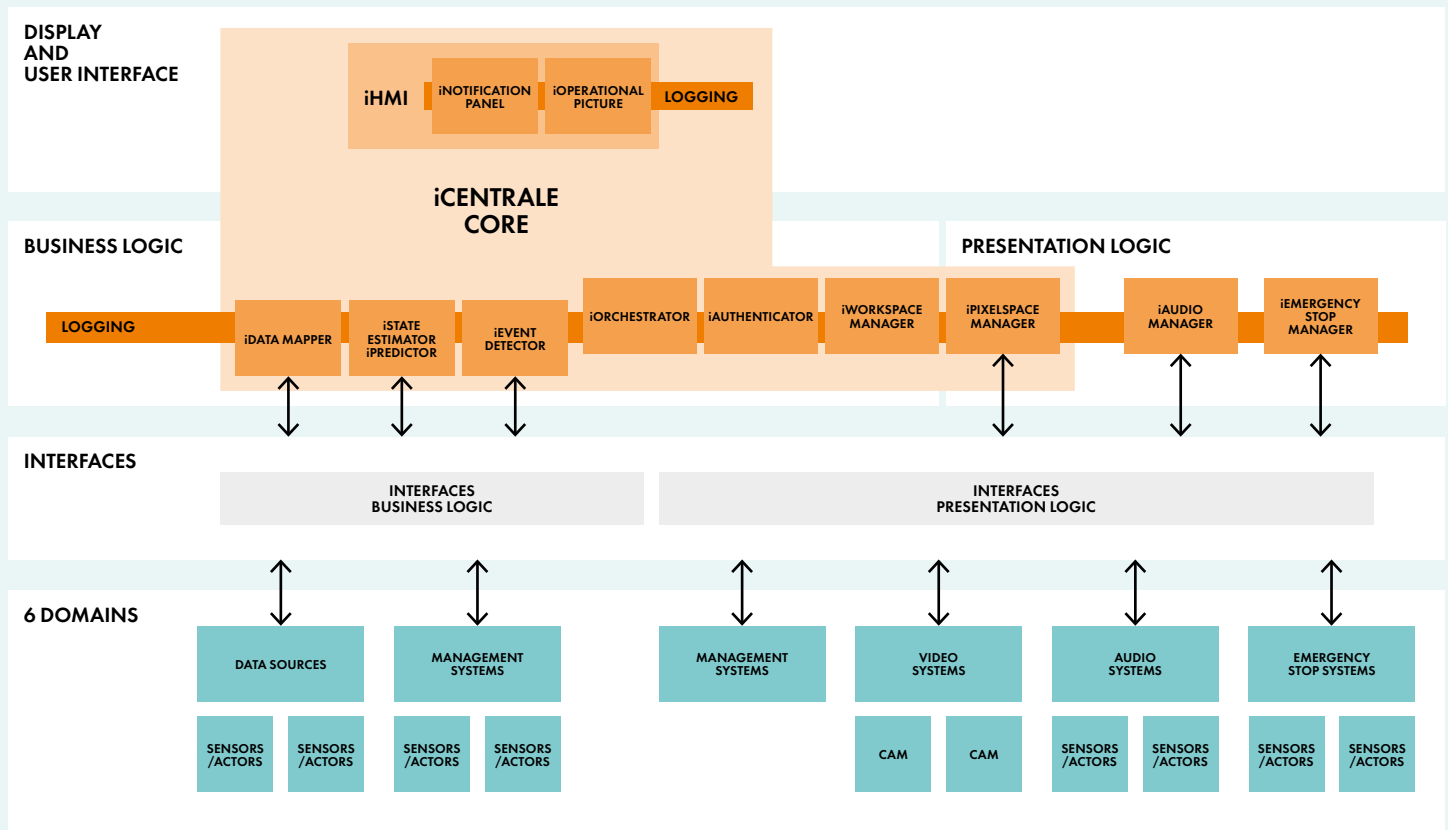
### An operator starts to work

An operator sits down at his desk and logs on to the iCentre platform via the **iAuthenticator**. With the help of the **iOperational Picture**, he builds up an image of the management area for himself. What is the status of the waterway network, road network, parking space and public space?

Meanwhile, the **iOrchestrator** keeps track of which operators are active, what their powers are, which tasks they have already taken up and what that means for their mental workload and for the 'filling' of their screens. The area coordinator supervises the current staffing and task allocation of his control centre via the iOrchestrator.

### An operator transfers tasks

Tasks that require 24/7 attention from an operator are easily transferred from one operator to another via the **iNotification Panel**. In the event that this new operator is working at another control desk, the



**iWorkspace Manager** will switch the management system associated with the task over to the new control desk.

In transferring, the **iPixel Space Manager** will automatically position the monitoring and operating interface of the management system and the corresponding camera images on the available screen space. Audio, video and emergency stop are also transferred to the new control desk via the **iAudio Manager** and the **iEmergency Stop Manager**. Similarly, an operator can pass on a subtask to a colleague. For example, if an incident has occurred in one of the tunnel tubes, the operator can transfer the monitoring of the other tunnel tubes to a colleague and concentrate entirely on the incident.

### Management systems perform tasks independently

Many of the management systems can now perform their tasks independently (trigger-based), using data from the various data sources. In an iCentre, however, the various management systems can also perform tasks in conjunction with other management systems. To this end, the management systems and the data sources supply their data – the measuring data as well as the triggers to which management systems have responded – to the **iData Mapper**. The **iState Estimator** uses this data to estimate the current situation of the objects, the waterway/road network, the public space and the parking facilities. The **iPredictor** taps into the iData Mapper to predict the situation in 5, 10, 15 to (maximum) 30 minutes. Based on the data, the (estimated) current situation and the predicted situation, the **iEvent Detector** will detect any events that need to be responded to and acted upon. These are events that happen outside the range of vision of the individual management systems. If any such event is detected, the iEvent Detector will determine which management system has to perform which task and pull the corresponding trigger on that management system.

### Assigning a new task to an operator

If it concerns a task that must be monitored or even performed by an operator, the iEvent Detector will pass this on to the iOrchestrator. The iOrchestrator checks which operators are authorized and competent to

take on the new task and to what extent these operators are also capable of taking on the new task, given their current mental workload and the filling of their screens.

The operators designated by the iOrchestrator as suitable and available are assigned to the task via the iNotification Panel. Via the iWorkspace Manager and the iPixel Space Manager, the corresponding management system (wherever necessary including video images, audio and emergency stop) is switched to the control desk of the operator who accepts the task.

### Steps

A number of (large) steps will have to be taken to achieve the workflow as described above. First, a city or road authority has to decide which of their existing control centres will be converted into an iCentre. In parallel, some companies will invest in their own iCentre to offer iServices to authorities that do not have their own control centres. Step 2 is to provide the existing video and object management systems and waterway/road network management systems with an iCentre interface. These systems can subsequently be linked to the selected 'iCentre location' via a redundant connection. The final step is to equip the location with the technical platform and the technical infrastructure as described above.

Are these simple steps? Well, some are and some are not. The technology and interface definitions are available to enable a quick, small step towards iCentre. However, many of those solutions do not or do not adequately fit the iCentre blueprint, and so are insufficiently scalable. In the next few years, the local and regional authorities and the private parties in iCentre will, therefore, have to continue to invest in new knowledge and new technology. That may take some time, but the results will be worthwhile ●

### The authors

Paul van Koningsbruggen is the Mobility director at Technolution.  
Bas Heutink is the Technology manager at Dynniq.

# Costs and benefits of central multidomain operation

An important promise of the iCentre is cost efficiency. By cleverly combining and integrating control points, we can achieve more at lower costs. But what, exactly, are the benefits? To gain more insight into the benefits, economic research and consultancy firm Decisio analysed the social costs and benefits of an iCentre transition in the province of Noord-Holland.



Provinces and municipalities in the Netherlands together own about 150 different control centres for the monitoring and management of waterways, roads, tunnels and public spaces. **Qualitative analyses** provide insight into the benefits that can be achieved by cleverly combining and integrating these control centres. For example, control centre personnel are less often deployed on standby and can be deployed more continuously for various domains and multiple authorities. It is also possible to share systems and applications and to coordinate domains more closely. In urban areas where the domains merge, this boosts network performance and service provision to users and citizens.

## Need for quantitative costs and benefits

In view of these benefits, the parties in the iCentre programme are developing services and applications to combine and integrate the control centre operation. Now that this programme has reached the phase where these so-called iServices are being rolled out, **quantitative insight** into the (social) costs and benefits is needed. At the beginning of 2018, the analysis of the business cases for the province of Noord-Holland was completed. What are the costs and benefits of transitioning

from the current way of operating to one with an integrated own operation control centre – or even none at all?

## Social costs and benefits analysis

At present, the province of Noord-Holland has 3 operation control centres: for traffic management (270 traffic signal control systems, 26 dynamic route information panels and 169 video camera systems) and for tunnels (2 tunnels and 1 aqueduct). The 40 bridges and locks of the province are still operated locally, but this year, the operation will be transferred to an operation control centre in Heerhugowaard. Since 2017, there has been a complete outsourcing of personnel for the domains of bridges and locks, but also for tunnel management and traffic management.

In the **iCentre Social Costs and Benefits Analysis (SCBA) for the province of Noord-Holland**, the integration of the tunnel and traffic management control centre and the integration and remote control of bridges and locks were analysed and compared with the current situation outlined above. In addition, the effects were assessed of completely purchasing the operation of the domains as an iService within an



	Integration of tunnel control and traffic management	Remote operation and integration of the operation of bridges and locks	iCentral (incl. earlier investments)	iService traffic management for municipalities
SCBA balance* (millions of euros)	2.3	15.1	39.4	15.1
SCBA benefits/ costs ratio	4.9	2.0	1.8	31.2
Business case balance* (millions of euros)	1.9	-6.6	17.3	-1.4
Payback period business case (years)	3	16	6	-

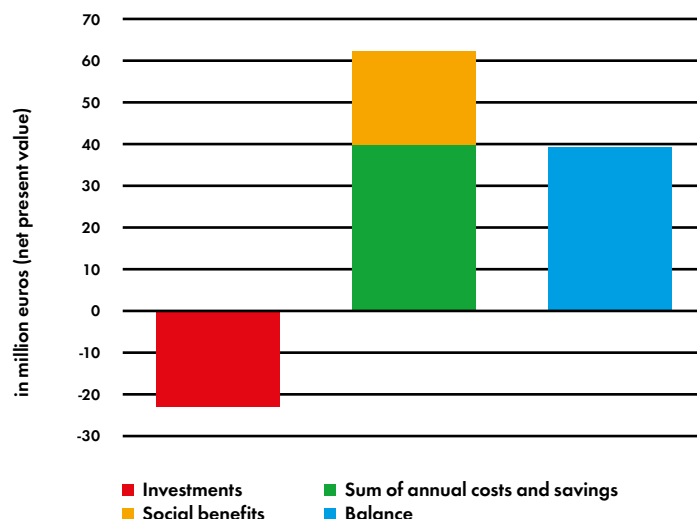
\* Over 15 years, expressed in net present values with a discount rate of 4.5%.

**Table 1:**

Summary of the SCBA figures for the transition road map of the province of Noord-Holland.

iCentre managed by market parties. The SCBA provides the following insights into the transition road map of Noord-Holland:

- The integration of tunnel control and traffic management, 24/7, requires a (relatively) modest investment, but it does ensure (relatively) substantial savings in annual costs. For this reason, the business case of this integration process is very positive. This is also apparent from a previously established business case by PricewaterhouseCoopers (2016) for the province of Noord-Holland. The integration will furthermore enable traffic management at weekends and at night, 24/7, at virtually the same cost. The traffic effects are positive, because the integrated control centre can intervene if an incident occurs or during roadworks and events.
- Remote operation and integration of the operation of provincial bridges and locks requires substantial investments. These include providing (digital) access to the bridges and locks and the establishment of the operation control centre itself, which will be opened in 2018 in Heerhugowaard. For this reason, the financial business case will not become positive until quite some time later (more than 15 years).<sup>\*</sup> However, from a social perspective, the benefits are reaped immediately: the control centre enables dynamic coordination between the situation on the road and on the water (the so-called blue wave bridge management system), and thus improves the traffic flow. As a result, the SCBA of the combination of both domains is positive.
- Further integration of domains, including the possible purchase of private iServices, will result in substantial savings. This is mainly because private parties can cleverly combine the operation of tunnels and traffic management centres for multiple local authorities – they can optimally use their capacity (of people, systems etc.). This final step in the transition builds on the earlier steps. Based on the sum of all investments in these earlier transition steps, the income/expense ratio is very positive.
- Being able to purchase iServices makes it easy for municipalities within the Province of Noord-Holland without (ambitions for) their own control centres to still achieve control centre operation, with-



**Figure 1:**

The costs and benefits of a Noord-Holland iCentre managed by market parties.

out high investments and too much risk. In comparison with the (relatively) limited costs of purchasing iServices, (relatively) major social benefits come in the form of improved network performance and service to users and citizens. The SCBA is certainly very positive.

The SCBA figures for the transition road map of the province of Noord-Holland are summarized in the table on this page.

The costs and benefits of an iCentre managed by market parties are shown in the graph – these are cash amounts from the business cases and SCBAs. In the case of the investment items (red), the most important factor is the physical and digital access to bridges and locks. In order to prepare these structures for remote operation, they have to be made uniform and new fibre-optic connections are required. In addition, investments are required for the training of personnel. The biggest savings (green) are achieved due to the fact that fewer staff are needed and staffing expenses are reduced (the expenses for employees of a contracted private party can be spread over multiple clients). The province also has lower to no accommodation costs for its operation control centres.

Social benefits (orange) come from an improvement in traffic flow on the road; on the one hand by better coordination between ‘dry’ and ‘wet’, on the other hand because the province can carry out traffic management 24/7. Furthermore, the operational security of the operation for the various domains increases as a result of the multiple backup options that are created.

## Rural and regional

The experiences with the SCBA of the province of Noord-Holland – the insights gained and the methodological calculations used – form a good starting point for a national SCBA. Regional SCBAs are also being prepared. Provinces and municipalities that want to use iServices for a smart combination and integration of their control centre operation can thus substantiate their ambitions quantitatively ●

<sup>\*</sup>This was sourced from a study by Arcadis, ‘Business case Control Centre 24-hour operation of bridges and locks Noord-Holland from two locations’ (2014). Incidentally, in other cases it can indeed lead to a positive business case, according to analyses conducted elsewhere in the country.

## The authors

Kees van Ommeren is a partner at Decisio.

Daan van Gent is a senior advisor at Decisio.

# Local authorities on using iServices

The local authorities that participate in the iCentral program already use the developed products and first services. What are their experiences so far?

**Emile Klep**  
**Director Urban Development**  
**Design at the municipality of Rotterdam**

'We were able to benefit from the knowledge and experience within the iCentre programme in formulating our performance indicators. For the time being, we carry out the control centre operation ourselves, but we are already making performance agreements between our internal services. We use the indicators, for example, in limiting the inconvenience caused by the closure of the Maastunnel. This makes our own organization stronger and more efficient. In this way, we are also sorting out the possibility to buy such services as a whole in due course.'

**Jaap Meindersma**  
**Director City Management at the municipality of Almere**

'At the municipality of Almere, we have been purchasing services on a long-term basis based on performance agreements. We have put our experience in this area, the dos and don'ts, into the iCentre programme. In this way, we contribute to sharing knowledge: other local authorities in the country can benefit from our experiences. At the same time, we also benefit, as the programme has developed a range of services that we are only too happy to use ourselves. For example, we want more integration between our Traffic Management, City Monitoring and Management and Parking domains.'

**Chris de Vries**  
**Director Management & Implementation at the province of Noord-Holland**

'As the national coordinator of the iCentre programme, I am proud of the steps we have taken since the start of the programme in July 2016. We are doing a lot of testing at municipalities and provinces with the first basic versions of twenty iServices. CROW awarded the national standard for the multidomain iOperation philosophy to the Ministry of Infrastructure and Water Management last November. In addition, we have our work cut out for us for the next few years, as we have promised the ministry to proceed with the implementation of the iServices package in practice and to continue developing it, with funding from the regions and companies themselves. This reflects the confidence we have in this approach.'

**Peter Nelissen**  
**Mobility domain manager at the province of Utrecht**

'As a province, we are certainly in favour of purchasing iServices for the central operation. With us, it is all about traffic management, and frankly, I feel that the faster we can proceed, the better. We want to focus on the substantiated and thorough formulation of performance-based operation in our policy in the Central Netherlands. We do not have to carry out the implementation ourselves. In fact, I would rather leave that to companies with a proven track record and specialization in this field. We have drawn up our own road map for this process and have started to make it a reality. The iCentre programme has helped us enormously and we are happy to use the products and iServices.'



Emile Klep (left), Peter Nelissen (second from the left) and Chris de Vries (right) promise Jan Bert Dijkstra that they will further develop the iServices. The picture was taken at the iCentre Summit, on 3 November 2017.

# Almere gears up to create an iCityCockpit by 2022

In 2022, Almere will be hosting the once-in-a-decade Floriade international horticultural exhibition. By that time, Almere is determined to have its own multidomain iCentre, the iCityCockpit.

Almere has three separate control centres, one for parking management, one for city surveillance, and one for traffic management. 'These centres have not yet been integrated,' according to Jaap Kroese of Almere City Surveillance. 'However, efficiency and innovation have always been our top priorities. For a couple of years now, we have sourced the traffic control centre "as a service" from a private party. This saved us from having to invest in a local (physical) control centre without having to compromise on functionality.' In fact, the results were so successful that Almere decided to expand the service to the traffic control of the municipality of Noordoostpolder and part of the province of Flevoland.

## iCityCockpit

When Almere joined the iCentre programme in 2016, their partnership delivered a significant contribution to their efforts in the area of the 'smart integration and combination of tasks'. Kroese explained: 'One of the objectives of the municipality of Almere with regard to ancillary equipment for our traffic control systems is to ensure independence of manufacturers and suppliers. In addition, we are conducting a pilot

project with the Image Director, exchanging camera images between the domains of city surveillance and traffic management.'

The timing of the iCentre programme could not have been better, according to Kroese. 'In 2022, Almere will host the Floriade. When the international horticultural exhibition closes its doors, the site will be transformed into an entirely new city district. This development will present unique opportunities for the smart combination of several urban domains. A control centre is a matter of necessity for the development of the Floriade site in terms of water management, besides the existing domains of traffic management and city surveillance and monitoring. Within the iCentre programme, we are currently defining the details of a road map towards the smart combination of domains in a single control centre, one that we refer to as the iCityCockpit. Our aim is to collect all of the data from the various domains – and I do mean all – before 2022, so that we can at all times take the appropriate management decisions for a smart city – and a successful Floriade exhibition.'

More details:

[jkroese@almere.nl](mailto:jkroese@almere.nl), [jtgroosenboom@almere.nl](mailto:jtgroosenboom@almere.nl)  
[btimmer@almere.nl](mailto:btimmer@almere.nl)

## The interests of local authorities

**What are the different ambitions that the six local authorities have brought to the iCentre programme?**

- **Municipality of Almere:** This municipality has three separate control centres for traffic management, parking and city surveillance. Due to the different work processes, the exchange of tasks is difficult. Traffic management is already performed 'as a service' in Almere. There is a wish to bring tasks to the market in a more comprehensive way.
- **Municipality of The Hague:** This municipality is currently working with two separate control centres but wants to transition to a combined control centre. The intention is to continue to do a lot for traffic management, also for neighbouring municipalities.
- **Municipality of Rotterdam:** This municipality has a Control Room for city management and supervision (camera surveillance, parking) with added traffic management, a separate control centre for the city tunnels and a control centre for the operation of bridges in the city. They want to work in a more integrated way rather than unnecessarily tackling problems for each individual sector.
- **Province of Flevoland:** This province has its own control centre for the operation of bridges and locks and is searching for more objects to be operated. They made a conscious decision to purchase services from other authorities (Almere and the Directorate-General for Public Works and Water Management, Rijkswaterstaat) instead of operating their own traffic centre. They feel that this fragmentation is less than ideal.
- **Province of Utrecht:** Until the end of 2019, this province will operate their own control centre for regional traffic signal control systems (integrated chain management) and a control centre for tunnel operation (for the city of Utrecht and the Directorate-General for Public Works and Water Management, Rijkswaterstaat) from a regional traffic management centre. They would like to develop an integrated approach to joint operation for the purpose of achieving independence, promoting innovation and reducing costs collectively.
- **Province of Noord-Holland:** This province has three control centres for traffic management, tunnels and bridges and locks. They control traffic signal control systems (TSCSs) as well as TSCSs of local municipalities from the traffic management centre. They have a tunnel control centre with a private Managing Agent, and perform control centre operation of structures with complete outsourcing of personnel. However, they want more (horizontal) synergy between the domains and a greater role for market parties.





# iServices: standardized solutions for control centre operations

The companies in the iCentre programme have developed twenty iServices that will enable smarter, more efficient implementation of 'multidomain operation'. A first basic version is available for all of the twenty services described on this page.

## PERFORMANCE AND GOALS

### Transition road map

Support for local and regional authorities to draw up their own road map: how can control centre operations be implemented smartly and efficiently? This is also suitable for city and road operators who do not have a local operation control centre.

### Reality check

A quick check to help the province or municipality to assess how the organization is geared to performance-oriented operation.

### Performance check

A more extensive baseline measurement of the quality level of all operational (operating) tasks.

### Step-by-step plan for iService

Local authorities are supported in tendering and contracting the purchase of iServices. This includes the formulation of KPIs and the preparation of SLAs.

## CENTRAL OPERATION AND PERSONNEL

### Training operational personnel

Training for the municipality's or province's own operational staff. Training courses focus on multidomain operation, but can also take place in one domain.

### Trained operational personnel

With this service, a local authority hires operators who are trained in several domains. The operators are employed by the private party.

### Training network manager

Training for our own staff focused on the role of the network manager: the strategic support of the (public or private) operators.

### Trained network manager

This involves hiring a network manager who has been trained for multiple domains. He is employed by the private party.

### Multidomain operation

Performing the (control centre) operation on the basis of predetermined (network) performances (SLAs and KPIs) for combinations of domains desired by the authorities.

### Managing Agent

Organizing and managing the private deployment based on SLAs for the operation (in one or several domains).

## DATA AND INFORMATION

### iGenerator

Provides a current multidomain overview of the (traffic) situation.

### iRadar

Predicts a multidomain overview of the (traffic) situation.

### EMaaS

Event Management as a Service: processing traffic, parking and crowds at (large-scale) events.

### TMaaS

Traffic Management as a Service. In the variants of Tunnel Management as a Service and Bridge Remote Control as a Service, and 'BoA as a service' (bridge remote control).

### Image director

Smart combination and use of video images from multiple domains for multidomain operations.

## TECHNOLOGY AND SYSTEMS

### Managing existing control centre units

This service takes care of the management and maintenance of existing control centre(s) and relieves municipalities and provinces in the area of integrated management.

### Business Logic

A service that provides for the delivery and maintenance of (multidomain) operating applications of an iCentre.

### Operating location

A functioning operating site is delivered and maintained on the basis of an availability fee (to public and private parties).

### Control centre operation and monitoring

This concerns a complete 'iCentre as a service'. A multidomain control centre owned by a private party.

### Transition and Integration

This supports provinces and municipalities in their own transition towards smarter and more efficient execution of their own control centre operation.

## Three ways to improve control centre operations

# Three clusters of iServices

Which iServices will be useful for a specific municipality or province? Obviously, this will depend entirely on their (political) needs. In general, however, local authorities will choose from three clusters of iServices.

The needs of the local authorities form the basis for the various iServices developed in the iCentre programme. That does not mean, though, that a municipality or province will need every single iService available. Depending on their point of departure, the municipality or province will choose from three clusters of iServices.

### 1. Using local control centres more efficiently

A local authority may already have one or several operation control centres. Now, imagine that this municipality or province wants to use its centre(s) smarter and more efficiently. For this situation, the private parties provide iServices that are included in or added to the existing operation control centre(s). Think of supplying qualified operational and strategic personnel, delivering systems and applications as a service that includes (technical and functional) management and maintenance, or providing a multidomain operating site as a service, including management and maintenance as well as data delivery and data

analysis. All this can be done on the basis of pre-agreed performance indicators. If a province or municipality so desires, the purchase of such iServices is the start of an internal transition: a transition towards a more performance-oriented approach, a transition to combining multiple domains and/or a transition to broader deployment of private iServices.

### 2. Extending the scope of control centre operations

A second 'point of departure' is that of a province or municipality that already has one or several operation control centres and that wants to extend the scope of the control centre operation(s), but without investing in the expansion of its own existing operation control centre(s).

For this situation, private parties can offer iServices from their own private multidomain operation control centre(s), with their own private systems, applications, data and personnel, in addition to what is now possible from the existing public operation control centre(s). Examples of such easy-to-implement additions are the provision of a backup control centre in the event of (extreme) disruptions, the provision of peak shaving during the evenings and weekends, and the provision of a 24/7 (disruption) service for the 24/7 processing of a multitude of operational tasks. Offering

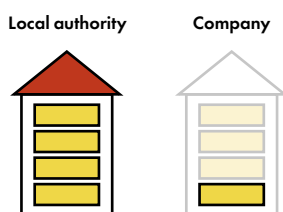
these iServices to multiple local authorities allows for cost reduction.

### 3. Control centre operations without a local control centre

The third situation may concern a province or municipality that does not have its own operation control centre and does not want one itself, but does want to implement control centre operation for one or several domains in order to improve the network performance and services provided to users and residents.

To respond to this need, the private parties invest in the creation of their own private multidomain operation control centres, invest in attracting and training operational and strategic staff, invest in obtaining data (open public data, supplemented with self-purchased private data) and perform data analysis. With these fully equipped private multidomain operation control centres, they can carry out multiple services for multiple municipalities and provinces, especially with regard to pre-agreed performance indicators (service level agreements, SLAs). This is particularly attractive for local authorities who do not have a local control centre but do have control centre operation ambitions for one or several domains, as it removes the need for their own public investment and reduces the need to employ experts themselves.

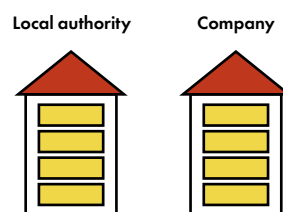
#### 1 Using local control centres more efficiently



Company helps local authority in transition by offering services:

- Transition to performance-based work
- Transition to combinations of domains
- Transition to private services (incl. personnel)

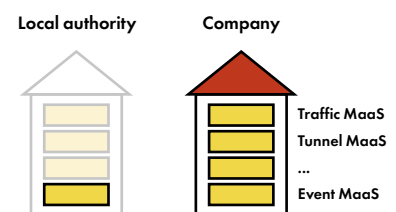
#### 2 Extending the scope of control centre operations



Company offers local authority's centre(s) extra services from own private centre:

- Back-up
- Peak shaving, weekends, evenings
- 24/7 (disruption) service

#### 3 Control centre operations without a local control centre



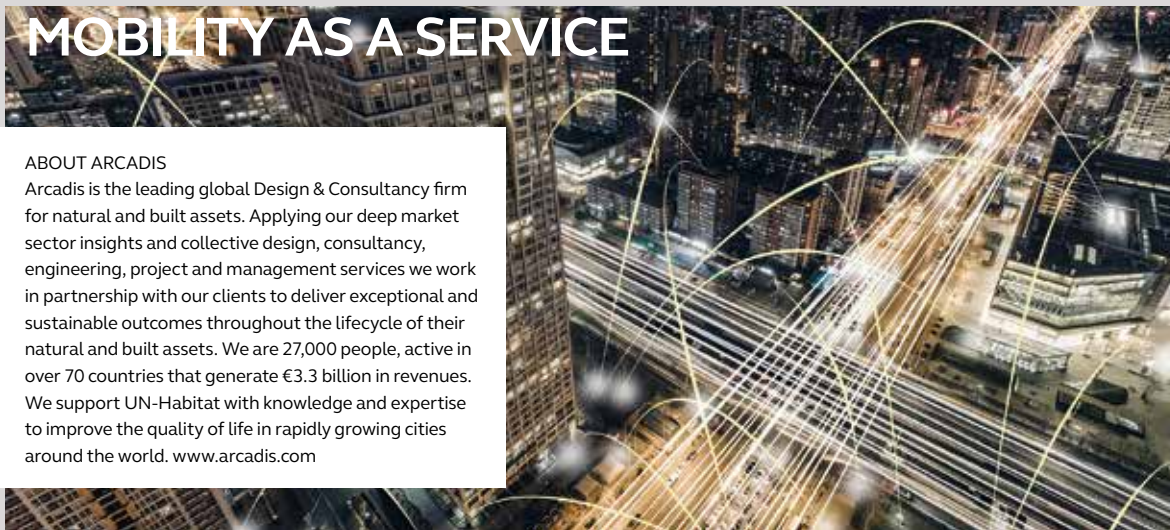
Company performs multidomain Management as a Service (MaaS) from own private centre, using:

- CMS/platforms (if available at local authority)
- Network connections with objects
- Objects of local authority

## LEADING IN INTELLIGENT TRANSPORTATION SOLUTIONS: MOBILITY AS A SERVICE

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# New 'multidomain' courses for iCentre staff

The more complex set of tasks in a multidomain iCentre requires more broadly trained personnel. Therefore, engineering firm Sweco and NOVI Traffic Academy are working together to set up new 'multidomain' courses.

iCentre staff will have to operate multiple domains. For example, an operator should be able to perform both tunnel operation and traffic management tasks. How can we help operators from 'single-domain' control centres to become 'multidomain-qualified'?

First of all, the availability of existing courses for the individual domains was analysed, according to Erik Brave of Sweco. 'This range of mainly short-term training courses was subsequently compared with the competences that are important for working in an iCentre.' Bo Boormans, director of DTV Consultants Breda, adds: 'The next step is to see whether we can combine and supplement all those different programmes in such a way that we can develop training for working in an iCentre.'

## Certification or accreditation

In developing a study programme, various options are open, Brave and Boormans explain. Brave states: 'Certification is often a matter of the professional world, and in the case of certification, there is also a chance that various courses will remain more or less independent and there may also be various providers.'

For an accredited degree programme, this is different, says Boormans: 'Such a programme is well-rounded and receives a quality stamp from the Ministry of Education, Culture and Science. So that is our preference. We would like to develop a Foundation degree course, the interim stage between an intermediate diploma and a certificate of higher vocational education. In fact, this is the first step of a higher vocational degree programme. Everyone can register for such a training programme and NOVI Traffic Academy can offer the training.'

By the summer of this year, it should be clear whether the identified range justifies the development of an accredited course in terms of quantity and level. Boormans concludes: 'If that decision is made, we can really start building the course.'



Erik Brave



Bo Boormans

## Courses for control centre personnel

The iCentre programme offers operators the possibility to be educated on different domains of operations. The control center can shop in a modular system of courses for the required education programme for the desired tasks in different domains for the operators. Several parties offer these courses, including Sweco, Arcadis, Nedmobiel, DTV Consultants and NNVO.

### Operate and monitor tunnels

This iCentre course is dedicated to the domain of tunnel operators. In the Netherlands, these operators need to be able to execute specific tunnel procedures according to local and national law.

### Traffic management

During this iCentre course, the operators learn about the demands of local traffic and the best control mechanisms to avoid gridlock.

### Operating and monitoring bridges and locks

This concerns an existing course programme (a modular system of several courses) to train operators in the nautical sector.

### City surveillance, city and parking management

This education programme trains students to become effective city surveillance opera-

tors. The operators take several courses, provided by several training agencies, to develop skills including managing aggressive behaviour, life-saving actions, camera observation and parking legislation.

### Crowd management

This is an existing course programme to train operators for crowd control and crowd management.

### Network manager (cross-domain)

This Sweco training course will provide network managers with the knowledge needed for cross-domain monitoring of large areas such as inner cities.

## Route to performance-based control is ready

Local authorities use a control centre for the management of traffic, tunnels and locks as well as parking, for example. In order to professionalize this form of 'central service provision' even further, it is necessary to show in detail how the performance of this service can be managed. One of the criteria is to make the performance measurable by establishing relevant key performance indicators or KPIs.

The step-by-step plan 'Road map to performance-driven central services' helps local authorities to formulate KPIs in a structured and compliant way for services provided from a control centre. The road map consists of three steps:

1. A guide to the description of the current situation and the description of the goals and ambitions in the field of central services.
2. A guide to test the feasibility of goals and ambitions in the field of central services.
3. A guide to the formulation of key performance indicators, which are linked to the ambitions and objectives in the field of central services.

The step-by-step plan is primarily intended for local authorities and therefore written from the perspective of a local authority.

More details:

[erik.verschoor@arcadis.com](mailto:erik.verschoor@arcadis.com)  
[gerben.quirijns@arcadis.com](mailto:gerben.quirijns@arcadis.com)  
[corianne.stevens@sweco.nl](mailto:corianne.stevens@sweco.nl)

## Identifying the distribution of public and private responsibilities

To improve the service provided to waterway and road users, it might be advisable to allocate tasks and responsibilities to authorities and companies. For clarity on the subject, the domains of traffic management (wet and dry), tunnel operation, city surveillance, crowd management and parking were investigated as to whether – and which – tasks could be performed by private parties without causing (legal) problems.

The research, performed by Arcadis and Sweco, led to an overview of the possibilities for dividing the responsibilities between public and private parties in the

purchase of iServices, or the assumption of certain roles by local authorities.

First of all, the tasks were categorized as being either the responsibility of the authorities under the law, public tasks with an unclear legal basis, or market tasks. Subsequently, it was identified for all public tasks what was necessary, for example in terms of legal measures, to transfer tasks to the market. Arcadius and Sweco also studied the options of laying down (in a contract) the distribution of tasks and powers of public and private parties.

More details:

[erik.verschoor@arcadis.com](mailto:erik.verschoor@arcadis.com)  
[bettinka.rakic@arcadis.com](mailto:bettinka.rakic@arcadis.com)  
[corianne.stevens@sweco.nl](mailto:corianne.stevens@sweco.nl)

## KPI database ready for six domains

**If a municipality or province wants to (continue to) optimize the service provided to waterway and road users, it must be clear how this service works. For a proper understanding of the current level of performance, this was analysed for the domains of traffic management (wet and dry), tunnel operation, city surveillance, crowd management and parking.**

Project participants from all six domains have studied a series of policy frameworks and contracts, identifying the set targets and adapting them to the current situation. All this information, including source reference, has been included in a freely accessible database for local authorities and private parties.

The result is a broad overview with a description per domain of the key performance indicators (KPIs) and requirements (SLAs) that are available. Furthermore, the 'white spots' are indicated per domain: gaps for which no information is available yet or for which no suitable key performance indicators have yet been developed.

The database is intended as a state-of-the-art basis for incorporating one's own performance measurement or as a basis for purchasing iServices in a targeted manner.

More details:

[erik.verschoor@arcadis.com](mailto:erik.verschoor@arcadis.com)  
[bettinka.rakic@arcadis.com](mailto:bettinka.rakic@arcadis.com)

## Clear requirements for operating staff

Operators and network managers play an important role in the operation of an iCentre. Their work extends over more than one domain and that means that a lot is required of them. The project 'SLAs and KPIs in practice for operating personnel and operating processes' has provided a complete overview of immediately usable requirements that may apply to operating personnel.

A service level agreement, SLA, contains agreements about the level of service provision from an operation control centre, also in terms of the requirements of the operating personnel (operators and network managers) for six domains. Key performance indicators, KPIs, then make the performance on these requirements measurable. In addition, they provide input for assessing the performance of the operating staff. This creates the opportunity to manage the further development of the employees and to select the right follow-up training courses.

The overview of directly usable requirements makes it easier for local and regional authorities to hire operating personnel and to monitor the quality of the service provided and the performance agreements made. The KPIs are also included in the overview.

More details:

[martijn.elting@sweco.nl](mailto:martijn.elting@sweco.nl)  
[marieke.bijl@maptm.nl](mailto:marieke.bijl@maptm.nl)  
[degeus@smartervision.nl](mailto:degeus@smartervision.nl)  
[gerben.quirijns@arcadis.com](mailto:gerben.quirijns@arcadis.com)



## Multidomain operation requires different knowledge and skills

**In a control centre that focuses on the operation of multiple domains, it is crucial to have well-trained personnel. At all levels, employees must be able to do their work across the boundaries of the various domains in a multidomain environment. In the 'Multidomain operation and the significance for personnel, management and training' project, the central question concerned what this required of the staff.**

The study, conducted by Sweco, ENAI and MAPtm, explicitly sought to answer two key questions: Which domains and tasks can be integrated and combined from the perspective of the employees? What does this integration and combination mean for staff training?

The result is a large number of products, including an overview of tasks and domains to be combined, competence profiles, and an overview of the range of training programmes offered. A number of new training courses have also been developed. In addition, six multidomain operators were trained within the project. They have all received a certificate for their successful participation in a traffic management course for tunnel operators. Completing the multidomain operator training course opens up more career opportunities for operators and brings them more varied work.

More details:

[erik.brave@sweco.nl](mailto:erik.brave@sweco.nl)  
[tzvetan.stantchev@sweco.nl](mailto:tzvetan.stantchev@sweco.nl)  
[andre.smulders@enai.eu](mailto:andre.smulders@enai.eu)  
[ivo.kalsbeek@maptm.nl](mailto:ivo.kalsbeek@maptm.nl)



## Operating process domains identified in a live test

In order for an iCentre to function efficiently and effectively, it is necessary to visualize the relevant operating processes in every detail. That is exactly what the 'High-level iHMI Operating Processes' project has done. The starting point included the question as to what a person at the operation control centre panel needs in terms of information.

All actions that an operator performs for each domain within the various operating processes – including the communication with the various parties involved – are described within the project. This resulted in a comprehensive description that is of great value to local authorities and companies.

The project delivered a range of products, including workflow diagrams per domain, 'decision trees' per domain and the description of the iHMI (integrated Human Machine Interface) operating processes in a practical case. This case was performed in September 2017. Three control centres were linked live to each other. An emergency centre in Schiedam took over the remote traffic management of the traffic control centre in Hoofddorp, while the network coordinator for tactical decisions was present in a control centre in Utrecht. On two separate days, the live test demonstrated that it is possible to link control centres and have them operate effectively in conjunction.

More details:

[andre.smulders@enai.eu](mailto:andre.smulders@enai.eu)  
[martijn.elting@sweco.nl](mailto:martijn.elting@sweco.nl)  
[marieke.bijl@maptm.nl](mailto:marieke.bijl@maptm.nl)



## iOperation philosophy: national CROW standard

**What can we expect from the next generation of control centre operation? This was the central question of the 'Uniform operation iCentre' project. Input for the answer included the knowledge of operating processes developed in the 'High-level iHMI operating processes' project. This resulted in a joint understanding of the optimal structure for smartly combining and integrating tasks, which was further developed into the so-called iOperation philosophy.**

The iOperation philosophy describes the future method of operation in every operation control centre and defines the starting points for how to set up the organization, technology and systems. The iOperation philosophy has been developed into a national standard together with CROW, the Dutch technology platform for transport, infrastructure and public space.

An essential element of the iOperation philosophy is that in a next generation of

control centres, local authorities will work on the basis of multidomain triggers; the operator is only prompted to take action when action is actually required. In addition, some of the operating processes will be handled automatically. The operator, or road traffic controller, is, therefore, no longer merely looking at 'endless images of traffic passing by'. Furthermore, we researched – and described – which information is important to provide the operator with insight into the situation surrounding the object to be operated (situational awareness).

Finally, the control application required for an integrated control centre was functionally described and an implementation plan was drawn up for this purpose. This lays the foundation for the actual creation of iCentres.

More details:

[marieke.bijl@maptm.nl](mailto:marieke.bijl@maptm.nl)  
[degeus@smartervision.nl](mailto:degeus@smartervision.nl)  
[mark.grefhorst@be-mobile.com](mailto:mark.grefhorst@be-mobile.com)  
[william.meijer@technolution.nl](mailto:william.meijer@technolution.nl)  
[peterrasker@vhphp.nl](mailto:peterrasker@vhphp.nl)

## iGenerator takes over monitoring tasks

Quickly see the wood for the trees – that is the essence of iGenerator, an application that almost completely takes over monitoring tasks from the operator or network coordinator in a control centre. The iGenerator service combines multiple data and information flows and presents the prevailing situation in a single graphical representation.

The graphical representation offers the operator or network coordinator in a control centre insight into the prevailing situation within the various domains at a glance. This could include, for example, the traffic situation, but also messages displayed

on variable message signs, or information about the occupancy of parking spaces in car parks. In addition, it is possible to generate multidomain triggers with iGenerator, for example when travel times are exceeded on a certain route, or when a car park is filling up to capacity.

The iGenerator has been applied in the Rotterdam region to allow road users to find their car park much faster on the basis of real-time information about the occupancy of the car parks at that moment in the region.

More details:

[mark.grefhorst@be-mobile.com](mailto:mark.grefhorst@be-mobile.com)

## EMaaS: integrated services for large-scale events

Many issues that occur every day on the road are characterized by a great deal of regularity; even traffic jams and incidents on the road are business as usual for a regional operation control centre. Sometimes, however, there is a special peak load, such as at a major event. Event Management as a Service (EMaaS) makes it possible to handle and manage everything that comes with the event using a pop-up iCentre.

EMaaS offers integrated services for event, location and road managers, ranging from planning and handling the permit procedure to operational support during the event in question. EMaaS maintains an

overview of all domains relevant to the event – from traffic access in the region, through crowd management of the visitors to parking facilities around the event as well as, for example, making the correlation between the access roads and the available parking spaces transparent. Moreover, EMaaS makes it possible to make direct contact with road users and to provide them with information about matters like the most suitable approach route and the availability of parking facilities.

More details:

[mark.grefhorst@be-mobile.com](mailto:mark.grefhorst@be-mobile.com)  
[jmunsterman@goudappel.nl](mailto:jmunsterman@goudappel.nl)

## iRadar data services looks into the future of the busy road network

How will the road traffic situation develop over the next ten to twenty minutes? Will jams get longer or shorter? What is the optimal moment to open the bridge? And, is there still room in the car park? These are all questions that used to be difficult to answer – until recently. iRadar brings the change.

iRadar is a data service that generates a short-term forecast for the road traffic situation for the next ten to twenty minutes and detects incidents. Incidents and unexpected disruptions on both the main road network and the underlying road network are then presented as triggers to a traffic management system. It is possible to extend the service to other domains such as waterways and car parks. This enables integrated predictions.

A short-term prediction of the traffic situation is often lacking in traffic control centres. The iRadar application requires an up-to-date regional traffic model. Based on an iRadar prediction, an operator or network coordinator can intervene and take measures at an earlier stage and weigh them against each other. A link with other control centre management systems is possible across the various domains.

More details:

[jmunsterman@goudappel.nl](mailto:jmunsterman@goudappel.nl)  
[hpalm@dat.nl](mailto:hpalm@dat.nl)  
[lkrol@goudappel.nl](mailto:lkrol@goudappel.nl)

# Image Director: smartly combining and sharing camera images

Traffic managers in a control centre can use camera images from City Surveillance and Management on certain conditions. How this can take shape and what is needed for it was studied and tested in the Image Director project. By combining and sharing camera images, a traffic manager gets access to visual information when he needs it.

City surveillance falls under the Municipalities Act and the Police Data Act. Camera images from city surveillance can be shared with the traffic management domain or other domains, if a number of conditions are met. For example, strict privacy regulations apply to the use of camera images. Images may be exchanged only if they are stripped of personal characteristics and cannot be saved. Furthermore, requirements include the necessity to record the time of and reasons for exchanges of images in protocols.

In Almere, a link has now been established between the city surveillance control centre of the municipality of Almere and the Traffic Management Centre of the company Vialis. This allows the traffic manager to request images from a number of selected cameras from city surveillance. He is authorized to do so, for instance, upon receiving notification of a traffic incident or an incident that involves an object under his control. An additional advantage is that a single camera will suffice for each site.

Image Director works in two ways: city surveillance and management also get access to the images from the traffic management in the city surveillance control centre.

More details:

[jmunsterman@goudappel.nl](mailto:jmunsterman@goudappel.nl)

[degeus@smartervision.nl](mailto:degeus@smartervision.nl)

[gerbrandt.van.staveren@cruxin.nl](mailto:gerbrandt.van.staveren@cruxin.nl)

# Self-learning software makes operation control centres smarter

Together with the municipality of Rotterdam, a feasibility analysis has been carried out of the application of self-learning, intelligent software – heuristics – in operation control centres.

The research focused on the question as to whether big data patterns can be detected in traffic flows and parking occupancy, and whether travellers can be given optimal route advice on this basis.

The most important conclusions are that parking occupancy can be predicted on the basis of historical data. This also applies to travel times. Including the weather situation may help to improve the reliability of these data. Traffic control centres can use these data to automate the provision of optimal travel advice. If there are noticeable differences between the forecasts and the current traffic situation, operators in traffic control centres can make adjustments and even intervene. The study has shown that such software solutions contribute to a dramatic reduction of the mental workload of operators in traffic control centres.

The analyses are highly promising and follow-up research aims to show how heuristics can be used to optimum advantage. This study should focus on adding extra data and variables, such as weather data and roadworks. The research could also take place in several cities. Cities are being called upon and invited to participate.

More details:

[mark.grefhorst@be-mobile.com](mailto:mark.grefhorst@be-mobile.com)

[evert.gellynck@be-mobile.com](mailto:evert.gellynck@be-mobile.com)

[peterasker@vhphp.nl](mailto:peterasker@vhphp.nl)





## Working demo and test control centre is running in Noord-Holland

The ‘Working user products’ project has produced a demonstration and test setup of a mobile iCentre running in the provincial office of the province of Noord-Holland.

With the demo and test setup (living lab), the multidomain operation has actually materialized. This shows the technical feasibility of the Blueprint, the technical basic design of the multidomain operation.

The test setup demonstrates the essence of the operation of multiple domains from an iCentre and makes it possible, for example, to test management for KPIs and trigger-based operation. The ‘living lab’ was designed to be mobile and (to a limited extent) to allow relocation to other sites and exhibition centres.

In addition, the demo and test environment shows that even in the innovation phase, new ideas can be specified, tested, aligned and refined. This way, the development of such a living lab accelerates the development of an iCentre.

*More details:*

[paul.van.koningsbruggen@technolution.nl](mailto:paul.van.koningsbruggen@technolution.nl), [william.meijer@technolution.nl](mailto:william.meijer@technolution.nl)  
[bob.kollmer@dynniq.com](mailto:bob.kollmer@dynniq.com), [tom.steijvers@vialis.nl](mailto:tom.steijvers@vialis.nl), [ron.hendriks@siemens.com](mailto:ron.hendriks@siemens.com)

## Interfaces connect existing systems to the iCentre

In the ‘Interfaces’ project, leading Dutch technology and systems suppliers have defined how the framework that the operator uses to perform his tasks, the iHMI, should be linked to the existing systems and installations that he has to manage.

In order to enable control from an iCentre, existing systems such as traffic lights, technical installations in tunnels and cameras must be connected to the integrated Human Machine Interface, iHMI, through interfaces. The defined interfaces are so-called open interfaces, serving as some sort of universal ‘adapter plugs’ to allow devices to link up and communicate. These open interfaces enable the connection of existing systems to the iHMI of the iCentre.

These same open interfaces also make it possible to expand the number of domains operated by the iCentre when needed. In addition, working with (generic) open interfaces enables local and regional authorities to switch to a new management system provider without involving any waste of capital or vendor lock-in.

*More details:*

[paul.van.koningsbruggen@technolution.nl](mailto:paul.van.koningsbruggen@technolution.nl), [michael.dubbeldam@technolution.nl](mailto:michael.dubbeldam@technolution.nl)  
[bob.kollmer@dynniq.com](mailto:bob.kollmer@dynniq.com), [tom.steijvers@vialis.nl](mailto:tom.steijvers@vialis.nl), [ron.hendriks@siemens.com](mailto:ron.hendriks@siemens.com)

## First multi-domain control tender is a fact

The ‘iHMI and Business Logic – tendering multidomain operation’ project resulted in an important milestone: for the first time, multidomain control has actually been put out to tender by a Dutch local authority.

The tender concerns the integration of the three domains in the province of Noord-Holland: tunnel monitoring and control, traffic management, and bridge and lock operation. In developing the invitation to tender, a large number of generic documents developed within the iCentre programme were used. Examples include the national CROW standards of the iOperation philosophy, the Blueprint and the Interfaces.

These national standards and the documentation can be used by regional and local authorities who are planning or preparing to invite tenders for multidomain control centres. The iCentre programme also supervises and coordinates tenders for other local authorities.

*More details:*

[mark.olivierse@mptm.nl](mailto:mark.olivierse@mptm.nl)  
[marieke.bijl@mptm.nl](mailto:marieke.bijl@mptm.nl)  
[andre.smulders@enai.eu](mailto:andre.smulders@enai.eu)  
[bob.kollmer@dynniq.com](mailto:bob.kollmer@dynniq.com)  
[verhagen@btmpartners.nl](mailto:verhagen@btmpartners.nl)



## Availability and performance requirements of technology and systems identified

In order to make good agreements with the supplier about the functioning of technical infrastructure for an operation control centre, it is important to draw up SLAs and KPIs. For this purpose, it is first of all necessary to make clear what reasonable requirements are in terms of the availability and performance of technical infrastructure. These requirements have been drawn up and listed within the 'Availability and Performance' project.

The requirements for the availability and the performance of the technical infrastructure were defined based on the question as to what is needed to be able to fulfil domain tasks and functions. This involves, for instance, the monitoring, management and operation of objects as well as coordinated area, network and corridor management for road and shipping traffic. Subsequently, these requirements were technically and functionally translated into requirements for hardware, software, asset management and life cycle management.

The project results include a set of availability requirements and performance requirements. These sets are needed to arrive at SLAs and to formulate key performance indicators to measure whether the agreed performance will be delivered. The availability and performance requirements are directly applicable for requesting or offering iServices.

More details:

[malderhout@vxcompany.com](mailto:malderhout@vxcompany.com)  
[verhagen@btmpartners.nl](mailto:verhagen@btmpartners.nl)

## Blueprint: standardized design guidelines and system architecture

What are the (technical) basic design principles for an iCentre? And which architecture would be best suited to enable optimal collaboration between the multitude of systems and subsystems in a multidomain control centre? These were the key questions of the Blueprint project. Four international companies developed concrete design guidelines and system architecture for the development of an iCentre.

An iCentre is an amalgamation of many technical components and systems. These include components that are located outside the control centre (such as traffic lights and technical installations in tunnels and bridges) and components that are present in the control centre (the central management systems, like software applications for different domains and video walls). Optimal performance of an iCentre requires that all of these different components be structured in the correct order. In addition, it is important to develop an international standard for a scalable control centre. That is why four international companies, Dynniq, Siemens, Technolution and Vialis, have developed these standardized design guidelines and system architecture.

The (basic) design of an iCentre and the design guidelines and system architecture that were drawn up for this were tailored to the iOperation philosophy, taking the following aspects into account:

- Functional operating procedure
- Operating procedures within the various domains
- Options created by the technical architecture
- Existing and new applications

More details:

[casper.moerbeek@dynniq.com](mailto:casper.moerbeek@dynniq.com), [bob.kollmer@dynniq.com](mailto:bob.kollmer@dynniq.com)  
[paul.van.koningsbruggen@technolution.nl](mailto:paul.van.koningsbruggen@technolution.nl), [ron.hendriks@siemens.com](mailto:ron.hendriks@siemens.com)  
[tom.steijvers@vialis.nl](mailto:tom.steijvers@vialis.nl)

## Managing Agent further defined

In the Managing Agent memorandum, a number of terms are worked out in more detail to arrive at a supported terminology and wording. This turned out to be necessary because there was no clear picture of what exactly is meant by Managing Agent. There was confusion especially around the relationship between Managing Agent and iService.

The memorandum defines a Managing Agent within an iCentre as an organizational form to (be able to) fulfil a performance agreement. The (main) supplier – the Managing Agent – bears the responsibility and associated risks. To deliver this performance, the Managing Agent can use one or several iServices.

Performance agreements are a translation of policy goals, needs and ambitions of a local authority and are laid down in a contract in the form of key performance indicators and service level agreements, which makes the Managing Agent an instrument for the local authority to achieve their goals. A Managing Agent performs certain public work processes for the local authority and manages the daily operational processes. The ownership of the resources to deliver the output remains with the supplier (managing agent).

More details:

[corianne.stevens@sweco.nl](mailto:corianne.stevens@sweco.nl)  
[eline.korthof@sweco.nl](mailto:eline.korthof@sweco.nl)  
[gerben.quirijns@arcadis.com](mailto:gerben.quirijns@arcadis.com)  
[coen.bresser@sweco.nl](mailto:coen.bresser@sweco.nl)  
[mark.olivierse@maptm.nl](mailto:mark.olivierse@maptm.nl)

## Models to support local authorities in procurement and tendering of iServices

In the case of an iCentre, a local government can transfer the execution of (a part of) the authority's tasks to the market after a tender. The procurement and tendering of these services differ from what local authorities are used to in these domains. Experience with this has already been gained in other sectors, such as public transport, public order and security, and IT and facility services.

In order to support local authorities in the procurement and tendering of iCentre services, examples and dos and don'ts have been collected from other sectors. These have been used as input for drawing up model applications and model contracts for iServices. A distinction was made be-

tween the different phases in the tendering process: from the preparation and tender strategy, to the tender and the execution of the contract.

For four archetypes of iServices, model applications and model contracts have been drawn up that enable local authorities to purchase these iServices. The models have been prepared for public-private contracts. For public-public and private-private contracts, checklists replace models.

More details:

[corianne.stevens@sweco.nl](mailto:corianne.stevens@sweco.nl)  
[bart.de.haan@significant.nl](mailto:bart.de.haan@significant.nl)  
[marcel@marcelwesterman.nl](mailto:marcel@marcelwesterman.nl)

## Towards effective supervision of iCentre services

The 'Regulator Exploration' project explored which forms of regulation are the most obvious for carrying out tasks in and around an iCentre. In addition, the parties involved investigated the conditions that regulation must meet and what this requires from the regulator.

Questions that were discussed and answered in the study include:

- Which powers are given to the companies that will carry out tasks and how do they relate to the political-administrative responsibilities and statutory tasks?
- Is there sufficient transparency and clarity in the distribution of internal and external tasks, responsibilities and authorization?
- Which forms of regulation are possible on the various services and activities?

On the basis of a large number of cases various forms of regulation are described and explained.

More details:

[henrik.stevens@gmail.com](mailto:henrik.stevens@gmail.com), [marcel@marcelwesterman.nl](mailto:marcel@marcelwesterman.nl)  
[bettinka.rakic@arcadis.com](mailto:bettinka.rakic@arcadis.com), [arnoud.neidig@arcadis.com](mailto:arnoud.neidig@arcadis.com)



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## Safe and secure mobility

The iCentrale programme stands for the smart integration of traffic management domains, tasks and systems to facilitate and support local authorities. As the first private party within the iCentrale programme, Trigion offers local authorities the services of a total operational centre. A fully-integrated centre that can be used for all operations, including those for roads, tunnels, bridges, locks, etc. This way, Trigion creates a safe and secure environment in which people both feel and are safe. Trigion takes a fresh look at safety, going much further than implementing standard solutions. New iSolutions emerge, as show on [Maasandmore.com](http://Maasandmore.com) and [Trigion.nl](http://Trigion.nl)



# Smart Mobility Embassy

## THE WORLD'S GATEWAY TO SMART MOBILITY IN THE NETHERLANDS

The Netherlands is an advanced society characterized by a successful economy and a highly complex transport infrastructure. As such, it offers an optimized environment for the research, testing and deployment of the transformative mobility technologies that will define the future of mobility. Within this context, the Smart Mobility Embassy acts as the source of knowledge, innovation, best practices and deployment options for Smart Mobility across the Netherlands.

## WHAT DOES THE NETHERLANDS HAVE TO OFFER?

### CUTTING EDGE DEPLOYMENT AREA

The Netherlands combines a demanding environment, the need to innovate, a receptive and open society with an attractive scale. The right size and combination for deployment of new smart mobility solutions.

### STATE OF THE ART INFRASTRUCTURE, FACILITIES & SUPPORT

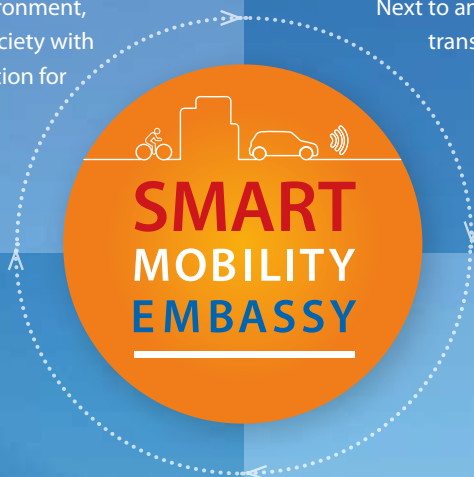
Next to an excellent physical infrastructure for all modes of transport and high data connectivity the Netherlands is organized to support the introduction and deployment of new mobility solutions. The Smart Mobility Embassy is the visible proof of the well-organized network that facilitates interested parties.

### REGULATORY INNOVATION

Active and open attitude towards regulation of innovations, in sync with EU-policies.

### PROOF OF PERFORMANCE

The Netherlands is easy to travel to for anybody who wishes to demonstrate deployed solutions to potential customers. Easy access to users and stakeholders facilitates the proof of performance in practice.



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