Halftime – an ambitious goal !

Richard Ruijtenbeek
Civil Engineer
Engineering Dept.
Municipality of Rotterdam,
The Netherlands
RR.Ruitenbeek@Rotterdam.nl

Flip Kolet
Construction Engineer
Engineering Dept.
Municipality of Rotterdam,
The Netherlands
FJ.Kolet@Rotterdam.nl

Henny Stolwijk
Senior Advisor
Engineering Dept.
Municipality of Rotterdam,
The Netherlands
HF.Stolwijk@Rotterdam.nl

Jelle van Atten
Civil Engineer
Engineering Dept.
Municipality of Rotterdam,
The Netherlands
J.vanAtten@Rotterdam.nl

Summary

In recent years the Dutch building and construction industry has produces a lot of knowledge related to renewal of the construction sector. All studied conducted by the Dutch building industry allegedly discovered that the benefits of renewal of the construction sector are numerous. The outcomes did not automatically ensure success in practice.
Each of the results of every study performed have their merit. When it came to practical implementation in projects, the insights did not lead to improvements needed within the supply chain. The improvements achieved mostly are related to individual partner in the supply chain, and also related to a single task.
In new construction and refurbishment an accelerating change is required, allowing for more innovation, sustainability, licence to operate from client and user etc. Since none of these improvements that haven been arrived at were satisfactory, the Rotterdam municipality together with CURNET adopted the idea of Catalyst management (ref Jim Collins). Where most of the time money is considered the criterion to optimise, Halftime adopts time to optimise against, keeping quality for routine procurement at least the same level.
Earlier, Halftime has been successfully adopted as in company improvement programme for HBG[1] supported and assisted by TNO.

The Halftime approach adopted by Rotterdam municipality focuses on routine procurement of infrastructural services and objects. In routine projects of several companies a waste of between 30 and 50 % has been proved. Waste is caused by institutions, miscommunication and habits related to routine work. ‘This is how we normally do our work …..”Routine prevents also the application of innovation related to material use, work processes, new arrangements of supply chain cooperation etc. As a consequence of applying the Halftime-catalyst, the City of Rotterdam will improve on accessibility. In addition it will decrease nuisance from refurbishment and construction. In that way Halftime claims to contribute to sustainable management of infrastructure.

Keywords:

Routine projects, Innovation stimulated, Reduction of squandered money, Reduction of emissions,

[1] BAM is the nowadays predecessor of HBG

Environmental, Risk, Construction time, Innovation stimulated, New construction materials, Prefabrication, Sustainable, bridges.

1. Introduction

Project Management & Engineering Rotterdam
Rotterdam is a 'working city', used to face new challenges. It is always aiming for a healthy economy, good working conditions and good living conditions for its inhabitants.

Rotterdam is also a city of construction. Annually a construction portfolio of more than three billion euro is invested in Rotterdam. Nowadays initiatives on new projects related to general building, housing and infrastructure are decreasing because of the recession and subsequent budget cuts. From the public point of view the work related to maintenance of infrastructure will prevail. Everyday routine work to refurbish public infrastructure has to continue in order to keep Rotterdam in good shape. The construction activities related to public works will inevitably cause inconvenience to citizens and companies.
In Rotterdam about 2500 temporary traffic measures are issued yearly. That equates to a daily amount of seven small or large detours in the city. This leads often to pressure on the local economy or disturbance in a neighbourhood, for instance shops being less accessible.
Also the environment is affected, for instance by congestions which lead to more air pollution and micro dust.

From the overall portfolio of the city some 70 to 80 percent is routinely performed, dayly work. While the concern from an engineers point of view is moderate, efficiency will not be an issue most of the time. Hence it can be concluded that there is a potential for optimization.

That is why Rotterdam together with CURNET[2] introduced Halftime, focussing on the procurement portfolio related to the construction work.
A vast range of R&D studies related to renewal of the construction sector has become available in recent years in the Dutch building and construction industry. Each of the results of the studies performed have their own merit. However when it comes to practical implementation of these results in projects, the new insights often do not lead to improvements needed within the supply chain. The improvements mostly achieved are related to an individual partner in the supply chain, and only related to a single task.

Adopting the Halftime concept produces a different relation between the ordering party and the contractor. Where money is considered as criterion for optimization, Halftime ads time as a criterion for optimization, keeping quality for routine procurement at the same level or better. This optimization creates opportunities for innovation, improved sustainability and a licence to operate from client to user in the supply chain. Halftime can be looked at as a catalyst (ref Jim Collins-Catalyst Management)[3].

[2] CURNET – precompetitive, public-private knowledge centre for the construction industry
[3] Holland Management Review 67-1999

2. The Halftime concept

2.1 It can be done faster

Halftime is looking to halve the overall time span of project development, from initiative to completion of the work. In this stage of the programme Rotterdam focuses on the time to execute the on site construction. Even then the 'Halftime'-ambition does have implications for all partners in the supply chain. It affects not only the work of the engineer, the contractor, but also the licence provider, the communication department, etcetera.
In many routine cases a time saving of 50% is achievable. Implementation of Halftime provides benefits to the city, i.e. less inconvenience.
Halftime applied in other sectors of industry cuts waste up to 30 %. This waste is caused by conventions, miscommunication and habits related to routine work.
'This is how we normally do our work ….." For instance the requirement of a detailed drawing when applying for a licence, where it can also be done when using a provisional drawing. Routine prevents also the application of innovation related to material use, work processes, new arrangements of supply chain cooperation etcetera.

2.2 Developing projects in 'Halftime'

Developing projects in 'Halftime', means new rules and new tools. Constructor HBG[4] has successfully adopted Halftime as an in company improvement programme, supported by TNO research. In the housing sector the 'Halftime' target of HBG resulted in reduction of its construction time from average 140 days to 40 days. Imagine the money gained by the contractor as a consequence of a late start of construction activities. Halftime can however also be a disaster. When applying Halftime only on the contractors side and not at the engineering side this can result in a heavy loss project. The internal Halftime programme of HBG resulted in new planning techniques, more attention to knowledge management and learning concepts, a shift from in situ to prefabricated production, a change in supply chain information and new methods for applying traditional construction materials, like asphalt and concrete.

For the time being Rotterdam is focussing on routine projects. This is done because the main stream of projects in Rotterdam is of a routine nature. In routine projects the overall knowledge of the end result, its quality and the project cost is considered alike on both sides of the B2B-relation. To achieve Halftime in routine projects Rotterdam applies time as a criterion in tendering, conditionally replacing cost, while allowing the contractor to be early involved. This allows the builder to introduce new techniques and to a better application of the Deming circle of Plan-Do-Check-Act.
Furthermore there exists an official 'Memorandum of Understanding' between region based SME-'s in construction related to the Halftime target. In this way 'Halftime' contributes to the ambition of Rotterdam to allow for an early involvement of contractors. In combining the knowledge and experience from both side of the B2B-relation earlier in the supply chain, additional value will be included in the project. This is also expected to have a positive effect on the lifecycle cost of the object.

A model has been developed to calculate the building traffic. Analysis of cost estimates provided the quantity of construction materials as well as the number of labour.

[4] BAM - Construction Industry – Bunnik, the Netherlands, the nowadays predecessor of HBG

3 'Halftime' and its environmental effects

Annually some 2.2 million tons of construction related material is transported in the Rotterdam region. The traffic related amounts up to 15 to 28% of the overall cargo traffic in the region. This overall cargo traffic is estimated to be 250 million kilometres every year, with subsequent environmental effects.
From these facts onward Rotterdam started a survey to explore how the building traffic and potentially reduction affects the environment.

The core of this survey[5] consists of 15 case studies: 7 in housing, 4 in general building and 4 in infrastructure. Analysis of the administration resulted in a profile of the traffic of personnel and the transport of building materials during the course of construction. In the traffic analysis only the last links in the supply chain were included. Hence the suppliers- and the of personnel transport.

A model has been developed to calculate the building traffic. Analysis of the cost estimate (project budgets) provided the quantity of construction materials as well as the number of labour. These quantities were used to derive the number of truck rides and car rides and subsequently the discharges of CO_2, NO_x and Micro Dust for trucks, vans and personnel cars. The planning of each project was used to relate these emissions with time.

This analysis[6] resulted in a detailed weekly profile of the transport rides, the kilometres and the emissions of Carbon dioxide, Nitrogen and Micro dust. The next figures show the kilometre profile and the Carbon dioxide profile for a reconstruction project of roads.

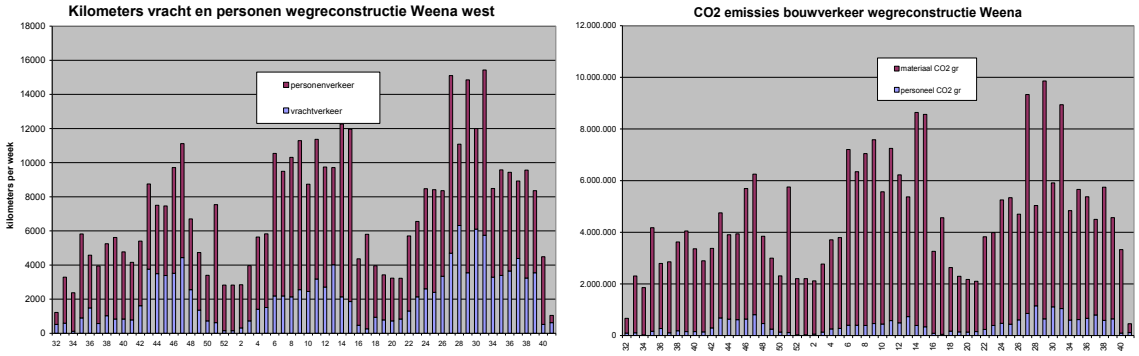


Figure 1 . Kilometre profile and CO_2 profile for a reconstruction project of a road. The red bars represent the transport of materials, the blue bars represent the transportation of personnel.

These profiles show the amount of transport fluctuating during the building period of 61 weeks, just as the emissions of CO_2 from the cars do. This is due to the different stages of construction. Nonetheless this pattern differs at the various sectors of the building industry (Housing , Utility and Infrastructure).
Not only do these profiles show the intensity of the transport and the quantity of emissions, they also produce insight in the flow of materials and workforce during the construction period. It visualizes at what pace the construction is produced combined with the number of workers and the quantity of applied materials per day or week.
The analysis of the 15 case studies resulted in a linear relation between the size of the work, the intensity of building traffic and the emission of CO_2, NO_x and micro dust.

[5] Materiaalgebruik Bouwverkeer en Luchtkwaliteit IGWR Rotterdam 2011.
[6] Naar een duurzame Bouwlogistiek IGWR Rotterdam 2012.

The size of the works does not appear to be the only factor influencing the building traffic and the emissions. The other factors are:

- The capacity of the building site to cope with the flow of materials and personnel. Insufficient capacity stagnates the building process. This results in longer building periods.
- The increased productivity of building by prefabrication of materials and mechanisation of labour allows shorter building periods with less transport.

These two factors were demonstrated in the case studies. In two cases there occurred inadequate building sites which disturbed the building process and which resulted in more labour and insufficient loads of materials. This resulted in more emissions caused by increased building traffic.

From analysis of the seven housing projects, it can be concluded that halftime construction not only increases the efficiency, but also decreases the overall transport kilometres and the emissions during the construction stage. This is done by analysing the cases for the building traffic and its emissions. Conclusions can be summarized as follows:

- In most cases half-time building results in lower transport and reduction of CO_2 emissions.
- When half-time building is combined with the mechanisation and prefabrication it will result in less transport and fewer emissions.
- From the analysis of the building cases and road works it shows that halftime building frequently occurs in regular projects.

The infrastructure was examined in four cases of road reconstructions. Civil works like road reconstruction have more transport of materials like soil, sand and gravel, that have to be processed on the site. Reducing the transport kilometres means also reducing CO_2 levels. Previous it was stated that shortening the building time also reduces the levels of CO_2.

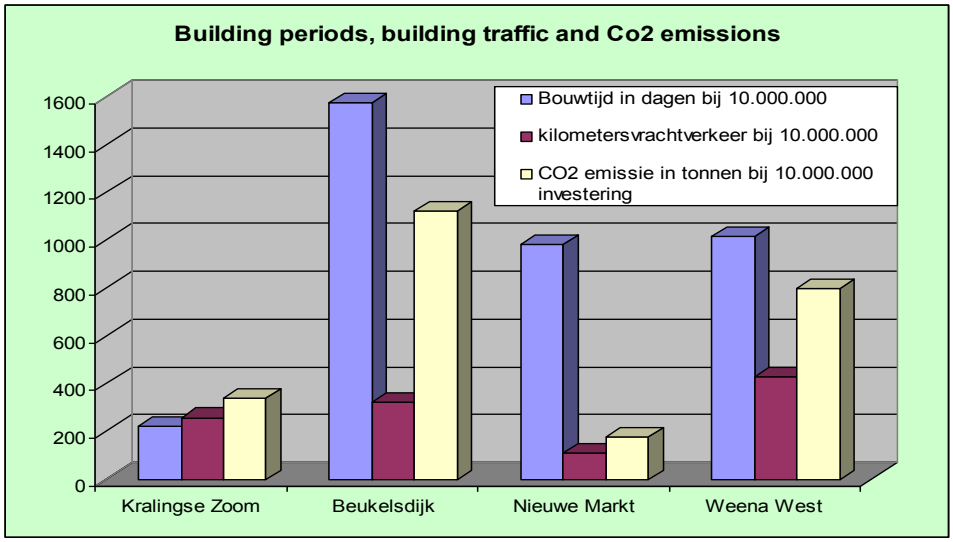


Figure 2. Building period, CO_2 emission and building traffic in four infrastructure projects

Kralingse Zoom is a reconstruction of the road deck in a very short period of three weeks. The ongoing traffic at the roads caused this limited construction time. It has a typical profile of a Half-time (quarter time) project: low levels of building traffic and accordingly low levels of CO_2 emissions. In this case the labour at the site was almost fully mechanised, machines to remove the asphalt and to cover the deck again with new materials. Only truck loads of asphalt were taken from and brought to the site. Nieuwe Markt is a road reconstruction including the reconstruction of

the sewage and the leads. Though there is few traffic and a low level of CO_2 there is a long period of construction. This has to do with the limited labour that is added to the works.

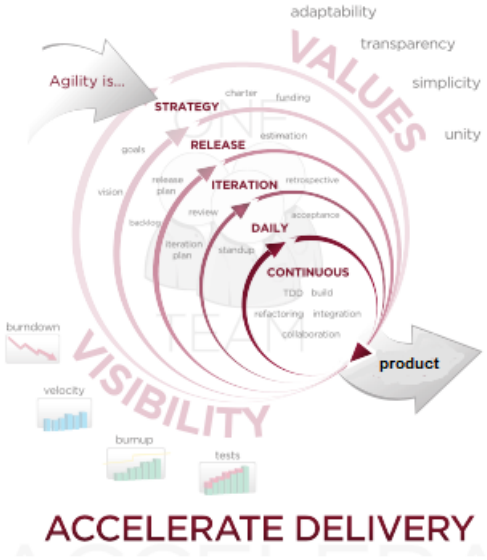
Working at halftime should not only cut environmental nuisance by half, but it will also result in significant cost savings. Rotterdam aims at cost savings of 20 to 30 percent in construction or refurbishment of roads, roundabouts, viaducts, tunnels and sewers.

4. Halftime: VISI

The 'resulting quality' of a project is largely depending on both 'supply quality' and 'process quality'. The reliability of the 'end result' quality proves to be largely dependent on the quality of process and supply. Everyone is convinced that quality should be based on a transparent process adopting Plan-Do-Check-Act as a basis. Also attention should be given to working conditions, supply partners interests and attitude to keep up the spirit which legitimates transparency.
The level of transparency in a project is thus a key factor in the success of a project. VISI improves transparency in a project. VISI is introduced as an open standard, which organizes the allocation of roles, tasks and responsibilities, of supply chain partners involved. After the allocation of roles, VISI provides a framework for arrangement of the formal communication in a project between the various roles. In this way VISI provides the basis for communication and information transfer, time management and data storage in construction projects. For routine projects this may result in a standardised framework. This phenomenon requires to give more attention to the process of the allocation of roles in order to ensure the awareness of everyone involved in one's specific role. This is done during the PSU-activities of the project.
Transparent communication and document management with the help of VISI allows for a better insight of work in progress, avoids confusion and misunderstanding, smoother cash-flow payments and procurement, faster decision making etc.
VISI is nowadays widely accepted in the Dutch Construction industry and is prescribed in many contracts.
In all infrastructural works in Rotterdam above € 150.000, engineers and contractors are pre-scribed to use a ICT-tool based on the VISI-standard.

5. Halftime: Agile scrum in standard work

In order to achieve Halftime during the design stage, new ways of work are experimented with. From the ICT world 'Agile scrum'-method has been borrowed.

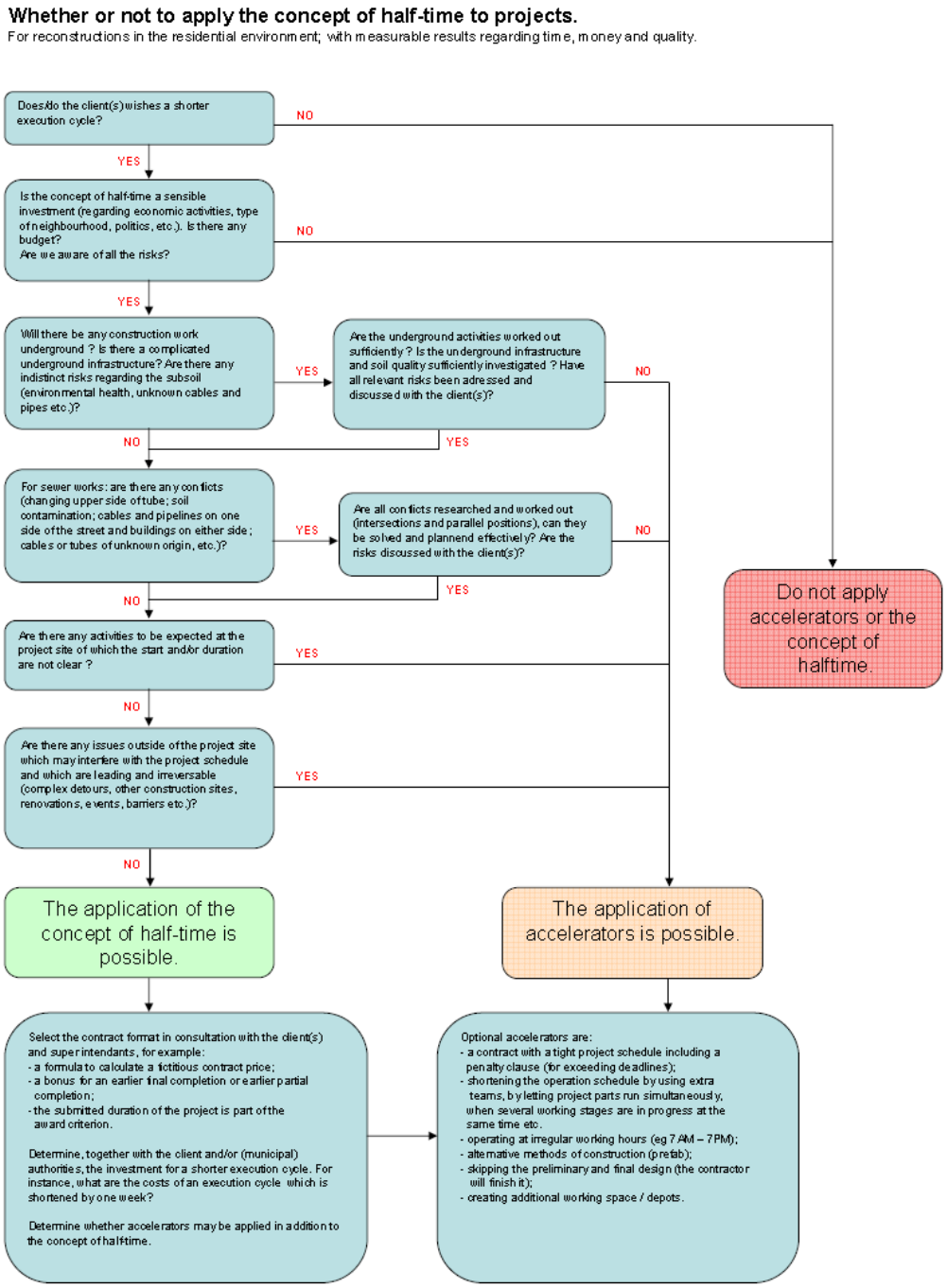


Normally a standard MS projects-waterfall planning is applied, as a standard planning method. A new action is then started when the action before this action is finished. The usual way of work within the Rotterdam Engineering office follows several stages. It starts with a sketch design, followed by conceptual design and a final design. When the 'Agile scrum'-method is applied, it appears that the sketch design is already good enough to start the preparation of a final contract and is sufficient basis for application of the required permits. Tests carried out with this design method proved a time saviour of 50 %.
In 'Agile scrum' actions are targeted for. Close monitoring of the action and the dedicated team, drastically reduces the number of mistakes. All the actions of each person, the progress and the resulting products are monitored in a web based 24/7 software like Basecamp

from 37 signals. Just by working organic (agile) from the start, there is more focus on risks in the project, on quality and on each deadline. This results in less mistakes in routine work.

6. Where to use Halftime in an urban infrastructural project ?

The flowchart presented below resulted from first successful applications of the Halftime concept, primarily focussing at the reduction of construction time. Projects were executed in the public space in the city of Rotterdam. It summarizes the experience up to now when to apply Halftime. In that way it also provides insight in the way Halftime is picked-up.
For above ground projects the Halftime concept can be applied. In case underground construction forms a relevant part of a project, Halftime can only be applied when risks as consequence of the underground construction are sufficiently addressed.



7. Halftimish – a first step toward Halftime: Bonus

In summer time there are 12 hours of light per day, why only work 8 hours a day? In places where there are living very few people it is possible to work 24 hours per day, why won't we? Why not in the best time of the year during summer holiday? It is also possible for the contractor to work with three teams in stead of one. The road works give a lot of hassle and inconvenience in the city. By giving the contractor a bonus for every day earlier he finish the roadwork, we give him the cost of renting the road signs for the detour and the extra hours for the engineering agency for saved for working, it won't cost the city any extra money. This is just an example of what is possible with tendering with time as a criterion.

8. Halftime: Composite bridges

Bridge builders have always been a conservative bunch – and perhaps rightly so, given the loads that bridges have to bear and their importance to our social and economic life. However, a revolutionary new method of making bridges from environmentally-friendly composite material may well make town planners and architects rethink their concepts. Fast forward to the present day, where bridge materials look set for another quantum leap into the future. Amazingly, an estimated 7% of global CO_2 emissions come from the making and use of concrete. Scientists in the Netherlands have proven that vast energy savings are possible if bridges are made of lightweight glass-fibre-reinforced composite resin instead of concrete or steel. Building a small 12-meter long traffic bridge using composite material instead of concrete would save 1300 gigajoules, and compared to a steel bridge the energy saved would even be 2700 gigajoules. This is a massive improvement, making resin 3-5 times more energy-efficient than conventional materials. To put this into context: if we use composite resin rather than other materials when replacing its 2000 park bridges, the energy saving would be equivalent to the total annual energy bill of 310,000 households. Source: www.dsm.com A composite bridge are fabricated in a moll. Because of the low weight of an park bridge (he will flow in the water), the bridge can be placed with an small hydraulic excavator in 0,5 day without any sheet piling and/or pillars like an steel or concrete bridge. This is one of the example that prefab construction is faster in the field and saves time.

9. Conclusions and recommendations

In Rotterdam the Engineering Department together with the private partners are well underway. Each finding specific merits when applying Halftime in routine projects. It took some years to prepare ourselves for a real start. This paper shows results following first analysis of projects executed and provides provisional guidelines to others to apply the Halftime concept.

From our first stage of the Halftime introduction following conclusions and recommendations can be derived:

- Halftime is accepted to be a stimulating challenge for the public and private partners to adapt the work flow
- Halftime is causing a different way of collaborating in the supply chain
- Halftime is a catalyst to a really apply new techniques and materials in routine projects
- Halftime really reduces transport kilometres of building materials and personnel. As a consequence thereof building traffic is reduces with subsequent reduction of emissions
- The Halftime concept should NOT be introduced to rigorously. 'Halftimish' could be a in between step.

Although Halftime seems ambitious, it can be achieved. Public and private perseverance is however required. It promises new challenges for new entering craftsmen and crafts women in a more dynamic innovative construction sector. Furthermore Halftime will affect projects in the more strategic part of Rotterdam's purchase port folio.