

SERIOUS GAMING FOR LOGISTICS

PREPARING FOR THE FUTURE



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TNO innovation
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THE FUTURE OF LOGISTICS

CHALLENGES IN THE LOGISTICS SECTOR

Is it possible to face the challenges of today while keeping track of the developments of tomorrow?

Being a player in the present-day logistics sector is a challenging profession. Competition is fierce and customers are becoming more and more demanding. Challenges like changing customer expectations, technological breakthroughs, new entrants to the industry and new ways to compete or collaborate are things that logistics parties struggle with everyday¹. On top of that, these challenges are increasingly becoming complex multi-stakeholder situations². To overcome these challenges, changes have to be made and large changes are rarely without risk.

Besides all these challenges of today, it seems as if the speed of technological developments is increasing constantly. Terms like big data, automated driving, block chain, self-organising logistics and physical internet are part of the discussion both on the news and at work. But what do they mean for the logistics sector and your business? And how can we benefit from them?

Traditionally, the logistics sector is characterised as cumbersome and locally organised with considerable fragmentation among the parties involved. Strong competition and ad hoc demand force logistic players to aim for short-term individual gains. This creates a large gap between the short-term focus of the sector and the long-term and collaborative view that is needed to deal with globalisation as well as technological developments that are emerging quickly.

Hence, the sector needs to adapt to solve the practical problems of today and get a grip on future developments. However, this is not as easy as it sounds. In complex multi-stakeholders situations, the impact of new measures on the logistics chain might be substantial but it is often unclear to individual stakeholders. Even if a stakeholder considers adopting new measures, it is difficult

to decide where to start and how to implement new ways of working while keeping the operational business running. On top of that, the success of the solution also usually depends on the behaviour of other stakeholders.

From challenge to opportunity

Being able to select the best solutions to face today's problems and to use the flood of disruptive technologies in your favour will give you a head start in keeping your ground in the logistics sector. TNO helps logistics organisations gain insight into the implications of both practical solutions and innovations before implementing them in a multi-stakeholder setting. Furthermore, TNO can support the adaptation to disruptive technologies and define future strategies to help logistics organisations get the most out of them. To build a bridge between logistics solutions and operational practice, TNO makes use of serious gaming.

SERIOUS GAMING AS A TOOL

To explore the implications of changes and innovations on all levels of the logistics chain and stimulate action and change, TNO makes use of a specific tool: serious gaming. The goal of serious gaming is to simulate real-life challenges to help players come up with possible solutions and enable them to test these in a safe environment. Players can learn from successful strategies, but also from mistakes. This allows them to experiment with and experience the consequences without putting their real-life operations at stake. Hence, it enables participants to select only those measures and technologies that are valuable to their business.

This paper displays the value of serious gaming to the stakeholders in the logistics sector. The first part elaborates on the value of a serious game itself by explaining the objectives, target groups and key elements of a successful logistics game by explaining the objectives, target groups and key elements of a successful logistics game. To illustrate the benefits of serious games further, several factsheets of serious games developed by TNO for the logistics sector are provided. The second part of the paper explains that not only the game

itself but also the process of developing and implementing a serious game has many benefits for participating stakeholders. Lastly, the vision of TNO on the opportunities of serious gaming for the logistics sector is discussed.

IS IT POSSIBLE TO FACE THE CHALLENGES OF TODAY WHILE KEEPING TRACK OF THE DEVELOPMENTS OF TOMORROW?



THE VALUE OF SERIOUS GAMING

WHY USE SERIOUS GAMING?

Serious games can be distinguished from regular games by their purpose. Where, regular games are developed primarily for fun and recreation, the main goals of a serious game are to learn and generate changes in behaviour. By enabling participants to experience new concepts rather than telling them about these concepts, the learning process is strengthened. This has helped gaming prove its worth as a tool in various other fields such as healthcare³, defence⁴ and business^{5,6}. Since games are tailor-made to address a certain issue, each player is able to experience the effects of a certain measure or innovation on their own operations. This motivates them to use the results of the session and work together towards successful implementation. This prompt to action is achieved in serious games by aiming for one or more of the following five objectives:

1. Raise awareness

The logistics chain is complex and multi-layered. In order to make new concepts fly, all parties involved need to be willing to change their current way of working. One of the main goals of serious gaming is to make parties aware of the implications of logistics innovations. A game is an ideal way to gain insight into the implications of alternative ways of working or new technologies on their way of doing business.

2. Stimulate collaboration

By means of simulating real-life scenarios, a game provides insights in the current challenges in the logistics chain. It aims to sketch an objective and holistic view of the entire chain. This stimulates the different stakeholders to think beyond their own perspectives. Closer collaboration across organisational boundaries is needed to improve the

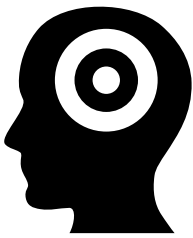
sector. A serious game creates a pleasantly challenging atmosphere among the players, which rather differs from regular business meetings. As such, players get to know each other from a different perspective, which helps them let down their guard and open up to each other. This stimulates collaboration among the different parties and it provides a safe environment in which such new collaborations can be explored.

3. Generate new ideas

Serious gaming can also be used as a tool to start the conversation and generate new ideas. The game itself does not directly provide a solution to the problem that is being tackled but it does stimulate all participating parties to use their creativity and try out different strategies when playing the game. In between rounds of the game there is also a possibility to discuss the challenges and come up with new solutions. Serious games are often played in a workshop setting. This helps create a stimulating setting that facilitates fruitful brainstorm sessions and discussions.

4. Experiment in a safe environment

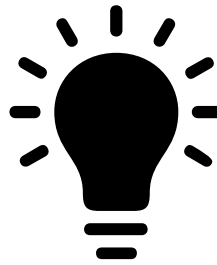
In addition to generating new ideas, serious games can also be used as a safe testing environment. Implementing innovations to deal with new developments in the logistics process, usually involves many risks since practical implications are rarely clear. By simulating the barriers and issues of new developments, serious games enable all the respective parties to work out new solutions in great detail and even provide insights into the opinions and feelings of other organisations that are involved. Hence, serious gaming helps reduce the risk exposure of participating organisations. Another advantage is that participants are able to compare different solutions to a certain problem. This makes it possible to gain an integral understanding of the challenge at hand and to come up with more creative and progressive solutions than they would in the real world when their business is at stake.



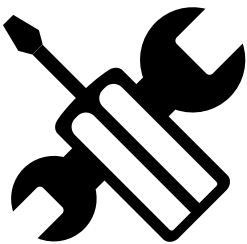
Raise awareness



Stimulate collaboration



Generate new ideas



Experiment in a safe environment



Education and training

5. Education and training

A common objective for serious games is the use for educational and training purposes. It allows people to practise and make mistakes and learn by doing so. Active learning in an environment where you directly see the effects of your actions but without any real implications of possible errors is an ideal way to develop new knowledge and skills. Furthermore, active and problem-based learning will make sure it is easier to memorise lessons learned.

The five objectives described above, give an initial impression of what value serious gaming can have and how it can motivate the logistics sector to take action.

MAIN TARGET GROUPS

Apart from setting the objective, the corresponding target groups need to be determined. Typically, for logistics games we can identify three main target groups, each with their own specific struggles and objectives.

1) Logistics parties

Serious games that are meant to be played by logistics parties are often deployed for demonstrating the implications of innovation and enhancing collaboration among the respective market parties as well as allowing them to test new concepts without a direct effect on operations.

2) Governmental organisations

Serious games that are designed for municipalities, port authorities, or other governmental organisations are often aimed at simulating the implications of policy-making and decision-making on long-term investments.

3) Educational institutes

Serious games that are deployed by schools and universities as educational methods often aim to provide students with better insights into logistics processes and innovations in the logistics sector. Additionally, these games also let students experience what type of challenges the different logistics parties encounter.

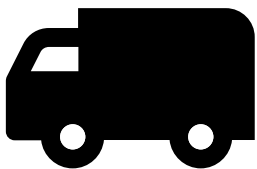
Different types of games can be used to achieve different objectives within games and thus serve different target groups. For example, a distinction can be made between single- and multiplayer games, and between boardgames and computer-based games. Games that are targeted at logistics parties and/or governmental organisations are often designed as multiplayer games, since they aim to stimulate discussion and enhance collaboration. Serious games that are meant to provide insights for students or researchers can be singleplayer as well as multiplayer games. If the goal is to incorporate simulations or data-analyses, a computer based game is preferred over a boardgame, but a combination of the two is also possible.

The above objectives and target groups give a high-level overview of the benefits of serious gaming, although each game that is developed is a tailor-made solution for a specific target group with a specific goal and topic. To illustrate this, the following section displays several logistics games developed by TNO.

EXAMPLES OF LOGISTICS GAMES AND THEIR BENEFITS

To show the variety of possibilities gaming has to offer to the logistics sector, this section provides an overview of the logistics games developed by TNO often together with one or more partners. As can be seen in the factsheets, each game is tailor-made for a specific topic. On the sheet the intended objectives and resulting short-term and long-term benefits are provided. Furthermore, testimonials from clients and parties who have participated in a gaming session are added. These testimonials show how the intended target group has experienced the use of gaming to address their issues.

Aside from the serious games described below, TNO is currently developing several new logistics games on topics such as self-organising logistics, the traffic management of inland shipping related to the operation of locks and two games on synchromodal transport. One game focuses on synchromodal transport from a shipper's perspective and the other game on the role of infrastructure managers.



Logistics (market) parties

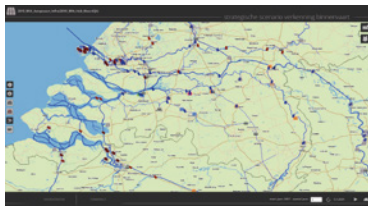


Governmental organisations



Educational institutes

IMPULSE DYNAMIC TRAFFIC MANAGEMENT WATERWAYS



FEATURES

TYPE: DIGITAL SIMULATION
DURATION: VARIABLE (4-8 HOURS)
PARTICIPANTS: VARIABLE (5-25 PLAYERS)

TARGET AUDIENCE



Logistics
(market) parties



Governmental
organisations

OBJECTIVES



Stimulate
collaboration



Generate
new ideas



Experiment in a
safe environment

GAMEPLAY

Players are asked to develop and refine scenarios for logistics concepts that are used as input for the simulation model. The model calculates the effects on costs, time and CO₂ for individual stakeholders and the sector as a whole. After several iterations, players arrive at an optimised concept together and discussions are held on implementation of the results.

DESCRIPTION:

The Dutch Inland Navigation market has a number of important strengths, such as economies of scale and environmental impact, but also has a complex interplay of different stakeholders (e.g. shipping companies, terminals, deep sea operators, government). Different optimisation concepts, such as the use of a hub location or re-use of empty containers, can only be applied if different stakeholders cooperate. To support the uptake of new logistics concepts for inland waterway transport, TNO, TU Delft and Ab Ovo developed a simulation game, in which stakeholders come up with new transport and logistics concepts, discuss the implementation and see the impact of these concepts. Eleven sessions with over 70 industry representatives were conducted for the main operating areas in the Dutch waterway system.

SHORT- & LONG-TERM BENEFITS:

- The simulation tool can be used to calculate and show the impact of new or modified logistics concepts in the logistics barge chain, both for individual companies and on a system level;
- Companies are triggered to really think about new logistics concepts and the way they can implement these concepts together in the logistics chain;
- The interaction between this mix of stakeholders (deep sea carriers, terminal operators in sea ports and hinterland, barge operators, logistics service providers and shippers) was appreciated very much and led to on-going cooperation after the gaming sessions stopped. Examples are the hub concept at the terminal of Nijmegen, the hub and hop concept to/from the northern part of the Netherlands and the reorganisation of port dues in the port of Amsterdam.

TESTIMONIALS:

“I AM VERY PLEASED WITH TANGIBLE INNOVATIVE INSTRUMENTS, LIKE THESE GAMES AND SIMULATION MODELS WITH WHICH ORGANISATIONS CAN TEST SEVERAL SCENARIOS FOR THE FUTURE. THIS MODEL STIMULATES LOGISTICS PARTIES AND GOVERNMENTS TO LOOK BEYOND THE LIMITS OF THEIR OWN ORGANISATIONS.”

Melanie Schultz van Haegen, former Minister of Infrastructure and the Environment

“THE SIMULATIONS SHOWED US IT IS MOST EFFICIENT TO BUNDLE HINTERLAND CONTAINERS IN THE NORTH OF THE NETHERLANDS AND SUBSEQUENTLY TRANSPORT THEM ON INLAND WATERWAY VESSELS TO ROTTERDAM. THAT IS A VERY CLEAR CONCLUSION.”

Willem van der Ark, terminal-operator MCS

“SERIOUS GAMING IS ONE OF THE METHODS THAT WE USE TO STIMULATE COLLABORATION. A SIMULATION OFFERS A SAFE ENVIRONMENT IN WHICH MARKET PARTIES CAN DISCUSS OPTIMISING THE LOGISTICS CHAIN OF A CORRIDOR.”

Jacco de Kok, Rijkswaterstaat

THE CHAIN GAME



DESCRIPTION:

One of the main challenges that international intermodal container logistics faces today is how to balance efficiency and security. Supply chain research proposes a new approach for this challenge called Supply Chain Visibility, which relies on data sharing and considers the risks from the perspective of the entire supply chain, instead of from each individual link of the chain. To explain the complex and abstract concepts of supply chain visibility and to initiate collaboration between key stakeholders in supply chains, TNO developed The Chain Game as a part of CASSANDRA, a project funded by the European Commission under the Seventh Framework Programme.

FEATURES

TYPE: DIGITAL SIMULATION
DURATION: 1,5 - 2 HOURS
PARTICIPANTS: 5 - 10 PLAYERS

TARGET AUDIENCE



Logistics
(market) parties



Governmental
organisations

OBJECTIVES



Raise
awareness



Stimulate
collaboration



Experiment in a
safe environment

GAMEPLAY

There are 5 roles: 2 manufacturers, 2 forwarders and 1 buyer. Each player's performance is measured based on his/her company's stock value. By investing in various supply chain innovations, players can increase their capacity to cope with risks and improve their compliance with Customs regulations. Investments can be made by each player in either individual innovations or chain-wide measures.

SHORT- & LONG-TERM BENEFITS:

- Confronting players with decisions and incidents that require them to share resources, contribute insights and align with partners and Customs;
- Illustrating how innovative data-sharing concepts can make supply chains more robust, reliable and efficient;
- Supporting the mindset shift from a 'transaction-based' (bilateral) thinking towards a 'chain-oriented' multi-party approach.

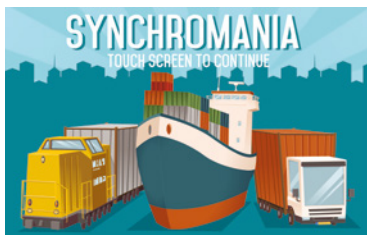
TESTIMONIALS:

"TNO BUILT THE SERIOUS GAME 'CHAIN GAME', IN WHICH STAKEHOLDERS, SUCH AS SHIPPERS, FORWARDERS AND AUTHORITIES COULD TAKE DIFFERENT DECISIONS ON SEVERAL EVENTS THAT OCCURRED IN THE SUPPLY CHAIN, AND THE GAME SHOWED THE INDIVIDUAL PROFITS OF DECISIONS AND THE OVERALL PROFITS. IT SHOWED IN A REMARKABLE WAY THAT DECISIONS THAT ARE TAKEN IN THE COMMON INTEREST, HAVE A MORE PROFITABLE OUTCOME EVEN FOR THE INDIVIDUAL STAKEHOLDER."

Frank Heijmans, Customs Administration of The Netherlands

SYNCHROMANIA

TNO innovation
for life



FEATURES

TYPE: DIGITAL SIMULATION
DURATION: 2 – 4 HOURS
PARTICIPANTS: MAX 8 TEAMS OF
2 PLAYERS

TARGET AUDIENCE



Logistics
(market) parties



Educational
institutes

OBJECTIVES



Experiment in a
safe environment



Education
& training



Raise
awareness

GAMEPLAY

Each team takes the role of a planner whose goal is to find the optimal route to ship the orders of clients. The game consists of 3 rounds. At the end of each round the planner's performance is evaluated in 3 metrics: total cost, emissions level and customer satisfaction

DESCRIPTION:

Synchromodal transport is a new logistics concept which can enhance the reliability and efficiency of transport. The concept requires both cargo owners and logistics service providers to change their way of working. The Synchromania game provides insight into the benefits of the concept and is aimed both at educating operational planners and sales employees of logistics service providers and at engaging conversation between different stakeholders.

SHORT- & LONG-TERM BENEFITS:

- By offering a safe environment to test new strategies, the game becomes an evaluation tool that can help collect valuable information on the requirements for IT and software support tools, such as planning software, but also for data;
- Companies were activated to extend the network with new routes and modalities for more flexibility and to develop a new pricing strategy;
- The game is used as an education and training method for both personnel and students. As a recruitment and development tool it can facilitate the scouting of talent and increasing the employability of personnel;
- The game can also be a valuable external tool for relationship management and sales.

TESTIMONIALS:

“WE HAVE GAINED A GREATER UNDERSTANDING OF THE BENEFITS OF THE SYNCHROMODAL APPROACH, AND OF THE CHANGES IN CORPORATE CULTURE NEEDED TO FACILITATE IT.”

Marco Zwaap, Containeroperator Danser Groep

“STUDENTS SEE THAT COLLABORATION WITHIN THE TRANSPORT CHAIN, RESULTS IN BETTER PRODUCTS. AT THE SAME TIME THEY LEARN THAT SYNCHROMODALITY IS BENEFICIAL BUT COMPLEX.”

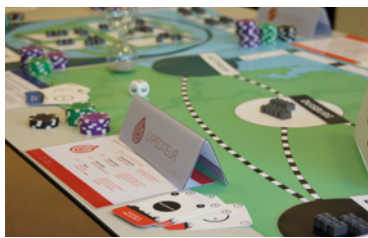
Guy Somers, Fontys Hogeschool Techniek & Logistiek

“THE GAME LETS YOU EXPERIENCE WHAT SYNCHROMODAL TRANSPORT ACTUALLY MEANS IN PRACTICE. AT EGS WE STILL MAKE USE OF THE GAME; WE PLAY SYNCHROMANIA WITH OUR EMPLOYEES AND EXTERNAL CUSTOMERS.”

Willemien Akerboom, European Gateway Services

RAIL CARGO CHALLENGE ROTTERDAM

TNO innovation
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FEATURES

TYPE: BOARD GAME
DURATION: 2 – 3 HOURS
PARTICIPANTS: 7 – 14 PLAYERS

TARGET AUDIENCE



Logistics
(market) parties

OBJECTIVES



Stimulate
collaboration



Generate
new ideas



Experiment in a
safe environment

GAMEPLAY

There are 2 roles in the game: competing rail operators and freight forwarders. The challenge of the game is to efficiently transport the dispersed freight by rail. The providers and operators need to cooperate with other stakeholders to get cargo to their destinations as efficient and cheap as possible – and to their clients' satisfaction.

DESCRIPTION:

With the opening of two new terminals on the Maasvlakte shipping companies now have more options to transship and transport their containers through the Port of Rotterdam. It is expected that this will lead to a situation in which containers are more dispersed between terminals. The Rail Cargo Challenge Rotterdam addresses this situation and aims to create awareness among stakeholders and gather insights into making decisions on utilising rail freight. At the same time, it opens up the discussion on possible solutions and concepts for handling containers and managing their transport to the hinterland. The Rail Cargo Challenge game was developed by The Barn, TU Delft, TNO and ProRail.

SHORT- & LONG-TERM BENEFITS:

- Validating the needs and urgencies of rail freight stakeholders and practitioners;
- Creating and improving collective awareness of the different roles in the transport chain and identification of areas for improvement for individual and mutual benefits;
- Initial game session served as an instigator for more frequent cross-sector dialog, focused on improving the current situation with the help of better collaboration and new bundling solutions;
- Ideas from the gaming sessions are used as input for analysis by simulation to discover the best solutions for rail bundling from the Maasvlakte.

TESTIMONIALS:

“IF YOU EXPERIENCE THAT COMPLEXITY IN A GAME IT REALLY HELPS TO DRIVE THE MESSAGE HOME”

Maurits van Schuylenburg, Port of Rotterdam

“THE SETTING ITSELF, IN WHICH PEOPLE SAT AROUND A TABLE AND PLAYED A PAPER-BASED BOARD GAME, REALLY HELPED TO STIMULATE THE DISCUSSION”

Bart van Riessen, Europe Container Terminals

“DURING THE GAME, PEOPLE FOUND THAT A LITTLE COURAGE AND A LITTLE BIT OF OPENNESS ABOUT BUSINESS MATTERS ENABLED THEM TO JOINTLY ACCOMPLISH MUCH MORE”

Pieter Förrer, Rail Service Center Rotterdam

RAIL CARGO CHALLENGE AMSTERDAM

TNO innovation
for life



FEATURES

TYPE: BOARD GAME
DURATION: 2 – 3 HOURS
PARTICIPANTS: 7 – 14 PLAYERS

TARGET AUDIENCE



Logistics
(market) parties

OBJECTIVES



Stimulate
collaboration



Generate
new ideas

GAMEPLAY

All teams represent different terminal operators with different types of storage possibilities. Players are stimulated to expand their terminals and maximise their profits while safeguarding the growth of the port. The operators need to cooperate with other players to get cargo to their destinations as efficient and cheap as possible – and to their clients' satisfaction.

DESCRIPTION:

The Rail Cargo Challenge Amsterdam is an interactive serious game in which terminals, carriers and shippers explore in what way the logistics network in the Amsterdam Port region can be further developed. It stimulates awareness about the potential of rail transport and is designed to give a new impulse to the development of rail services in the region. The Rail Cargo Challenge Amsterdam is developed by The Barn, TU Delft and TNO.

SHORT- & LONG-TERM BENEFITS:

- Bringing together stakeholders from diverse companies and organisations and providing them with a platform for open dialogue to discuss new opportunities and how to resolve (perceived) issues;
- Creating awareness about the potential of freight bundling and logistics cooperation;
- Providing inspirational examples via follow-up sessions with stakeholders and creating enthusiasm about the potential of rail services;
- Generating enthusiasm to share information (i.e. destinations and volumes) and to create an overview of the potential for logistics cooperation;
- Creating concrete dialogue and the first steps in setting up new rail services via a hub in Antwerp.

TESTIMONIALS:

“THE GAME TRULY CHALLENGES YOU TO WORK TOGETHER IN A RAIL FREIGHT TRANSPORT THEMED SETTING.”

Rob Smit, Port of Amsterdam

“A LOT OF PEOPLE WERE PREPARED TO OPEN UP DURING THE GAME, WHICH LED TO MORE INTERACTION.”

André Kooloos, DCG Handel bvba, part of Rotim Holding

“I BELIEVE THAT SOME OF US ARE NOW EVEN MORE CONVINCED THAT WE NEED TO COOPERATE IN ORDER TO LOAD THAT TRAIN, AND I THINK IT'S AN ENCOURAGING STEP IN STARTING DISCUSSIONS ON WHICH WE HAVE BEEN STALLING FOR YEARS.”

Marc Kleinjan, ProRail

KEY ELEMENTS OF LEARNING WHILE PLAYING

As explained before, serious games can vary in many ways, such as the time it takes to play or the level of decision-making in the game (operational, tactical or strategic). Besides the game itself, also the setting in which it is played can differ. However, there are some ingredients that all these games and gaming sessions have in common. These elements create an environment that stimulates effective learning. This makes serious games such a powerful tool.

Research shows that effective learning requires an environment that is interactive, experiential, problem-based and provides the learner with immediate feedback⁷. Based on several studies the key elements creating such an environment can be summarised into five categories, namely active participation, challenge, interaction, feedback and flow and engagement^{7,8,9,10}. To build an effective serious game it is essential to include all elements. More insight into the value of these elements will be given in the explanation below. This is done using examples from the beforementioned game called SynchronoMania.



Active Participation

Active participation concerns the active and experiential elements in a game environment that trigger players to become aware of their own learning process and gain a sense of unrestricted options. For example, game elements in which the player has an active role in manipulating certain outcomes of the game, provide the player with a greater sense of personal effectiveness and control.

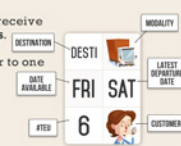
GAME PLAY

Synchro Mania consists of a number of rounds.

Each round represents one week at the planning desk of Synchro Transport Services.

At the start of each day, you receive a number of transport orders.

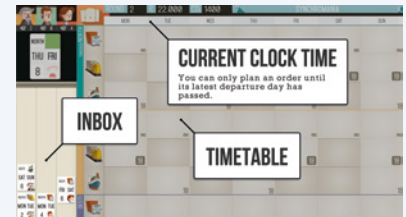
You need to assign each order to one of your transport services.



In SynchronoMania players are in charge of the planning process and they are allowed to plan the incoming orders as they see fit. The only restrictions are the rules that the clients set for the orders, such as destination and modality. This large amount of freedom and the ability to score when orders arrive at their destination in time stimulates active participation.

Challenge

Challenge concerns the amount of difficulties that a player has to overcome while playing the game. A challenging game possesses specified goals, progressive difficulty and information ambiguity. Besides the entertainment aspect, challenge also makes players more eager to do a good job. By creating barriers between the current state and targeted state, the participant is provided with a problem-based learning environment. Such barriers can be caused by the game environment itself or by competition with opponent players.



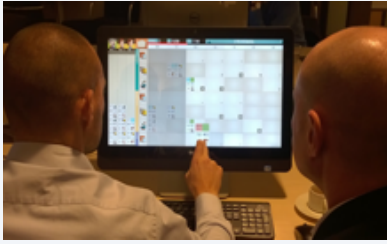
Challenges are implemented in SynchronoMania in several ways. During the game players have to make sure that all containers arrive at their destination in time via the correct route and modality. This is combined with time pressure since the order has to be planned before its latest departure date. Furthermore, the capacities of the routes and modalities are limited and new orders come in everyday. On top of that, the game is preferably played in a setting in which teams compete with each other to achieve the highest scores in the game.

Interaction

Interaction between players, either face-to-face or online, provides opportunities for achieving a sense of belonging and acknowledgement by others. But also interaction with non-players, for example receiving hints during the game from an external source, contributes to learning. Interaction also gives players the opportunity to link their experiences in the game to real life by brainstorming and discussing.



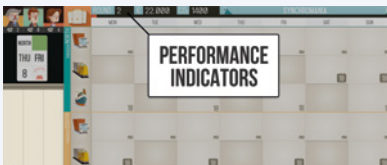
In SynchronoMania, two types of interaction are present. First, during the game, players interact with their fictive customers, can for example calling those customers to ask whether they can use a different modality. The clients will respond with a yes or no answer and a reason behind it.



Second, participants of the gaming session will have interaction with their teammate during the rounds and with the other pairs of players during the discussion time between rounds. The interaction and sharing of experiences and strategies between players enhances the opportunity to learn from the game and link it to real life.

Feedback

A serious game gives the player feedback on the outcome of his actions. It is often provided by means of rewards or penalties. However, in serious games feedback can also mean showing the implications of specific actions or decisions. This enables players to learn from their previous actions. It also provides players with a better idea of the consequences that certain actions would yield in the real world.



While playing SynchroMania, feedback is given in several ways. The consequences of each action are directly shown in the different scores. As can be seen in the illustration, cost and CO₂ emission are displayed in figures. Client satisfaction is shown by coloured bars (red, orange, green) and facial expressions (from angry to neutral to happy). Seeing a client with an angry face directly motivates the player to try to improve the customer satisfaction by improving their own performance.

Flow and Engagement

Flow and engagement are linked to the all elements mentioned above and to the fun side of a game. This element concerns features that keep the player enthusiastic, motivated and involved in the game. Motivational features for playing digital games include competition, challenge, social interaction, diversion, fantasy and arousal⁷.

During SynchroMania, several elements stimulate flow and engagement.

Examples are the time pressure, the direct response of customers using facial expression and colour bars, the competitive setting with several teams and the comparison of the scores after each round.

The elements described above display the key benefits of learning while playing. With the illustrative examples from SynchroMania it becomes clear that a successful serious game requires a combination of all elements to achieve its purpose.

As mentioned before, the learning experience is not only about the game itself but also about the setting in which the game is played. Therefore it is important to consider factors such as the location, agenda, group composition and how to create a link between the game and reality. The following part will zoom in on these elements and describe the key factors for successful development and implementation of gaming sessions.

INTERACTION ALSO GIVES PLAYERS THE OPPORTUNITY TO LINK THEIR EXPERIENCES IN THE GAME TO REAL LIFE BY BRAINSTORMING AND DISCUSSING.

KEY FACTORS FOR SUCCESSFUL DEVELOPMENT AND IMPLEMENTATION



HOW TO USE GAMING

In order for a serious game to become a success, several steps need to be taken. On a high level, these steps boil down to:

- 1) Selection of the target group and goal setting;
- 2) Game design and development;
- 3) Implementation.

To make this process work, it is crucial to involve the target group of the game early in the design phase. In this way their needs, wishes and logistics knowledge can be incorporated into the game. Moreover, early involvement contributes to engagement, raising awareness and stimulating behavioural change, even before the game is played. In order to make the game as realistic and to the point as possible, stakeholders are encouraged to become more concrete about the real-world situation, future possibilities and bottlenecks. The (learning) effects of a game are thus not only triggered by playing the game itself, but also by the process of developing and implementing the game. For this reason, the process of developing and implementing the game itself can help in achieving the goals set out for the game.

DEVELOPMENT: HOW TO BUILD AN EFFECTIVE GAME?

After setting the goal of the serious game, the design process can begin. The first step is to translate the identified goals into the required tasks and experiences that should be implemented in the game. To make this translation, a good understanding of the content and the context in the logistics sector is needed. Thereafter, the next step is to come up with the first ideas for the game concept.

To continuously align the design of a serious game with its goals, the content should be developed in an iterative process of testing and readjusting. This process usually starts with a high-level game concept idea. Then a first basic version of the game is developed, using simple materials at hand such as paper and legoblocks. In this way the concept of the game can be tested as soon as possible in a simple and cost-effective manner. From there, if the basic level concept works, it can be developed further by adding and adjusting aspects

of the game and testing it along the way until it meets the requirements. By developing a game and testing the ideas, real-life bottlenecks and possibilities automatically emerge linking to the gaming philosophy of learning by doing.

Developing a game should be focused not only on the actual tangible game (the Small Game), but also on the whole set-up around the game, such as the invitation, location, workshop programme and participants. This is what is referred to as the Big Game, which is a vital part of the implementation process. The box on the following page provides a more

technical description of the Goal Design Alignment Method designed by TNO.

IMPLEMENTATION: HOW TO USE THE GAME EFFECTIVELY?

Once the final design of the game has been determined, several factors need to be taken into account to successfully implement the game at the predetermined organisation(s). In the implementation phase we distinguish four key successfactors for the effective deployment of a serious game. These success factors are explained below, illustrated with examples from the Rail Cargo Challenge Amsterdam and SynchroMania:

“AS A CLIENT, WE DEVELOP A SERIOUS GAME WITH A GOAL IN MIND AND MEASURES TO ACHIEVE THAT GOAL. THE SESSIONS PRIOR TO THE DEVELOPMENT OF THE GAME FORCE YOU TO BE REALLY SPECIFIC ON THE DETAILS OF THE GOALS AND MEASURES. THAT’S REALLY HELPFUL. IN ADDITION, ALREADY DURING THE FIRST TEST SESSIONS, WE NOTICED WHICH MEASURES CONTRIBUTE THE MOST TO OUR GOALS. THAT IMMEDIATELY CALLED FOR DISCUSSION ABOUT THE IMPACT OF THESE MEASURES IN REAL LIFE. THAT’S A NICE ADDED VALUE OF DEVELOPING A SERIOUS GAME.”

MICHAEL SCHREUDER, RIJKSWATERSTAAT

THE GOAL DESIGN ALIGNMENT (GDA) METHOD

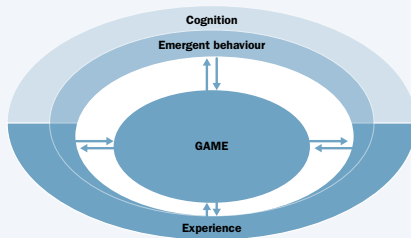
In order to build an effective serious game that succeeds in achieving the pre-determined goals, TNO developed the Goal Design Alignment (GDA) Method¹¹. This method aims at systematically analysing the suitability of the design of a serious game to the intended (learning) goals. The GDA method is intended for use through expert-analysis and it incorporates a Goal framework and Design framework.

Goal framework

Supporting the development of the goals of a serious game in terms of:

- 1) Cognition: competencies (knowledge, skills, attitudes) to be acquired as result of gaming;
- 2) Experiences as result of gaming (including emotions);
- 3) Emergent behavior: emergent (visible) player behaviour evoked during the game.

The first step in designing a game is to translate the determined goals in terms of required competences and experiences of the players as a result of the game. In order to gain these experiences and competences, certain behavior of players needs to be evoked during the game.

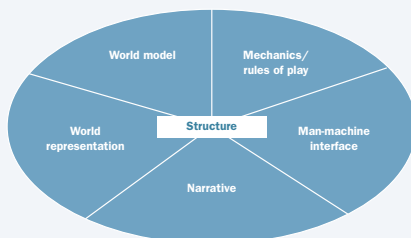


Design framework

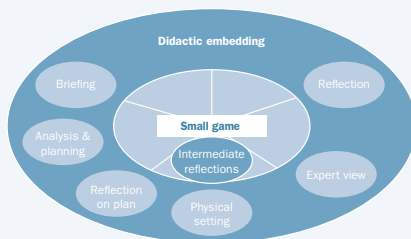
Supporting the rational (re)development of a serious game in terms of its:

- 1) Small Game: the actual tangible game including its core structure and elements, mechanics, narratives, and world model.
- 2) Big Game: incorporates all that needs to be designed, including the didactic and organisational embedding of the game (surroundings, reflection, expert view, physical setting, analysis and planning, briefing and debriefing) as well as the actual game (the small game). Serious games are often offered in a workshop setting, such that the content and learning objectives of the game can be discussed more thoroughly afterwards. The workshop itself is part of the big game and thus needs to be taken into account in the design process.

SMALL GAME



BIG GAME



1) Brief and debrief (workshop)

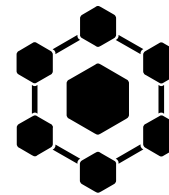
Before the game starts a briefing should be given to the players in order to provide a meaningful context for the topic, to inform them of the learning goals, and to explain the rules of the game.



Brief and debrief (workshop)



Neutral game facilitator



Interdisciplinary expertise



Follow-up

In between gaming rounds and/or at the end of the game a debriefing should be hosted to enable a discussion among the players. The debriefing part is relevant to give meaning to the experiences in the game and to reflect on actions and corresponding implications. It also assists in translating the learnings from the game to the real-life situation. Often the debrief of the game is considered to be at least as valuable as playing the game.

In the case of the Rail Cargo Challenge Amsterdam the debrief focuses on the possible measures for bundling containers using rail and possible ways in which parties can collaborate in this. During the first gaming session, the debrief resulted in several ideas for bundling. In follow-up workshops that were planned directly after this session, the best ideas were picked out and translated into a collaborative action plan.

2) Neutral game facilitator

The game and corresponding workshop should be facilitated by an independent and neutral party that has no preference for a specific outcome of the game.

To host an effective discussion during the debriefing it is important that the facilitating party is able to involve all the different stakeholders and to highlight their different interests. Furthermore, the facilitator needs to have the time and the knowledge to explain the argumentation behind the presented effects during the game¹².

For the Rail Cargo Challenge Amsterdam, facilitation was done by the game developers who had no interest in the exact outcome of the discussions and could therefore focus on facilitating an effective discussion for all parties. A logistics expert from TNO was involved to support when the discussion became more technical.

3) Interdisciplinary expertise

Successful implementation of a serious game in the logistics sector requires expertise on three fields: serious gaming, logistics, and (technological) future innovations. Gaming experts need to be present during the implementation phase to ensure that the preconditions for successful gameplay (flow, engagement, timing, etc) will be fulfilled. Logistics experts need to be present to provide valuable input for the discussion. And expertise on the implications of innovations is needed to make the next step from gameplay to organisational changes in real life.

The success of the implementation of the Rail Cargo Challenge Amsterdam can largely be attributed to the great team of developers and participants involved, consisting of gaming developers, experts on logistics and possible bundling concepts, the Port of Rotterdam and market parties located in or near the port.

4) Follow-up

In order for a serious game to have maximum impact, it is important to consider what the follow-up of the game-development and workshops should be. Will the game be played more often with other colleagues or stakeholders? What will be done with ideas that come up during the workshop or during the development process? Implementing follow-up workshops, a train-the-trainer concept or even implementing the ideas in daily business will enhance the value of serious gaming and form important steps in the process. The follow-up can be divided into two parts: the follow-up related to the use of the game and the follow-up of conclusions and results of the game.

a. Conclusions and results

The debrief during the workshops often sparks an interesting and useful discussion which is strengthened by the energy the participants get from playing the game. In order to enhance the value of the workshop and make sure the insights and ideas are remembered and used, it is vital to think about the next steps in advance. Are follow-up workshops useful? What will be done with the conclusions? Who will take the lead?

A successful example of this is the follow-up from Rail Cargo Challenge Amsterdam. In order to go from first ideas for collaboration that came out of the gaming workshop, three follow-up meetings were planned with all participants in order to go from ideas to an action plan for implementation. The key factors that contributed to this process were strong involvement from a coordinator (Port of Amsterdam), preparation for the follow-up before the gaming workshop and assigning parties to be responsible for the action points.

b. Use of the game

A game is developed for a specific goal and target group, but it's applicability can turn out to be broader than planned. The game can be used by other organisations or different target groups. Key factors for expanding the use of the game are adaptation of the brief and debrief to the

target group and offering train-de-trainer sessions for the facilitators that will be hosting the gaming workshops.

A good example of this is SynchroMania which was originally developed to be played in workshops with planners, customer service and sales employees of logistics service providers. During the game design and after the successful workshops, several ideas emerged for further use of the game. One of these was that the logistics service providers realised that the game could also be used as a tool for relationship management by playing it with customers. At the same time the implementation of the game in logistics education was explored and set up by offering a train-the-trainer session in which teachers were trained to use the game for educational purposes.

“CURRENTLY WE ARE ALSO USING SYNCHROMANIA EXTERNALLY WITH CUSTOMERS. IT IS A MEANS TO BRING ACROSS OUR VISION AND THE CONCEPT OF SYNCHROMODAL TRANSPORT. WITH THE HELP OF THE GAME WE CAN SHOW CLIENTS WHY WE FOCUS ON SYNCHROMODAL TRANSPORT IN ORDER TO TAKE THEM ALONG IN THIS DEVELOPMENT AND FURTHER DEVELOP IT TOGETHER WITH THEM IN PRACTICE.”

WILLEMEN AKERBOOM,
EUROPEAN GATEWAY SERVICES

THE FUTURE OF SERIOUS GAMING AND LOGISTICS



CONCLUSIONS

Nowadays, the logistics sector is faced with many short-term practical challenges such as scarcity of labour, sharing of data with partners and frequent delays due to disruption and congestion. Aside from challenges in day-to-day operations, it might sometimes feel impossible to keep up with innovations like synchro-modal transport, automated driving and self-organising logistics. On top of this, most of these challenges occur in complex multi-stakeholder situations.

The abovementioned new technologies might have a very substantial impact on many stakeholders in the logistics chain. Therefore, it is important to understand the impact of such developments. This ensures that you can take the right measures yourself and are able to benefit from developments in cooperation with other stakeholders. For these complex multi-stakeholder situations, serious gaming has proven to be a very powerful tool to:

- Provide insight into the impact of measures for individual stakeholders and on system level;
- Provide insight into the feasibility of measures given the roles and interests of individual stakeholders;
- Facilitate interaction between the right mix of stakeholders (partners and competitors) about the required cooperation for successful implementation of measures.

Games such as the IDVV barge game, the Chain Game, SynchroMania, the Rail Cargo Challenge Rotterdam and the Rail Cargo Challenge Amsterdam have been played successfully multiple times with a large amount of stakeholders. The players of the games are very enthusiastic about the interactive way of exploring new measures with a mix of relevant stakeholders. As a result of these games, several logistics concepts that were discussed during the sessions have been developed further or are already being implemented.

Hence, serious gaming is a valuable instrument to help understand new measures and developments and to gain insight into the consequences for both the entire sector and individual stakeholders. Given this added value, there is strong need to develop and play serious

games, especially for complex multi-stakeholder situations. When measures or developments are still rather new – such as in the case of synchro-modal transport or self-organisation in logistics – the focus of the games will be on creating awareness, stimulating cooperation and generating new ideas and concepts.

Once the interesting concepts are more clear, the focus of the games will shift to experimentation in a safe environment to prepare for implementation in practice. On top of that, using (a portfolio of) games for training for company wide implementation and education of students as the future logistics professionals can be a valuable addition.

PROSPECTS

TNO has already worked on a number of successful serious games and is still in the process of developing more. Due to many positive reactions of participants of several gaming sessions and their follow-up, TNO is very keen to continue working on and with serious games as part of our innovation methodology. Thereby, we aim to help the sector cope with its challenges and address emerging (disruptive) technologies. If you are interested in the topic of serious gaming in logistics or if you have a specific idea for a serious game, feel free to contact us.

“SERIOUS GAMING IS A VALUABLE INSTRUMENT TO HELP UNDERSTAND NEW MEASURES AND DEVELOPMENTS”

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