OPTIMIZE SPORTS OPERATIONS BY PREDICTIVE ANALYTICS

Planning, Utilization, Safety & Security

INCONTROL

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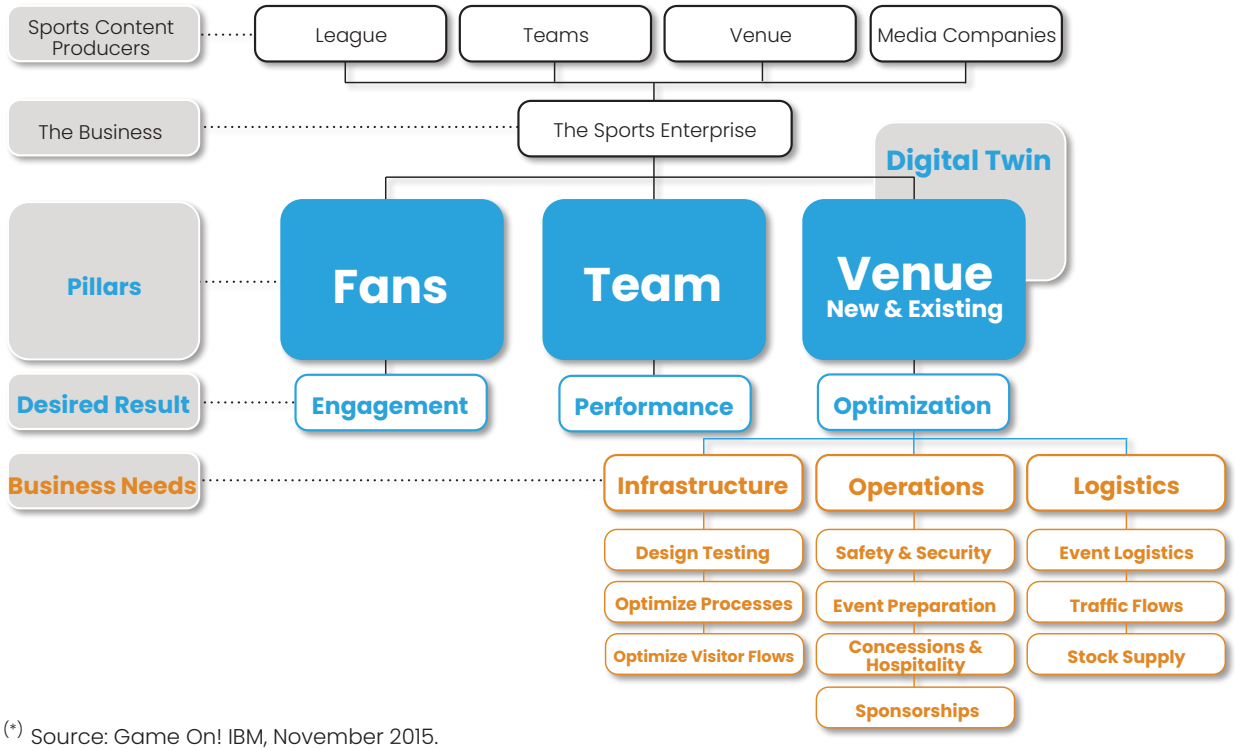
1. The sports enterprise: trends and challenges

1.1 INTRODUCTION

The success of a sports enterprise can be measured by the engagement of the fans, the performance of the teams and the level of optimization of the venue that hosts the events(*). In the figure below these three categories are defined as the pillars of the sports enterprise. The challenges that come with the optimization of sports venues vary from the design of the building construction (the infrastructure) to operational issues, such as pedestrian, (public) traffic and logistic flows in and around the stadium. The continuous balancing of the event, safety rules, spectator experience and financial and commercial goals of the venue is a complex process which requires insights based on thorough analysis.

1.2 SPORTS ENTERPRISE: TRENDS AND CHALLENGES

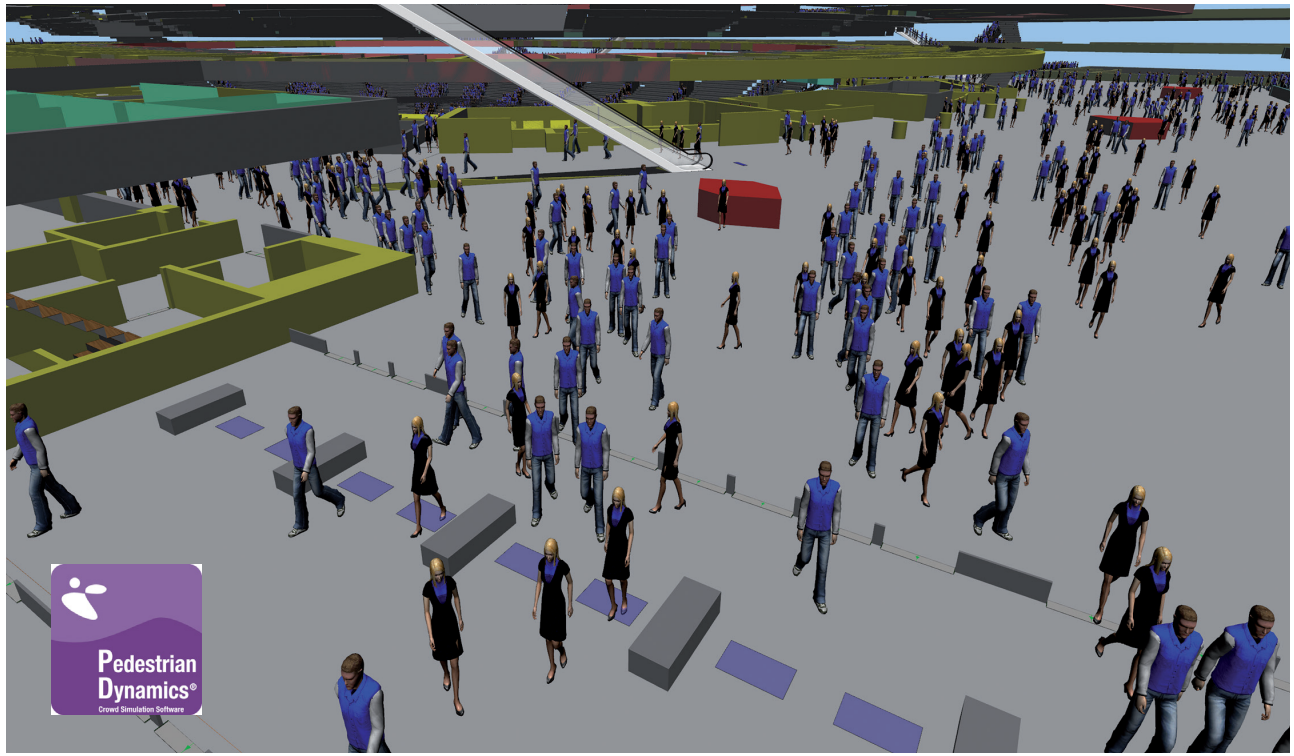
Simulation – as a predictive analytics solution – helps sports clubs, architects, owners and operators to improve issues related to planning, utilization, safety and security. Our Enterprise Dynamics Platform® including our crowd modeling software Pedestrian Dynamics® enables users to develop a virtual, mirrored 3D model (a Digital Twin) of a new or an existing stadium or venue. Using the models, it is possible to analyze the crowd flows of any "what-if" scenario, from normal or special game day operations to emergency scenarios. The academic crowd algorithms realistically simulate spectators, depending on their profile characteristics. Quantitative reporting helps in assessing stadium performance and benchmarking different options. Using this predictive analytics solution InControl contributes to the optimization of new and existing sports venues (see the picture below).



(*) Source: Game On! IBM, November 2015.

2. Simulation

Why Simulation Modeling? Organizations become more and more data driven. With Simulation Modeling InControl offers customers information and insights of their processes, increasing Accuracy while Decreasing Uncertainty, Mitigates Risks and can be part of Cost Reduction and Efficiency Programs. A simulation model (or digital twin) of a stadium or venue will be based on multi-source data input e.g. CAD drawing and BIM models. Once the layout is made, the simulation will be filled with input data regarding expected number of visitors, the ingress and egress, of visitors during regular, intermission and evacuation, arrival rates, process times for processes like security checks and ticket control etc. It will also underpin possibilities for concessions and commercial advertising displays.



The input data comes from different sources, which can for example be:

- Forecasting data
- Statistical historical data based on measurements
- Camera counting systems
- WiFi/Bluetooth tracking systems
- Expert knowledge
- (LED) sensors

All input data will be processed by the InControl simulation model run the simulation for a given period. This can be the duration of an event, match or concert, the duration of an evacuation, etc. By using data models, predictive analytics can be provided.

3. What we offer

3.1 OUR SOFTWARE

InControl is a worldwide leading manufacturer of analysis and control software for the safety and sustainability of critical infrastructures. By imitating the flow of people and goods through critical infrastructures, we help our clients to keep their customers, employees and environment Safe and Sustainable.

Our software is the premier comprehensive modeling, analysis, communication and decision support tool that meets today's standards for Business engineering. It helps to analyze and predict the impact of business changes in terms of performance, people and profits. It is also a strong communication tool through visualization that gives insight to business processes, movement and to support implementation. It helps to avoid unnecessary risks by predicting the future performance of any business process.

With InControl software you can predict and control all kind of scenarios, or as we say: it enables you to **Experience the Future!**

Worldwide, our solutions are implemented in logistics, manufacturing, transportation and crowd management. Clients use our simulation software to simulate large scale logistic systems and infrastructures such as baggage handling systems, container terminals, train stations, assembly lines and football arenas and stadiums. The following six themes reveal our application areas.

We Create:
From raw material to products

We Move:
Shipments of products

We Travel:
Public transportation

We Enjoy:
Visit places & experience events

We Live:
Personal well-being

We Learn:
Improve know-how

3.2 OUR SERVICE OFFER

Our Simulation Software enables you to cope with resources, costs, time, reliability, safety and sustainability. InControl contributes to the above-mentioned challenges by delivering:

- PaaS: Simulation Platform as a Service with InControl's integrated Simulation Platform, which can be integrated with customer processes and systems
- SaaS: Software as a Service, our Simulation Software packages to be used by customers to analyze their processes and venues themselves
- Professional Service Project, our Engineers implement and execute simulation projects as a service

As part of our Crowd solutions we contribute to development of urban areas including (Sport) venues and (Public) Transportation. InControl delivers Software: a Simulation Platform, Custom made, Embedded and Off the Shelf Software. Our Services consists of implementation, training and support.

InControl contributes to the following customer issues:

1. Decision Processes
   - Sharing results and insights in complex and unpredictable (business) processes
   - Providing relevant information, graphs, dashboards, insights and scenario's
2. Optimize Business Processes
   - Streamline and integrate processes
   - Contributing to One-Time-Right solutions & deployment
   - Reducing time, effort and costs
3. Support during Design, Built, Test and Maintenance stages
   - By gathering, modeling, simulating and analyzing data
   - Presenting relevant 'What-If?' information
4. Safety and Security
   - Impact analyses, advise, improvement, train personnel, procedures
   - Support for Safety Act Certification and implementation of EO13636 and PPD21

3.3 SOLUTION AREAS

Solutions are implemented at leading companies worldwide.
Our key market Urban Development includes:

- Leisure: sports venues, theme parks, museums
- Transportation & Logistics
- Manufacturing
- Airports
- Harbors
- Public transport including Rail
- Crowd Management.

InControl offices are located in The Netherlands, Germany, USA, and Japan. Via these offices and a worldwide Partnership and Educational network of Universities, Applied Sciences and R&D Institutes InControl provides an advanced software platform, specific software applications e.g. Pedestrian Dynamics®, product training and support services.

3.4 EXPERIENCE & BENEFITS

Our software is intensively used for traffic and crowd flow analysis. Many projects have been implemented at airports, public transport stations, (football) stadiums, arenas, events, expositions and museums. Some examples are Amsterdam Airport Schiphol, Brisbane Airport,

PSV Eindhoven Stadium, Detroit's Little Caesars Arena and Amsterdam public transport terminal.

- InControl has a knowledge base regarding the usage, application and evaluation of different stadia standards and regulations (FIFA, UEFA, Green Guide 6th edition).

- InControl owns, develops and maintains the state-of-the-art Enterprise Dynamics Simulation Platform including our crowd simulation software Pedestrian Dynamics. Due to the user-friendliness, speed of modeling and ability to deal with large numbers of pedestrians InControl is able to provide services for a reasonable investment, contributing to cost reduction and innovation programs and even generating additional revenues.

3.5 SAFETY & SECURITY

The ability to model and simulate infrastructures at each level of required detail and the virtual utilization of these infrastructures allows you to analyze the behavior of such infrastructures and their cascading effects under all sorts of hazardous conditions. Such as egress, traffic congestions, queuing, evacuations/ sheltering, bomb threats, active shooter, terrorism, adverse weather and congestion during ingress and equipment logistics.

Running scenarios in the design and preparation phase and during staff training allows you to develop a situational awareness capability of how the infrastructure and people within it are functioning under normal parameters as well as the potential risks and threats. By visually analyzing these potential risks and threats, simulation can assist you in understanding the cascading consequences of the infrastructure, individual movement, equipment and procedural failures.

The InControl Simulation Software can be used pre, during and post event as a predictor, operational tool, training module and for after-action lessons learned.

Pedestrian Dynamics® is used as the preferred tool to provide assistance in preparing organizations for the Safety Act Certification. It allows these organizations to analyze possible risks and threats and how to mitigate the effects. These simulations allows you to visualize the risks and threats and the designed procedures to all staff and first responders making it an excellent training, preparation and evaluation tool.

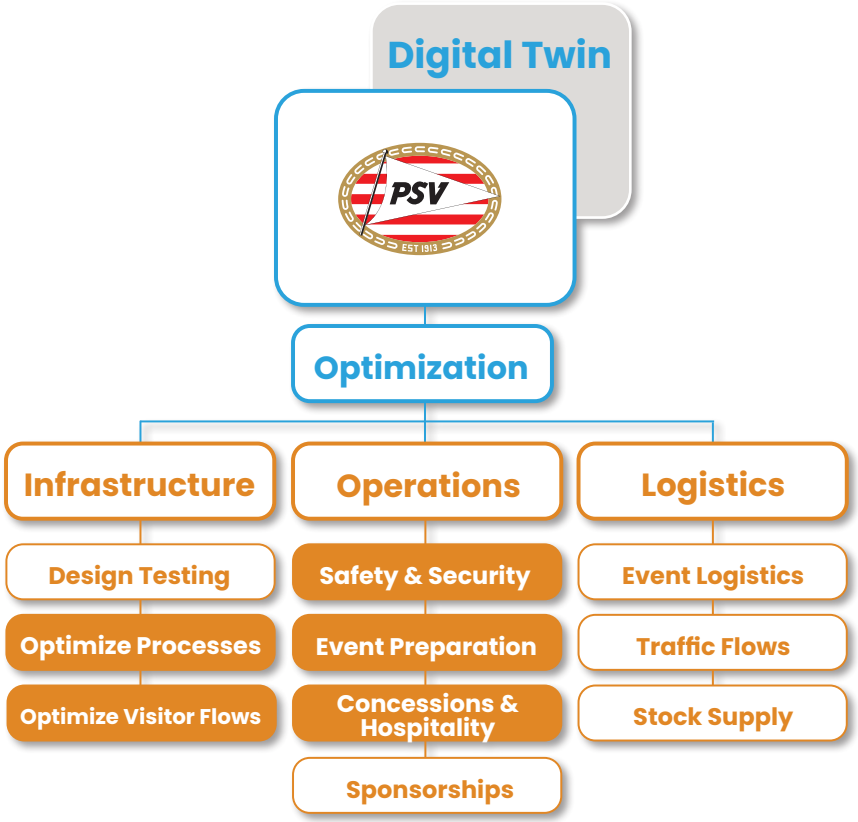
Simulations developed with Pedestrian Dynamics® can satisfy the fire marshals need to validate safe person capacities and evacuation times. It further provides accuracy and clarity in business continuity and disaster recovery planning.

Appendix I: Our track record

1. GAME DAY PLANNING USING SIMULATION: PSV PHILIPS STADIUM

The PSV Philips Stadium, Eindhoven soccer stadium has a capacity of 35,000 seats. Every soccer game PSV seeks the optimization of the pedestrian flows by managing the different activities that people undergo during their stay e.g. ticket sale, security and concessions. Next to this, PSV wants to create insight into evacuation scenarios. The last years the stadium is also used for other purposes like pop concerts. The infrastructure was initially not created for these other commercial purposes. Therefore the goal is to optimize the pedestrian flows during these events.

InControl developed a tool that enables PSV to analyze different scenario's and prepare for matches, concerts and possible evacuation.

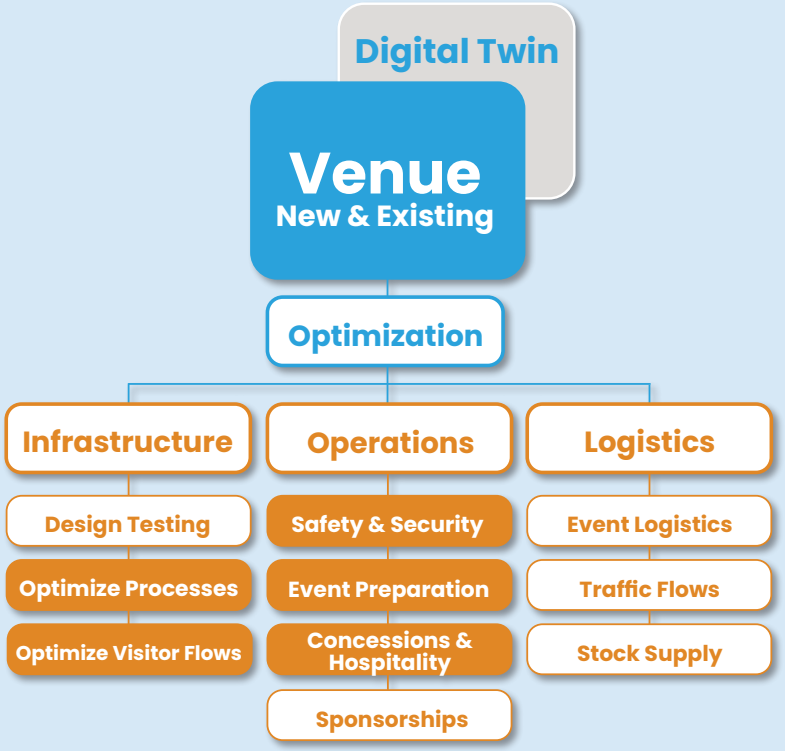


DELIVERABLES:

- User friendly tool to support/enable game day planning and prepare for different possible scenarios.
- The PSV stadium is a test site for new technologies e.g. light guided evacuations and people counting systems.
- Using the simulation PSV could optimize utilization and operational performance.

2. SIMULATION USED TO PREPARE HIGH PROFILE MATCHES AND CHAMPIONSHIPS

When high profile events e.g. the Football World Cup, European Football Championship, Olympic Games or other events are hosted in a certain stadium, it brings new challenges and questions to the table. Expected pedestrian flows, visitor profiles, catering and means of transport will be other than usual. Security levels might increase. Also, organizations might require compliance with guidelines and regulations that were not applied until that moment. Using a simulation platform is a helpful solution to prepare big high visual events and helps in the decisionmaking of all involved stakeholders. The INCONTROL Software Platform contributed to the preparation of the Europa Football Cup (Ukraine 2012), World Football Cup (Brazil 2014, Russia 2018) and lately the Champions League final in Madrid in 2019.



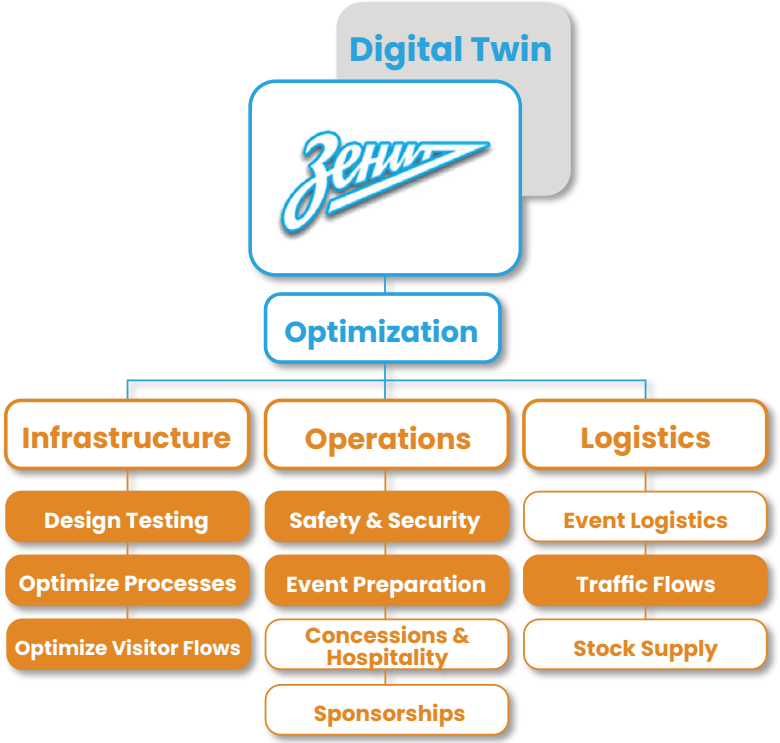
DELIVERABLES:

- Preparation for high profile matches and events.
- Evaluation against relevant standards and regulations: Green Guide and other FIFA/UEFA standards.
- Analysis & optimization of spectator flows inside and outside the stadiums for ingress, egress and evacuation. Using the simulation visitor routing was improved and validated crowd management measures were implemented.
- Analysis of surrounding area with hospitality center and supporters square
- 2D and 3D videos of the simulations as well as the simulation report supported the communication and decisions for all stakeholders.

3. SIMULATION OF A STADIUM AND ITS SURROUNDINGS: ZENIT ARENA

For the world cup in 2018 a new stadium was built in St. Petersburg (65,000 seats). The Zenit Arena was developed on the Krestovsky Island. Being situated on an island brought specific challenges in the accessibility of the area by car and public transport.

The analysis therefore were not limited to the stadium itself, but included the area with traffic flows to and from the stadium and the pedestrian flows to and from the metro station too.



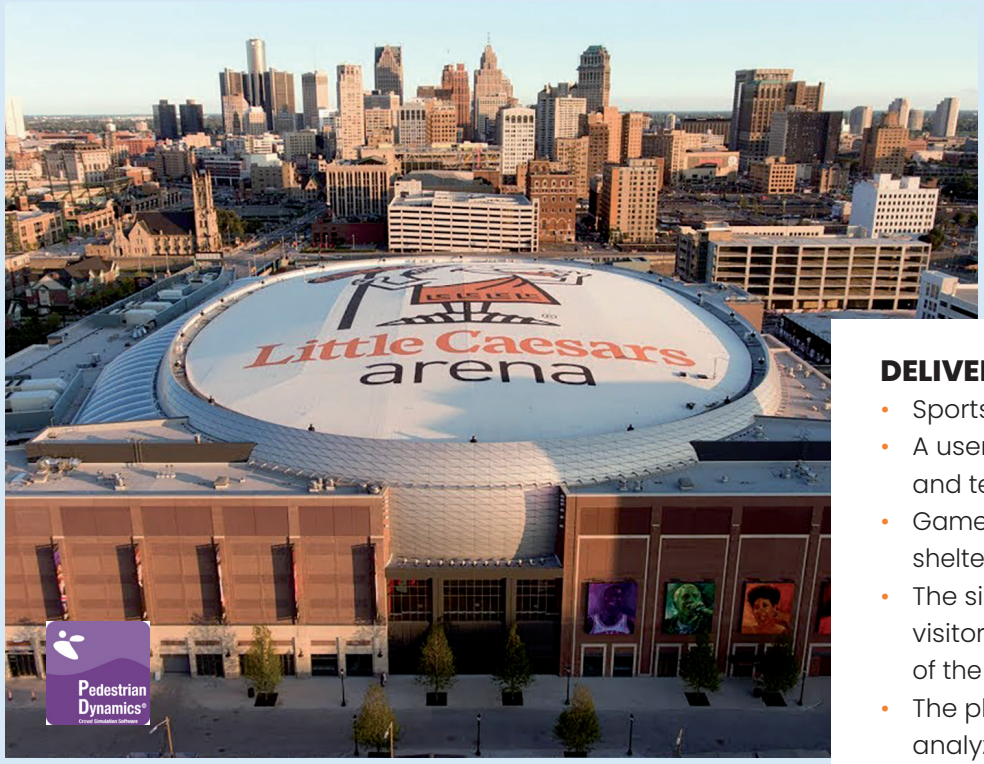
DELIVERABLES:

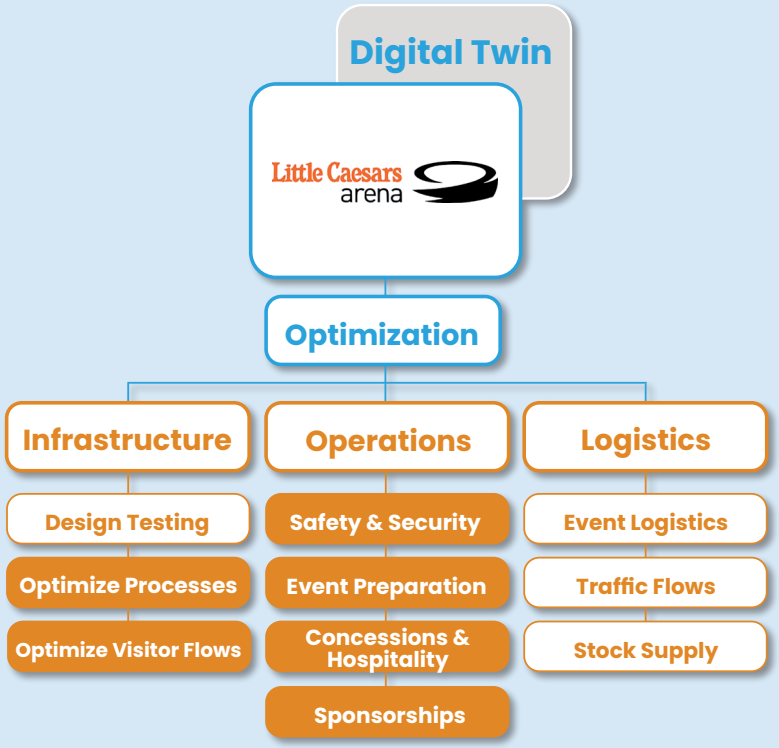
- New developed stadium Zenit Arena for world cup 2018, simulation used during building construction design process.
- Analysis & optimization of spectator flows during ingress, egress and evacuation scenarios.
- Testing required widths and process capacities.
- An important part of the analysis covered the surrounding area including traffic flows, check points for cars and access to public transport. In that way presenting insights and possibilities to optimize multi modal traffic from and the venue.

4. AN OPERATIONAL DIGITAL TWIN: LITTLE CAESARS ARENA

The Little Caesars Arena in Detroit is a sports center that hosts ice hockey and basketball matches as well as concerts and other events. The complex also contains a practice arena for ice hockey, many offices and restaurants and an outside plaza where events can be organized. The variety of activities and visitor types results in an environment that changes from day to day.

InControl developed a user-friendly digital twin of the complex. The software solution allows the user to load the details of specific events (including concessions and advertising displays) and then easily simulate and prepare scenarios for ingress, egress and evacuation.





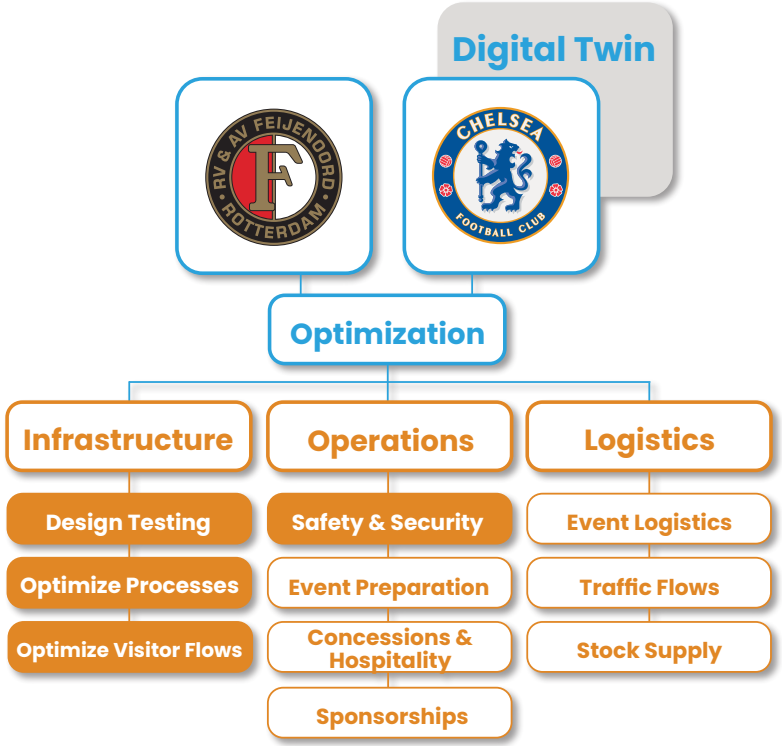
DELIVERABLES:

- Sports center home for the Detroit Red Wings and Detroit Pistons.
- A user-friendly operational application that allows the user to easily define and test scenarios for a variety of (sports) events.
- Game day planning: ingress, egress and emergency egress scenarios, also shelter-in-place can be analyzed.
- The simulation Software was used to test the effect of a sponsoring object on visitor flows. As a result, a $3.500.000 sponsor item could be placed near one of the entrances, generating a significant budget.
- The platform also allows the customer and safety & security advisors to analyze the effect of explosives and other threats.
- The platform is used to optimize utilization and train staff.
- Easy Fire Marshal approval.

5. SUPPORT ARCHITECTS AND CONSTRUCTION ENGINEERS: CHELSEA STADIUM & FEYENOORD CITY

During the early stages of a building construction design process simulation provides valuable insights by visualizing expected flows in the architectural design. In an early stage it is possible to foresee and mitigate the risks of having areas with very high densities due to cross flows, unacceptable bottlenecks around stair cases, access controls and other processes. And testing the design should an evacuation be necessary.

InControl is involved in the construction design phases for the new Chelsea Stadium (60,000 seats) and the new Feyenoord Stadium (63,000 seats, Rotterdam, The Netherlands). During the process every new design is tested with simulation and optimizations can be validated in each phase of the design process.



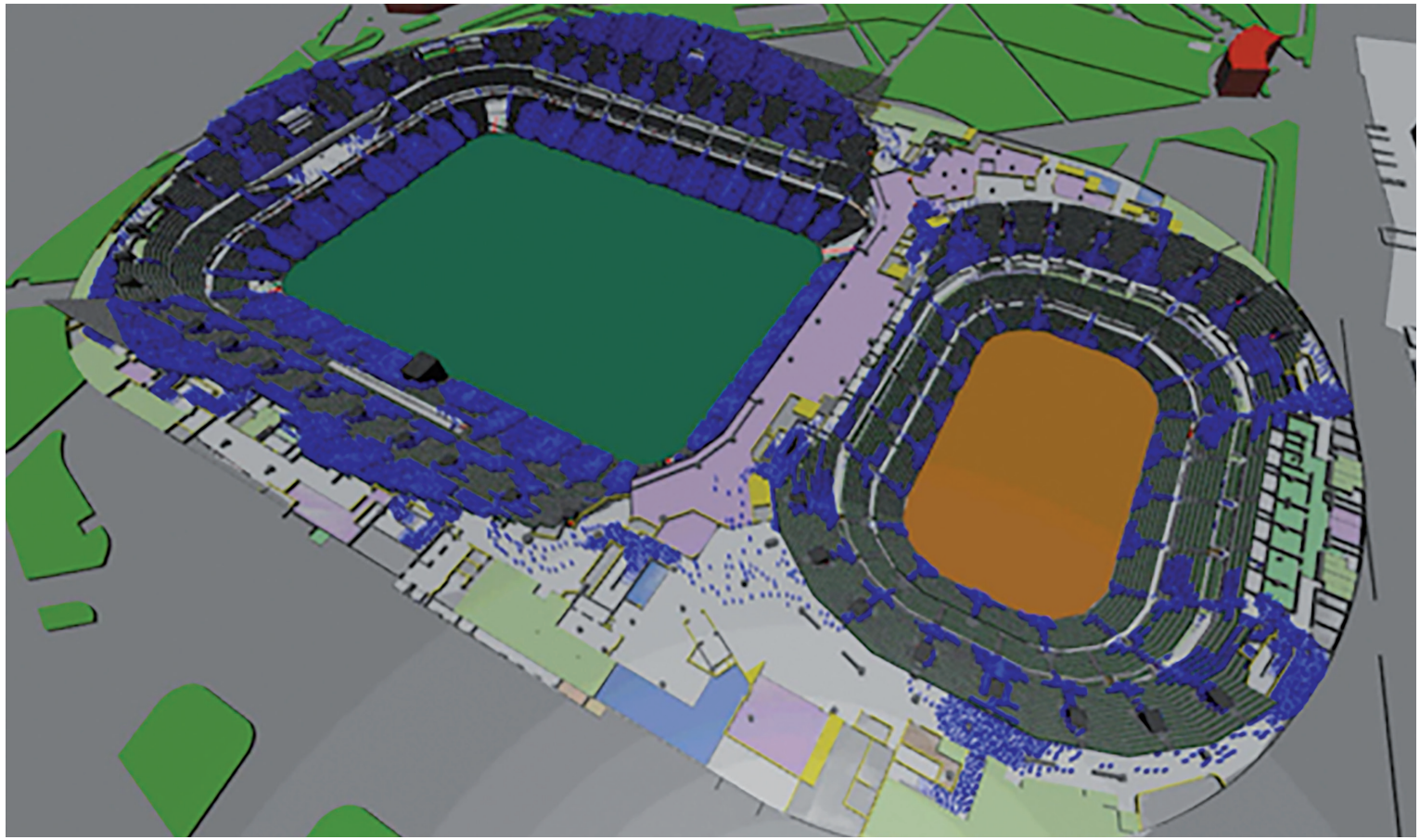
DELIVERABLES:

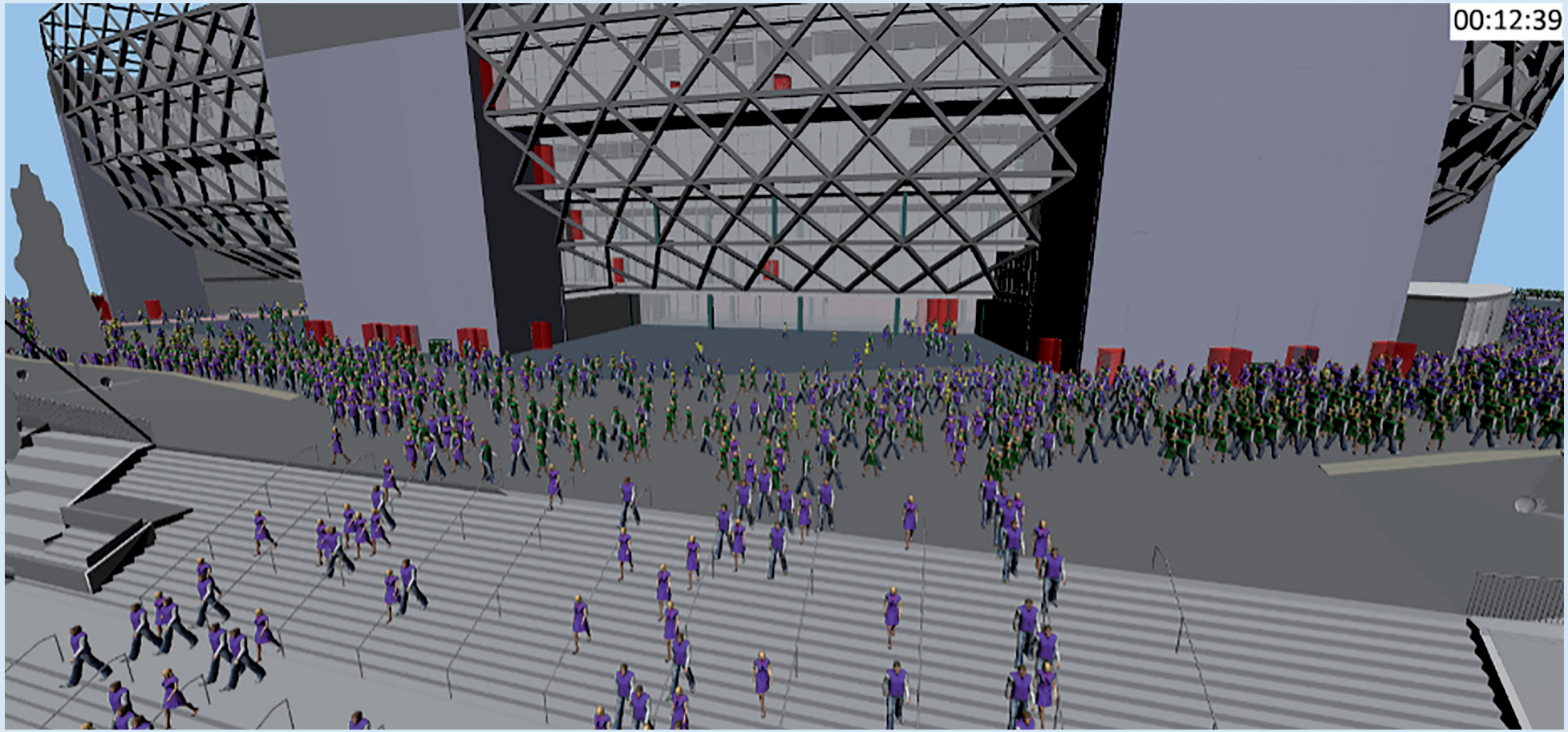
- Early construction design phase testing of alternative designs.
- Optimize stadium design by testing and simulating each phase of the architectural design.
- Continuous focus on pedestrian flows in- and around the stadium and by doing that, foresee and mitigate risks for high density areas and unacceptable bottlenecks in an early stage of the design.
- Testing ingress, egress, evacuation and break time scenarios.
- Test the architectural design for compliance with local and international guidelines and regulations.

Appendix II. Examples of simulation results

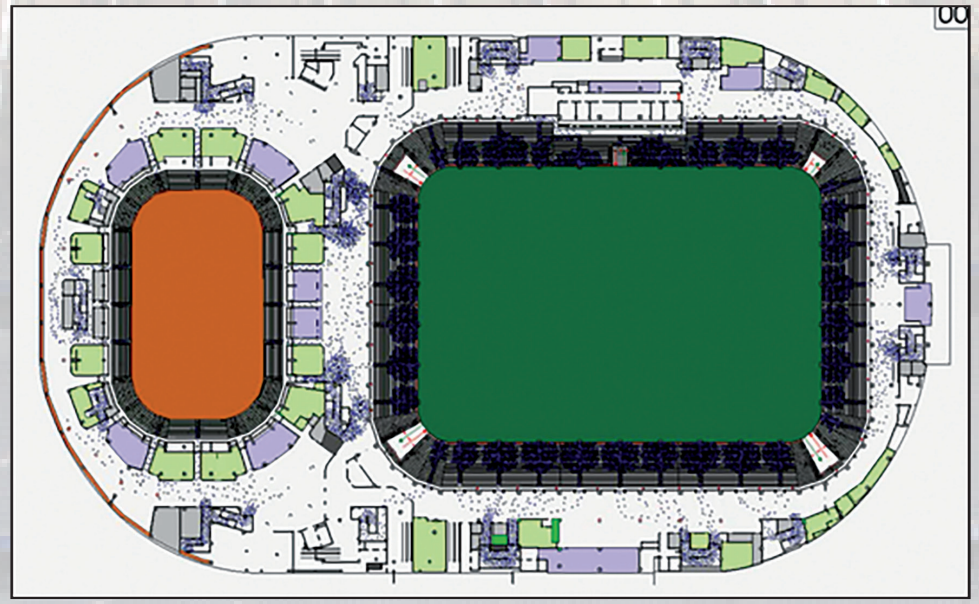
Insights from the model will be presented by the many available result options that Pedestrian Dynamics offers. The following screenshots show a selection of these results. The simulation provides insights via 2D and 3D videos of the simulation. The simulation will show bottleneck locations with high densities of people. Also, it gives insight in the duration of these high-density moments and situations.

Screenshot of a 3D model view

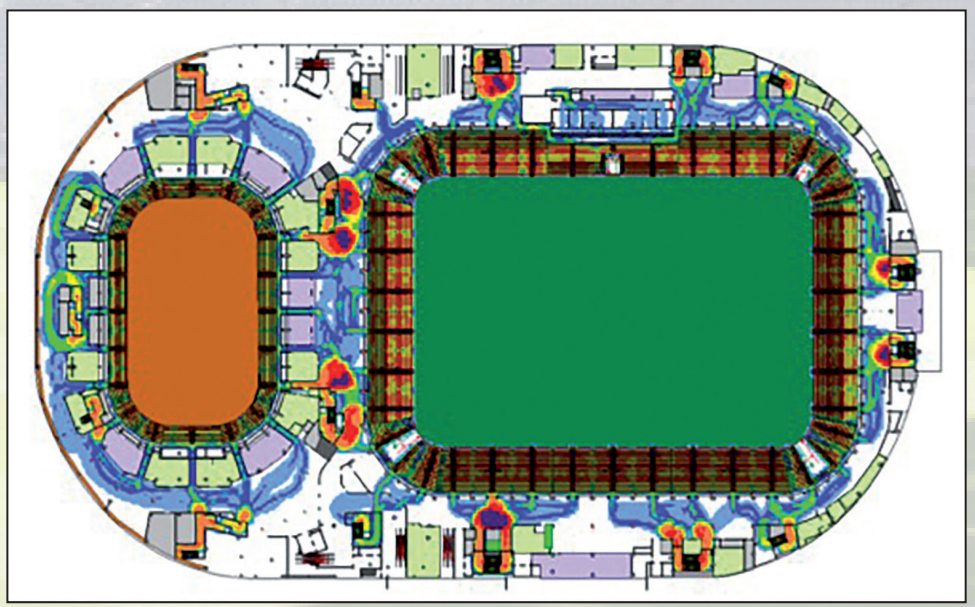




Pedestrian Dynamics®



Screenshot of a 2D model views

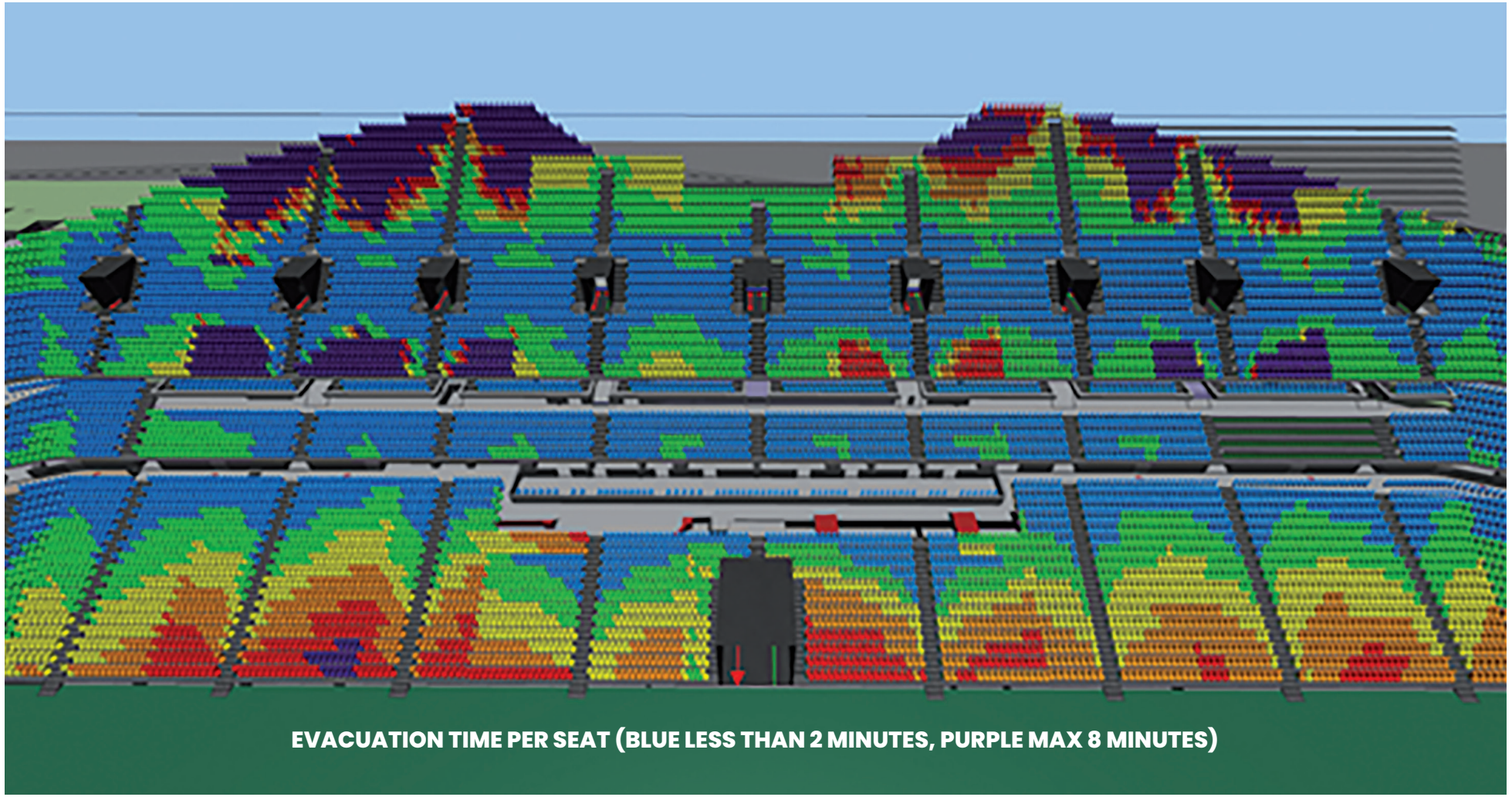


2D DENSITY MAPS

Via density maps the user gets insight in the busy areas. Blue and green indicate areas with low densities, where red and purple indicate areas with higher densities and thus giving an indication of the bottleneck areas. These density maps can be further analyzed to see the height and duration of uncomfortable or even unsafe densities. Based on the required Level of Service it can be defined if densities are too high or if the duration of these higher densities is too long. In this analysis the density map provides insight in the locations that need further optimization. Also, it can be used to determine at which locations crowd management actions, or the presence of (extra) staff is needed to guide visitor flows.

The analysis of these results can be a reason to define other optimized scenarios, which can be loaded into the simulation and tested for their performance.

Analyzing walking (or evacuation) times is another important part of the results. The screenshot above shows another way to presents results. It shows the required evacuation time per seat in a stadium. Blue and green areas indicate short evacuation times, where red and purple areas indicate the longest evacuation times. This gives an immediate insight in which parts of the stadium possibly need further optimization to reduce evacuation times.



EVACUATION TIME PER SEAT (BLUE LESS THAN 2 MINUTES, PURPLE MAX 8 MINUTES)

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