



ENHANCING FAN ENGAGEMENT

Based on Digital Twin Technology



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TruVenue

FAN JOURNEY

Our application enables users to simulate the entire fan journey, from purchasing their ticket to experiencing the actual event, and returning home. With our user-friendly interface, individuals can seamlessly navigate every step, enhancing their engagement and anticipation throughout the entire process. Additionally, various types of data are available during the journey for use in the simulation of the digital twin.



FAN ENGAGEMENT INTRODUCTION

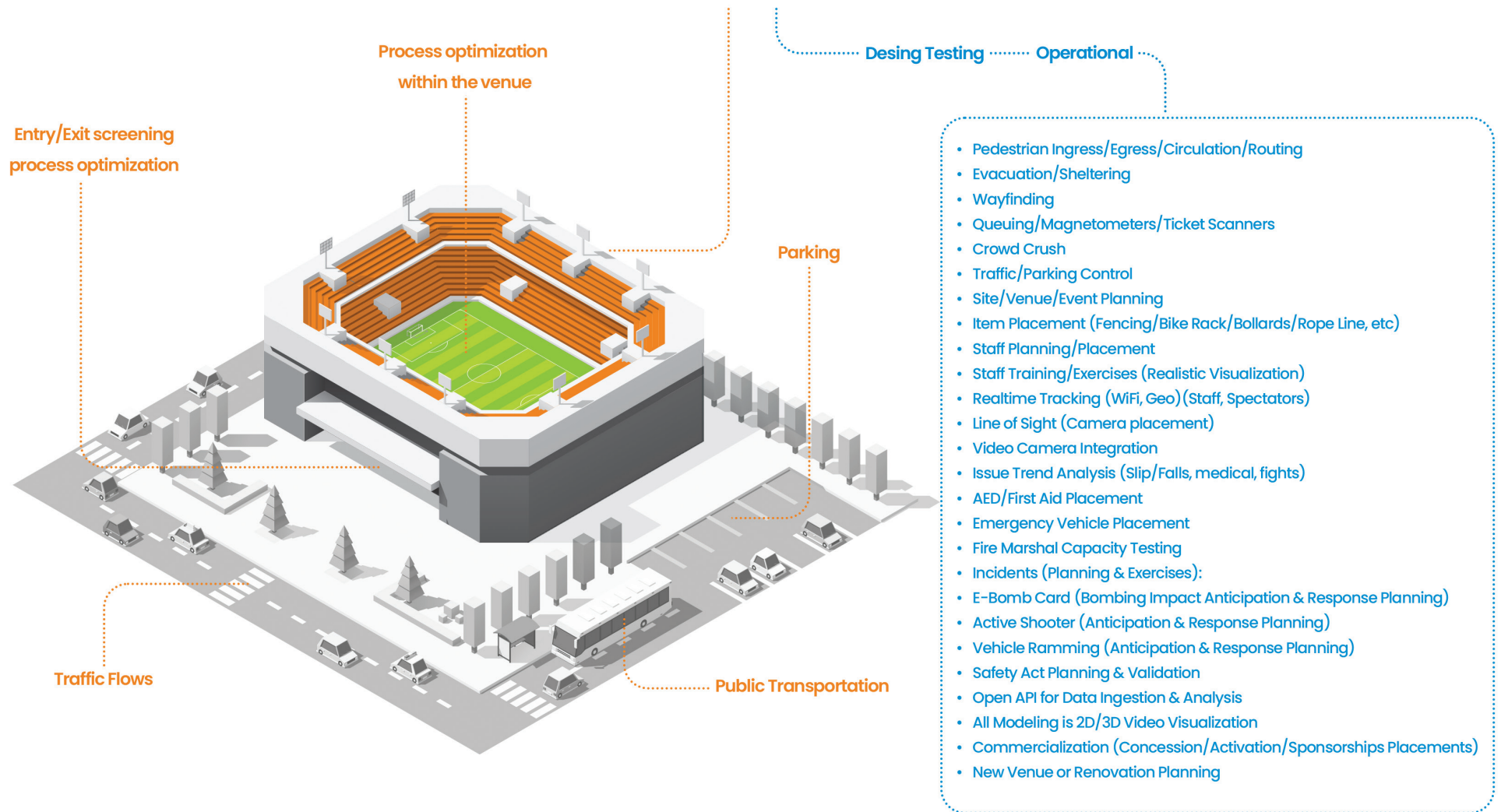
The success of a sports/entertainment enterprise event/venue can be measured by fan engagement, team/entertainer performance, revenue generation and a level of optimization of the venue that hosts the events. The challenges that come with optimization of venues vary from the design of the building construction/management (infrastructure) to operational issues such as pedestrian, traffic, transportation and logistics flows in and around the venue. The continuous balancing of the event, safety/security rules. Spectator experience, financial and commercial goals of the venue/event is a complex process which requires insights based on thorough analysis.

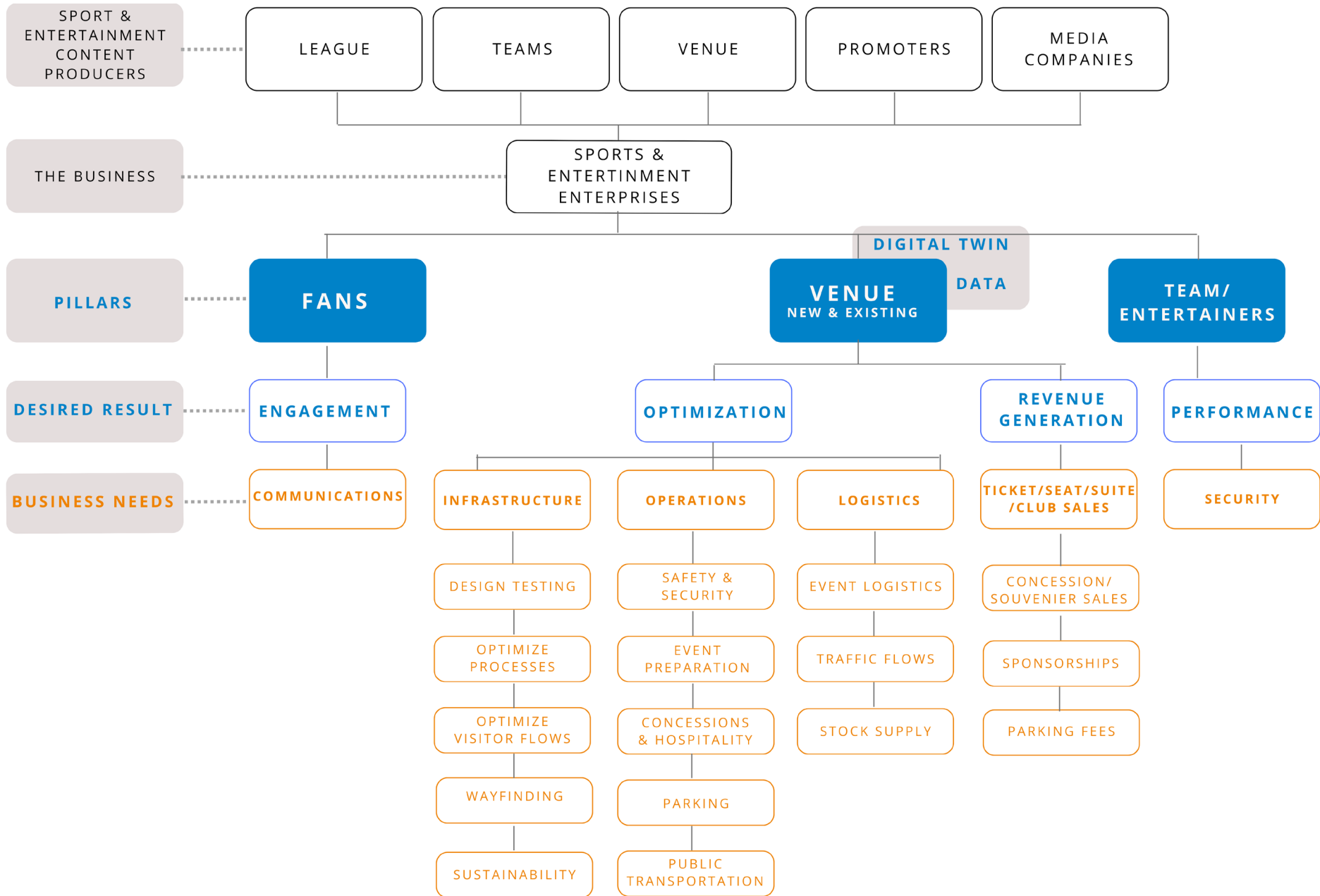
TRENDS & CHALLENGES

Simulation – as a predictive analytics solution

- Helps architects/contractors, venue/event operators /staff to improve issues related to assessing, planning, utilization, commercialization, safety and security.
- Our Total Event Management Application enables users to develop a virtual mirrored 3D model (a Digital Twin) of a planned, new or existing venue that includes crowd and traffic modeling software.
- Using the application, it allows you to analyze crowd or traffic flows and any “what-if” scenarios’ from normal or special event operations to emergency scenarios.
- It uses scientifically validated crowd algorithms to realistically simulate spectators, based upon their demographic profile characteristics.
- Using this application’s predictive analytics solution InControl contributes to the optimization of new and existing venues.

TruVenue





Three key categories, defined as pillars, of the sports/entertainment enterprise encompassed into the digital twin.

Digital Twins

THE IMPORTANCE OF DIGITAL TWIN SIMULATION

A digital twin is a digital representation of a physical object, person, or process, contextualized in a digital version of its environment. Digital twins can help an organization simulate real situations and their outcomes, ultimately allowing it to make better decisions.

Put simply, a digital twin is a virtual replica of a physical object, person, or process that can be used to simulate its behavior to better understand and predict how it works in real life. Digital twins are linked to real data sources from the environment, which means that the twin updates in real time to reflect the original version. Digital twins also comprise a layer of behavioral insights and visualizations derived from data. Digital twins can be particularly helpful in improving sustainability efforts by modeling energy uses to reduce demand.

Once a digital twin is running, an organization can expand its capabilities by adding more data layers and analytics to support new use cases. At this stage, organizations frequently advance their twins from simply representing assets, people, or processes to providing simulations and prescriptions through the use of AI/ML and advanced modeling techniques.



SIMULATION – PREDICTIVE ANALYTICS

Why Digital Twin Simulation Modeling? As Sports & Entertainment Enterprises become more and more data-driven it allows the InControl Simulation Application to:

- Offer customers information and insights into their assets, processes, and people.
- Increase accuracy while decreasing uncertainty, mitigating risks and can be part of cost reduction and efficiency programs.

A simulation model (or digital twin) of a arena, stadium, ballpark, theater, concert hall, convention center, or festival is based upon multi-source data. Once the digital twin is made, the simulation will be filled with input data regarding the expected number of visitors, ingress/egress, arrival rates, processing times for security checks and ticketing, during processing times of visitors regular, intermission, evacuation or sheltering. It will also underpin possibilities for concessions and commercial advertising.

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

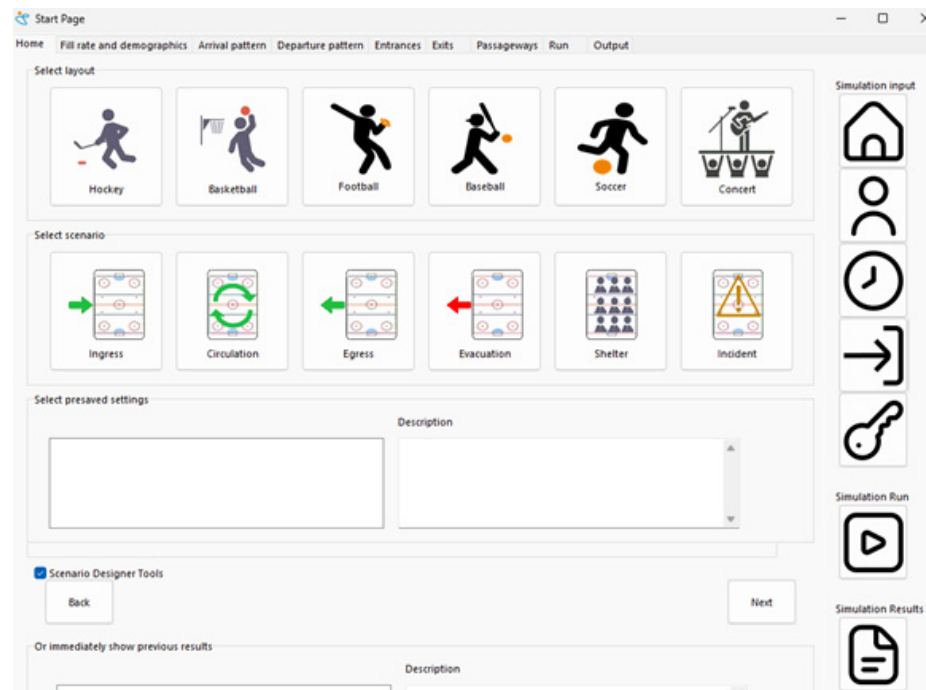
- CAD/BIM Drawings
- Forecasting Data
- Camera Systems
- Parking
- LED & Other Sensors
- Ticketing & Access
- Statistical/Historical Data
- WiFi/Bluetooth Tracking Systems
- Concession Sales Data
- Expert Knowledge

By using scientific data algorithms for various demographics, predictive analytical models can be generated.

Digital Twin Technology for Sports & Entertainment

InControl recognized the importance of having a non-technical user interface for venue/event staff to use on a daily basis, (as we learned that one-off modeling is of limited value). Thus **TruVenue** was developed as a powerful tool for venue/event managers to operate successful events!

It is a tool for fan enhancement, risk prediction/mitigation, cost savings and revenue generation. First a digital twin is modeled from the venue CAD/BIM with its specifics of capacity and layout. Then the application is configured to your venue.



Home > Select Layout & Scenario

Fill Rates & Demographics

Departure or Arrival Times & Security Screening Times

Exits or Entrances to be used

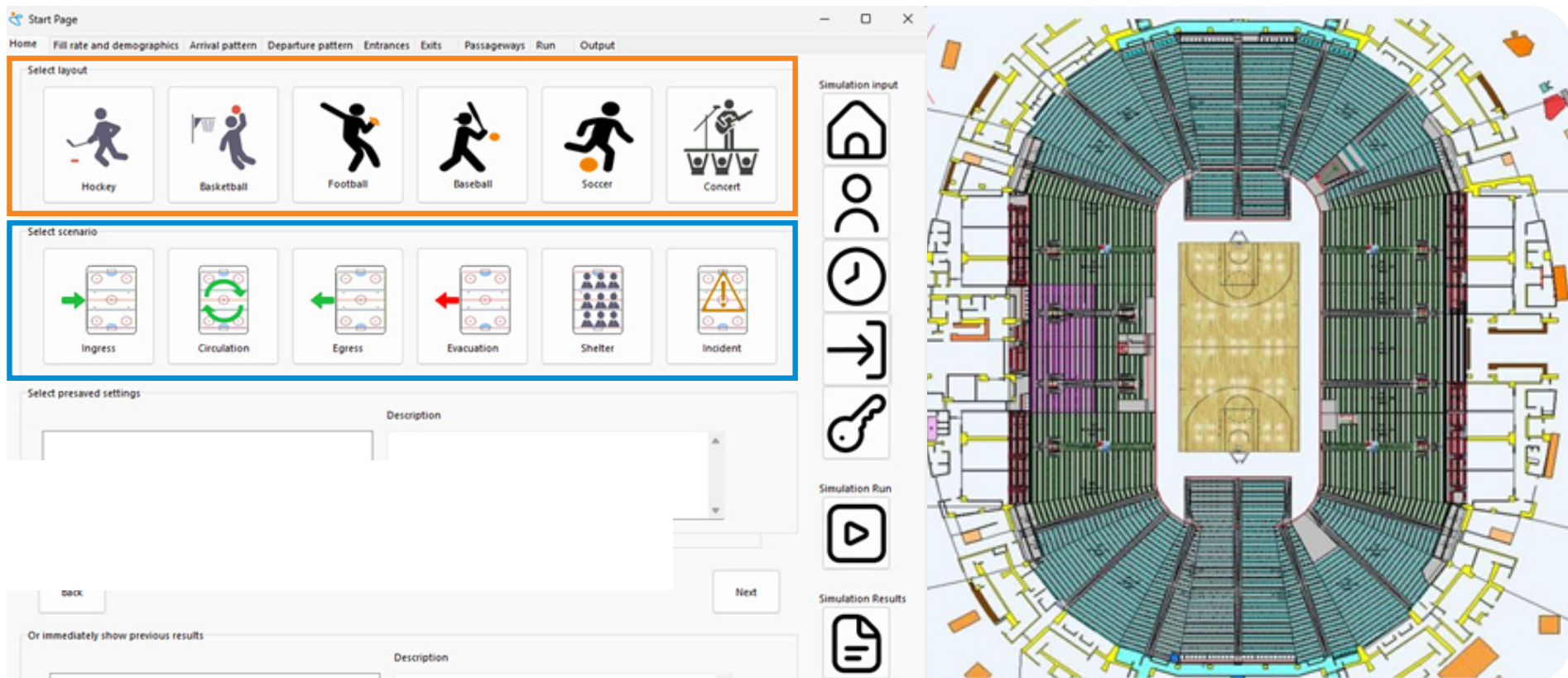
Passageway opening or closing

Execute Simulation

Show Results

Main screen of the intuitive application, the icons on the right represent the event layout and scenario, while the icons on the left represent the capabilities/settings.

You have the option to change floor seating and obstacles yourself (once built), especially for stage layouts. It includes a drag-and-drop function. You can load any earlier used settings to prefill the input on the following screens or you can click 'Next' to guide you through all relevant settings for the chosen scenario. The orange box represents event types that depend on your specific venue, while the blue box illustrates different scenarios within your venue. The specifics, of course, depend on the characteristics of the venue.



Different standard outputs are easily accessible by pressing the corresponding buttons based on the following settings for ingress, circulation, egress or emergency egress or sheltering:

- Spectator Demographics (with auto defaults)
- Seats Sold & Locations (could auto load from ticket seller)
- Arrival Patterns/Fill Rate & Screening Times (could auto load from scanner) (by section)
- Internal Passageways/Portal (open/close or direction setting)

Arrival pattern

Eric Church Concert - Ingress

Current fill rates
 Total arena: 16,395 out of 21,065 seats filled (78%)
 Selection: 113 out of 755 seats filled (15%)

Set arrival pattern

Minutes prior to event	0-15	15-30	30-45	45-60	60-75	75-90	90-105	105-120
Arrivals (%)	67.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Arrivals (#)	2049	2049	2049	2049	2049	2049	2049	2049

Set security screening and ticket taking

Visitors take between 2 and 14 seconds to be screened (8 seconds on average).
 Visitors take between 1 and 7 to get their ticket scanned (4 seconds on average).

Entrance	# mags	# ticket takers
Comerica	10	8
Meijer	10	8
Chevrolet	8	6
Huntington	8	6
Mike's Pizza Bar	1	1
Mixing Board	1	1
District Market	1	1
Points Bet	1	1
Premium Bridge	2	2

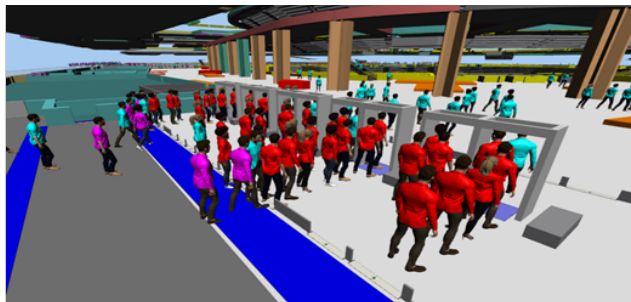
Simulation input

Simulation Run

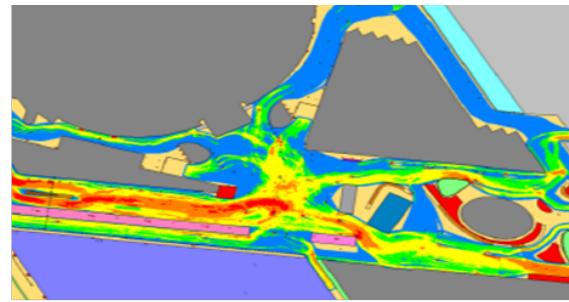
Simulation Results

Once the selections have been made and the simulation run various Outputs are available to pick:

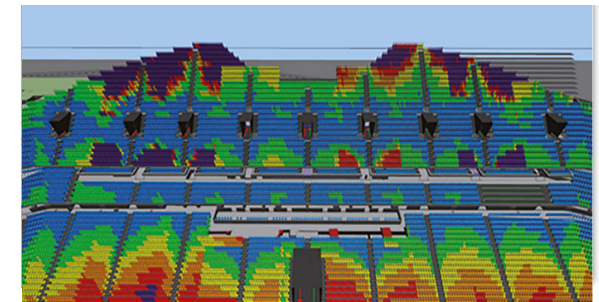
- 2D &/or 3D Video
- Density/Heat Map or Graph to show bottlenecks locations with high densities of people and to give duration of these high-density moments and situations.
- Travel Time Map or Graph (A map colored according to the time it takes to travel from e.g. seats to the exit)
- Flow Counter Graph
- Camera/Simulation Comparisons



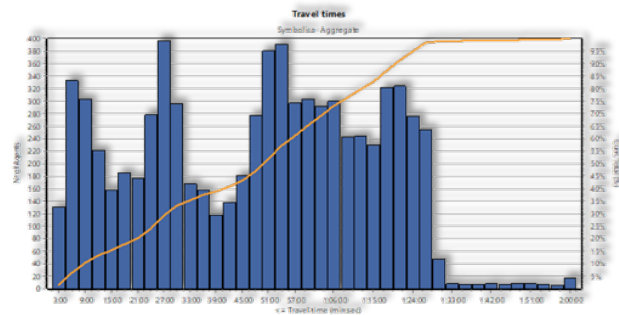
Viewer 2D & 3D



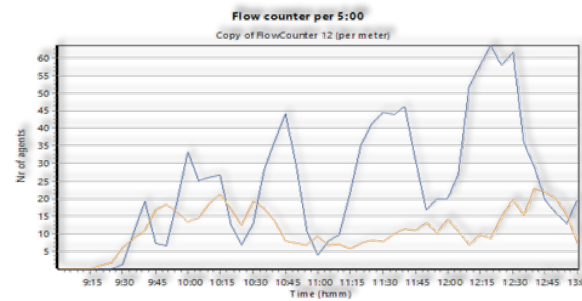
Density maps



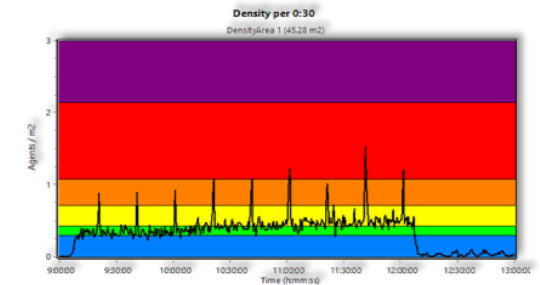
Travel time maps



Evacuation / shelter times



Flow counter



Level of Service

CAPABILITIES OF THE TOTAL EVENT MANAGEMENT APPLICATION

InControl TEMA enables Sports & Entertainment Venues/Events to improve decision making processes and predictability through the following capabilities:

- Pedestrian Ingress/Egress/Circulation/Routing
- Evacuation/Sheltering
- Wayfinding
- Queuing/Magnetometers/Ticket Scanners
- Crowd Crush
- Traffic/Parking Control
- Site/Venue/Event Planning
- Item Placement (Fencing/Bike Rack/Bollards/Rope Line, etc)
- Staff Planning/Placement
- Staff Training/Exercises (Realistic Visualization)
- Realtime Tracking (WiFi, Geo)(Staff, Spectators)
- Line of Sight (Camera placement)
- Video Camera Integration
- Issue Trend Analysis (Slip/Falls, medical, fights)
- AED/First Aid Placement
- Emergency Vehicle Placement
- Fire Marshal Capacity Testing
- Incidents (Planning & Exercises):
- E-Bomb Card (Bombing Impact Anticipation & Response Planning)
- Active Shooter (Anticipation & Response Planning)
- Vehicle Ramming (Anticipation & Response Planning)
- Safety Act Planning & Validation
- Open API for Data Ingestion & Analysis
- All Modeling is 2D/3D Video Visualization
- Commercialization (Concession/Activation/Sponsorships Placements)
- New Venue or Renovation Planning

SAFETY & SECURITY ADDRESSED BY INCONTROL'S APPLICATION

InControl's ability to model and simulate infrastructures at various levels of detail allows you to analyze the behaviour of these infrastructures under both routine and hazardous conditions. This includes scenarios such as traffic congestion, evacuations/sheltering, bombing/bomb threats, active shooter, terrorism, vehicle ramming, adverse weather, congestion during ingress, and equipment/supply logistics.

Running scenarios during the design and event preparation phase and staff training helps develop situational awareness of how the infrastructure and people within it function together under normal conditions as well as during potential risks and threats.

Simulation assists in visualizing the consequences of the venue/event movement of people, equipment, the application of processes and procedural failures. The InControl application serves as a predictor, operational tool, training aid, and evaluation tool, applicable before, during, and after events. Simulations aid in visualizing risks, threats and in designing procedures for all staff and first responders, making it an excellent training, preparation, and evaluation tool. Simulations also serve to satisfy fire marshals' requirements for validating safe person capacities, evacuation times and prevent crushing.

With InControl Digital Twin Simulation Software you can predict and control all kinds of scenarios, or as we say:

It enables you to Experience the Future Today!

InControl Portfolio

ABOUT INCONTROL

InControl is a worldwide leading developer of digital twin analytical simulation software for personal and property efficiency, safety/security, 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!

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

Our software is the premier comprehensive digital twin modeling, analysis, communication, and decision support tool that meets today's standards for business engineering. It is essential 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 processes, transit, people or action.

Worldwide our solutions are implemented in material handling & logistics, manufacturing, transportation, and crowd management. Clients use our digital twin software to simulate large scale logistic systems and infrastructures such as baggage handling systems, container terminals, trains and train stations, assembly lines, city-wide coronations, stadiums and arenas.

Our digital twin software application is extensively used for traffic and crowd flow analysis in various settings, including stadiums, areas, festivals, events, expositions, museums, airports, and public transport stations.

OUR SERVICE OFFERS

Our Digital Twin Simulation Software enables you to cope with resources, costs, time, reliability, safety and sustainability.

As part of our Crowd solutions, we contribute to development of urban areas including smart cities, (sport/entertainment) venues and (public) transportation. InControl delivers Software: a Simulation Application, Custom made with Client Data Embedded. Our services consist of implementation, training and support.

InControl contributes to the following customer issues:

- 1 Decision Processes
- 2 Predictive Analytics – What if
- 3 Sharing results and insights in complex and unpredictable (business) processes
- 4 Providing relevant information through visualization, graphs, dashboards, insights, and scenarios
- 5 Optimization & Efficiency of Business Processes
- 6 Support during Design, Build, Test, and Maintenance Stages
- 7 Safety and Security – Crowd Management
- 8 Trend/Incident Analysis
- 9 Cost Savings & Revenue Generation

EXPERIENCE & BENEFITS

Our software is intensively used for crowd and traffic flow analysis. Many projects have been implemented at sports & entertainment venues, events, expositions, and museums. Also, at airports, public transport stations, harbors and cruise ships. Some examples are Detroit Caesars Arena, Charlotte Bank of America Stadium, Nashville Nissan Stadium, Utah's Dallas Cowboys – The Star, Brigham Young University Stadium. Also, projects involving Amsterdam Schiphol Airport, Brisbane Airport, Amsterdam Public Transport Terminal, Miami Cruise Terminal, Museum of the Bible, Johnnie Walker Experience, and the Tokyo Olympics.

Appendix I: Our track record

SIMULATION OF A STADIUM: **NISSAN STADIUM**

(NASHVILLE, TN)

Nissan Stadium is a sports and entertainment venue that is home to the Tennessee Titans, an NFL football team, and it hosts various other sporting events, concerts, and entertainment activities. The stadium has a seating capacity of over 69,000, and this number can even increase during concerts when people are seated or in a mosh pit on the floor.

Weather in Tennessee can be unpredictable, and that's why having a reliable shelter plan is essential. InControl introduced a cutting-edge digital twin solution tailored for both football matches and concerts. This powerful software enables a thorough evaluation and enhancement of the sheltering plan, offering valuable recommendations and adjustments.

DELIVERABLES

- Developed a digital twin of Nissan Stadium with pedestrian flows.
- Optimization of the Shelter-in-Place plan.
- Time required to shelter everyone in the venue, considering each seat and those standing in the mosh pit during an event.
- Recommendations on the most effective locations for sheltering everyone and the appropriate duration.
- Know exactly when to pause the match or event and initiate the Shelter-in-Place procedure before the storm arrives, so everyone is safely out of harms way.



AN OPERATIONAL DIGITAL TWIN: **LITTLE CAESARS ARENA**

(DETROIT, MI)

The Little Caesars Arena is a sports and entertainment center that hosts NHL Red Wings ice hockey and NBA Pistons basketball matches as well as concerts and other events. The complex also contains a practice arena for ice hockey, many offices and restaurants, parking garage and an outside plaza where events are held. The variety of activities and visitor types, results in an environment that changes from day to day.

InControl developed both a digital twin of the complex and a user-friendly application. 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, evacuation and sheltering.

DELIVERABLES

- Developed a digital twin of Little Caesars Arena and adjacent area.
- A user-friendly operational Application that allows the user to easily define and test scenarios for a variety of sports and entertainment events.
- Game day planning: ingress, egress, and emergency egress scenarios, also shelter-in-place can be analysed and optimized.
- The simulation Software was used to test the effect of a sponsoring object on visitor flows, as requested by the Fire Marshal. As a result, a multi-million-dollar 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, active shooter and other threats.
- The platform is used to optimize utilization and train staff.
- It is also used for traffic and pedestrian deconfliction from parking to arena.
- Easy Fire Marshal approval.
- Allows for data (ticketing, entry scanning & concession sales) direct load into model.

EVENT DAY PLANNING USING SIMULATION: **BANK OF AMERICA STADIUM**

(CHARLOTTE, NC)

Bank of America Stadium is the home of the Carolina Panthers and the Charlotte FC soccer team having a capacity of 74,867 seats, which can increase during events where people are also seated on the field. For both football matches and special events, Bank of America aims to create insights into load-in, shelter-in-place and evacuation scenarios. The goal is to optimize pedestrian flows, especially during special events when there are increased numbers of people on the field.

InControl has developed a digital twin of the arena and immediate area to analyze various scenarios and prepare for matches, concerts, and potential shelter-in-place and evacuation situations.

DELIVERABLES

- Developed a digital twin of Bank of America and adjacent area.
- Ingress for normal events and spaced queuing during COVID.
- Optimization of the Shelter-In-Place plan.
- Optimization of the Evacuation plan.
- Time required to either shelter or evacuate all the people.
- Recommendations on where to shelter people and how to evacuate.
- Valuable insights into the time it takes to shelter or evacuate each individual.
- Advice on reducing potential bottlenecks.

SIMULATION OPERATIONAL PLANNING: **BYU – LAVELL EDWARDS STADIUM**

(PROVO, UT)

LaVell Edwards Stadium, situated on the Brigham Young University campus, serves as the home of the BYU Cougars, primarily hosting college football events. It has a seating capacity of 63,470 seats. In an effort to enhance safety and operational efficiency, InControl created a digital twin of LaVell Edwards Stadium. This digital twin allows for the simulation of diverse scenarios, including ingress and egress, evacuation procedures, and Shelter-In-Place protocols.

The digital twin serves as a powerful tool for analyzing and optimizing the stadium's response to different situations, ensuring a secure and streamlined experience for attendees during events. By providing valuable insights into crowd management, emergency preparedness, and overall operational efficiency, InControl's digital twin contributes to the continued success and safety of events held at LaVell Edwards Stadium.

DELIVERABLES

- Developed a digital twin of LaVell Edwards Stadium and adjacent area.
- Valuable insights into the ingress and egress processes.
- Optimization of the Shelter-In-Place plan.
- Optimization of the Evacuation plan.
- Time required for either sheltering or evacuating all individuals.
- Recommendations on shelter locations and evacuation procedures.
- Valuable insights into the time it takes to shelter or evacuate each individual.
- Advice on reducing waiting times and addressing potential bottlenecks.

HIGH PROFILE MATCHES AND CHAMPIONSHIPS: **FIFA | UEFA | OLYMPIC GAMES**

When high profile events e.g. the Football World Cup, European Football Championship, Olympic Games or other events are hosted in a certain venue, 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 and safety 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 decision making and training 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), Summer Olympics Tokyo 2020, and lately the three major UEFA finals (Champions league, Madrid 2019 and Istanbul 2023; Europa League, Budapest 2023; Conference league, Prague 2023).

DELIVERABLES

- Preparation for high profile matches and events.
- Evaluation against relevant standards and regulations: Green Guide and other FIFA/UEFA, NCS4 Best Practices and 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
- Analysis, Optimization & Deconfliction of Traffic and Pedestrians.



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