UDT project	Scale	UDT lifecycle stage	Purpose and Use case	Level (s) of integration	Integration Methods and Tools
Future Resilient Systems project "Digital Twin-Enabled System Resilience"	City	Update	Estimating buildings' operational GHG emissions for Singapore's residential buildings	Lv 3	GHG App : Custom UDT architecture. Users interact via a front-end interface to run simulations on top of the data from cloud storage.
Multi-scale Digital Twins for the Urban Environment: From Heartbeats to Cities	Campus	Creation	Development of a digital twin campus platform	Lv1	Multi-source data integration via extensions based CityJSON encoding
Hydrodynamic simulations in a 3D Digital Twin	City	Update	Hydrodynamic simulations, integrating flood forecasting models into 3D Digital Twins Dynamic Digital Twin for Sewerage, hydrodynamic calculation model in a 3D Dynamic Digital Twin	Lv3	By combining API's and open standards
DigiTwins4PEDs	District	Creation	Co-Creation of Flexible Positive Energy Systems Using Urban Digital Twins	Lv 1, 2, 3	Level 1 data intergation by further extending CityGML Energy ADE, level 2 integration using DDL with SQL scripts and Level 3 integration using WFS-T or custom web series as an API interface between database and client using gml IDs
City Digital Twin pilot project	City	Creation	Spatial and temporal analysis of urban processes and phenomenon. Computational Fluid Dynamics (CFD) simulations	Lv2	Geospatial data integration and enrichment of 3D city model following the CityGML 2.0 standard.
Modellprojekt Smart City Dresden, Measure "Environmental modeling and pluvial flood twin".	City	Use	a) Early flood warning system for immediate assessment of risk areas, b) climate-adapted urban planning, c) heavy rain modeling	Lv 1 and 2	If no common interfaces exist (e.g. OGC, semantic databases), self-written processing pipelines are developed/utilized. Especially since the use-case is specialized e.g. "live-stream" flood inundation maps while simulations are running.
ASCEND	District	Creation	Create Positive Clean Energy Districts (PCEDs) across Europe to mitigate the effects of climate change	Lv 1 and 3	Using Open Standards such as CityGML, IFC and SensorThings API
3DBAG	National	Update	Applications related to energy use in buildings, such as estimating energy demand, retrofitting costs, and finding suitable roofs for solar panels. Simulating the wind flow and pollutant dispersion in urban areas (e.g. Simwind) Calculating noise pollution in urban areas (e.g. 3D Noise)	Lv 2	python and c++

			Analyzing urban structure and evaluating new developments.		
Thermal Comfort UDT (Urban Digital Twin)	District	Creation	Thermal comfort	Lv 2	The data is integrated through simple files, it does not always follow strictly existing models or standards, but standards are followed when possible.
Liveable city digital twin	City	Use	3D analytics for urban micro-climate: urban heat islands, temperature propagation, shadowing and its effect on pedestrian thermal comfort, mobility and walkability across selected urban scenarios	Lv 2	Several datasets (building, roads, waterbodies, etc.) are mapped to 3DCityDB without extending the schema, and by relying on generic classes (e.g., GENERIC_CITYOBJECT) when there was no direct matching.
Samothrace	European	Creation	Improvement of safety on maritime navigation	Lv 3	Use of open-source software, namely GNSS-based solutions, and integration of IoT technologies, Python modules, Postgres DB, and WebGIS visualization using Leaflet.js libraries.
Semantic 3D City Models for Energy Applications	National	Use	Energy Applications	Lv2	ETL tools such as FME or self-developed SQL or Python scripts
3D city model and use cases	City	Update	Urban Heat Mitigation: Analyzes how new developments affect airflow and heat, supporting strategies for climate-resilient urban planning. Urban planning, geodesign, and modeling future scenarios: Allowing architectural designs to be embedded in the digital twin for visual impact assessment, such as comparing shadow effects Visualization of traffic noise scenarios	Lv3	FME-Workbenches and Python-scripts
https://riis.org.au/; https://archmanu.com/	National	Creation	Asset management, simulation and prognosis, construction and design Generic library of spatial concepts and asset definitions Simulation of architectural manufacturing prior to construction	Lv 1, 2, 3	Spatial Data Infrastructure repositories and blockchain- Blockchain approaches for the management of Digital Twins
The iSite Project	Various test beds in the USA	Use	Emergency response applications	Lv3	CAD model, transformed to light weight digital twin for use in web applications for first responders
UNUM - Unification for Underground Resilience Measures - Underground utility model	City	Creation	Develop a standardized, interoperable framework for sharing and integrating underground infrastructure data across sectors to improve resilience to extreme climate events,	Lv3	MUDDI standard (OGC)

			natural disasters, and emergencies.		
DEMLAS	National	Creation	Efficiently support land governance based on a modern multipurpose land administration system (MLAS).	Lv1 and 2	by applying and adapting standards (LADM ...)
TwinBy – Digital Twins for Bavaria	Different municipalities in the state of Bavaria	Use	17 Projects Across All Bavarian Administrative Districts Focused on Mobility, Health, Energy, and Environment, these projects operate under the Smart District Data Infrastructure (SDDI) framework. SDDI provides a modular structure for defining organizational and technical workflows to: Estimate building energy demand and solar potential Simulate traffic density and pedestrian flow Model noise propagation and flood risks	Lv 1, 2, and 3 and possible adoptions and combinations of different levels	Common semantic models such as CityGML and IFC are used to represent 3D data, ensuring interoperability across domains. Visualization is handled through 3DTiles. Data from diverse sources is harmonized and transformed using ETL processes, often leveraging tools like FME and NodeRED. For storage and access, CityGML is typically managed in 3DCityDB, with some deployments mapping it into ArcGIS Pro, while IFC data is stored within commercial BIM platforms. Sensor data follows the OGC SensorThings API data model. Metadata and service discovery are handled using a catalog based on the DCAT 3.0 model, customized with specific code lists tailored to the SDDI (Smart District Data Infrastructure) framework.
DiDiMoS - 3D Digital District for Energy Monitoring and Simulation	District	Use	Energy monitoring and simulation	Lv3	Semantic data models (IFC, CityGML, geoJSON, LandXML); spatial data bases (3DCityDB, SpatiaLite); Standard for Webservives (WFS, WMS) quasi Standards for time series (Influx, Grafana) for Sensor integration and simualtion results; based on Container-Apps with Kubernetes
Near Real-Time Responsive Flood Event Representation: An Open-Source Interactive Web Application Architecture.	City	Use	flood applications near real-time responsive flood event representation	Lv3	A Cesium-based Webpack JavaScript application that uses live API data feeds. Webpack is used to bundle the application and optimize asset loading. This approach ensures the digital twin dynamically reflects real-time flooding conditions while maintaining a scalable and modular data model.
3D Netherlands	City	Use	3D Visualization	Lv2	Based on the dataset, in some cases direct APIs and in others a data pipeline for ETL. For GIS data, FME is used.
Ground-based Modeling, Simulation and Training geospatial data production - One World Terrains	Global	Use	Provide a single geospatial dataset (digital twin) for US Army training and operations from best available data using a fully automated process	Lv2	Built tools to conflate and integrate various extracted and derived sources. Creating a set of rules, implemented tools, to provide a structured integration of sources into a single consistent

			And enhanced modeling and simulation		representation of a geographic area
TOOLS4CITIES	Multiscale from block to city	Use	CityLayers: multi-source data visualization - Energy and emissions simulations Cityplayer: Gamified neighbourhood simulator for citizen engagement RETROfitter: retrofitting strategies	Lv2	Data model for simulation purposes created and importers/exporters to deal with heterogenous data sets
NUAR - National Underground Asset Register	National	Use	Underground Infrastructure Management and maintenance enhancing safety, efficiency, and planning in excavation, maintenance, urban development, disaster response, and smart city initiatives.	Lv 1 and 2	Agreement of input data structure and repeatable transformation into published open standard target data model
https://chekdbp.eu https://www.usage-project.eu https://ad4gd.eu	European	Creation	Supporting the digitalization of building permit issuing and automated compliance checks. Provide solutions and mechanisms for making city-level environmental and climate data available to everyone based on FAIR principles (findable, accessible, interoperable and reusable data). Green Deal Data Space for water quality, biodiversity connectivity and air quality.	Lv 1 and 2	By converting GIS data into BIM data and the other way around, to use the specific tools for the two kinds of data. Profiles and extensions are provided where needed.
Programma Digitale Stad (Digital City program); www.digitaalecosysteem.nl; www.rotterdam.nl/open-urban-platform-rotterdam; www.rotterdam-oup.nl	City	Use	Permit Control Service - Develop the city of tomorrow together. Increasing physical safety in the city by helping the Safety Region in particular with better and more reliable information. A generic BIM facility : a central location where BIM models can be stored and accessed.	Lv 1, 2 and 3	The OUP is the middleware between data sources and data users. The basic principle is the mandatory use of open, internationally well-known standards: interoperability is key.
Digital geoTwin	City	Creation	Support of the urban planning processes	Link databases on object level	A CityGML-based data model developed by profiling CityGML 2.0 and extending it with a custom Application Domain Extension (ADE)
Digital interoperability 3CIM, phase 2	National	Creation	Develop a framework for digital collaboration in the built environment, aligned with the European Interoperability Framework	Lv 1 and 2	UML-modelling and linking relational DB. Use ontologies and linked data for integration.

3D city models for noise and daylight simulations			(EIF) and Sweden's Digital Collaboration Framework Develop an open-standard information model for semantic, object-based 3D city models to support the transition from simple visualization tools to fully functional digital twins that address societal challenges such as climate change and urban safety. Noise and daylight simulations		
Disaster Management Digital Twin	National	Creation	Disaster Management	Lv 2 and 3	Through OpenAPI with other servers, raw data pre-processing for facilitating simulation
The concept of the geospatial digital twin of Slovenia for supporting complex spatial decisions of the state	National	Creation	Develop a concept for a national geospatial digital twin tailored to the needs of Slovenia, based on state-of-the-art technologies and best practices from abroad, and to provide recommendations or guidelines for actual implementation	Lv 1	Different approaches of data integration are under test
Digital Twin for Shade Equity: A 3D Spatiotemporal Analysis of Socioeconomic Disparities in US cities	City	Creation	Shade simulations to analyze hourly shade patterns and assessing equity in shade availability across different socioeconomic communities in seven U.S. cities over the course of the summer diurnal cycle.	Lv 1	Python and ArcGIS pro.