Going Digital...

Bentley Systems

Advancements Update

Spring 2019
2018 Performance Highlights

Founded in 1984, Bentley Systems has more than 3,500 colleagues in over 50 countries. Bentley is a global leader in providing engineers, architects, geospatial professionals, constructors, and owner-operators with comprehensive software solutions for advancing the design, construction, and operations of infrastructure.

Constant Currency ARR

Organic 2013 – 2018 CAGR: 7.2%

• Annual revenue runrate surpasses $700 million
• 83% Annual Recurring Revenue (ARR; not including license sales) with 98% subscription retention rate
• Organic revenues (constant currency) grew 6.5%
• Closed 7 acquisitions, funded by operating cash flows
• Increased colleague headcount by over 250
• Achieved revenue runrate growth exceeding 20% in Greater China
• Achieved revenue runrate growth exceeding 20% for brands including AssetWise, ContextCapture, OpenRoads
• Since 2014 nearly $1 billion invested in R&D and acquisitions

News...

New in this issue:
Welcome to the Spring 2019 edition of Bentley’s Advancements Update. Here is a listing of what’s new and noteworthy in this issue:

• Bentley Systems’ 2018 Performance Highlights
• Our latest acquisitions
• Global Advancement, featuring winners and finalists of the 2018 Year in Infrastructure Awards
• Bentley’s Open Modeling Environment

Acquisition News:

Agency 9 (October 15, 2018)
Bentley acquired Agency9, provider of city-scale digital twin cloud services. Bentley’s iTwin cloud services add digital alignment and change synchronization for infrastructure engineering digital twins and enable OpenCities Planner (formerly Agency9 CityPlanner) to serve urban planning requirements at fuller levels of detail.

SignCAD (February 11, 2019)
The acquisition of SignCAD Systems augments Bentley’s software portfolio with traffic sign design solutions, enabling greater detail for digital twins of transportation assets. The acquisition builds upon Bentley’s comprehensive set of solutions for design and construction of transportation assets through its OpenRoads applications.

AIWORX (November 20, 2018)
Bentley acquired AIworx, Inc., provider of machine learning and internet of things (IoT) technologies and services. Incorporation of data provided through AIworx technology with Bentley’s digital twin cloud services enables users to leverage analytics visibility to improve productivity and efficiency of infrastructure assets.

ACE (November 12, 2018)
The acquisition of ACE enterprise Slovakia, provider of innovative technology solutions to interface with enterprise resource planning (ERP), enterprise asset management (EAM), and geographical information systems (GIS), extends Bentley’s scope of engineering digital twins beyond IoT to include IT.
The Year in Infrastructure 2018 was a year in which juries chose winning projects from everywhere in the world.
Sharing digital components and connecting digital workflows across disciplines are the foundation of an open modeling environment. Comprising MicroStation-based engineering and BIM applications specialized for asset types and solutions, the open modeling environment advances collaboration, enabling clash resolution and production of multidiscipline deliverables from any application.

Bentley’s Open Modeling Environment achieves project savings by advancing design integration...

Guangxi Communications Design Group Co., Ltd.

BIM-based Collaborative Design and Construction Management of All Elements and Objects in the Lipu-Yulin Expressway Project

Guangxi Zhuang Autonomous Region, China

The Lipu-Yulin Expressway has a main roadway spanning 263.1 kilometers. Guangxi Communications Design Group is responsible for design, coordination, and construction management. The CNY 23.06 billion roadway project featured technically complex structures, involved numerous engineering disciplines, and required a large amount of land requisition and demolition in an area with geological and geographical site constraints.

ContextCapture helped the team save substantially in survey and mapping costs, OpenRoads optimized the modeling of the highway elements, and Navigator facilitated collision detection to identify and solve issues in advance. Bentley’s Connected Data Environment based on ProjectWise reduced communication and collaboration costs. Bentley’s BIM solutions saved 10 percent in design and construction management, which reduced costs by 30 percent. Project Playbook: ContextCapture, Descartes, LumenRT, MicroStation, Navigator, OpenBridge Modeler, OpenBuildings, OpenPlant, OpenRoads, OpenRoads ConceptStation, ProjectWise, ProSteel, ProStructures, RM Bridge

Northern Engineering & Technology Corporation, MCC

SINO Iron Ore Mine

Perth, Western Australia, Australia

Located in the remote Pilbara region of northwestern Australia, SINO iron ore project is the largest monomer mining project in Australia to be invested by China. The highly precise installation requirements contributed to design, transport, and installation challenges. Northern Engineering & Technology Corporation, MCC formed a BIM team to implement a combined design and construction concept that focused on modular construction.

The team used Bentley software to design a variety of 3D models and imported them into RAM for finite element analysis and to perform collision detection. Bentley’s modeling applications simulated a module assembly and construction environment, which enabled potential problems to be identified and resolved in advance, improving construction efficiency and shortening the construction period. The BIM solution facilitated accurate drawing extractions in compliance with general international standards, reducing design changes by 80 percent. Project Playbook: MicroStation, Navigator, OpenBuildings, OpenPlant, RAM
OpenBuildings applications integrate multiple disciplines for the design, analysis, construction, and management of high-performance buildings of any size, form, or complexity. Integrating data from different files and formats, OpenBuildings applications enable better project collaboration and help to reduce costly rework.

OpenBuildings applications include:

- **OpenBuildings Designer**
- **OpenRoads and OpenSite**
- **OpenRail**

OpenBuildings applications provide:

- **LumenRT for Real-time Visualization**
- **ContextCapture for Reality Modeling of the Building Site**
- **OpenBuildings Energy Simulator for Energy and Lighting Analysis**
- **SYNCHRO for 4D Construction Modeling**
- **STAAD for Structural Analysis and PLAXIS for Geotechnical Analysis**
- **LEGION for Pedestrian Simulation**
AssetWise CONNECT Edition leverages a connected data environment to facilitate the management of performance digital twins via interoperation of multiple data sources across IT, OT, and ET domains, for improved decision support and proactive maintenance of infrastructure assets. The AssetWise platform uniquely federates the contexts within which asset information can be effectively managed across the infrastructure lifecycle, to comprehensively support functions that improve asset performance.

Learn more: www.bentley.com/AssetWise.

New ProjectWise CONNECT Edition cloud services for comprehensive project delivery include:

- Deliverables Management to create, send, and receive transmittals, submittals, and RFIs
- Issues Resolution to submit, manage, and resolve issues
- Field Data Management for configurable, forms-based data collection
- Project Performance Dashboards for insight into project progress
- Share to securely share project information
- Construction Management for contract, cost, change, and risk management

If ProjectWise is a 2D Drawing, then ProjectWise Insights is the 3D Model that has illuminated ‘all of that dull ProjectWise information’. Our Project Managers now see the value of the CDE and how accurate metadata can help to identify trends in project performance and provide the information needed to pro-actively influence better outcomes…

– Elizabeth Bema, Information Manager, AECOM

Bentley and Siemens: APM for PowerPlants
Bentley and Siemens’ new, jointly developed APM solution empowers plant owners to take full advantage of digitalization, leveraging Siemens’ deep power plant domain expertise and accelerating the time-to-value of APM implementation. Using intelligent models based on predictive analytics, the APM-as-a-service solution integrates into existing Computerized Maintenance Management System (CMMS)/Enterprise Asset Management (EAM) environments to improve maintenance planning, reduce outages, and increase workforce efficiency.
During project delivery, the practice of industrializing BIM can improve predictability, performance, and outcomes by using—and reusing—ready-made digital components from concept to completion, adding more engineering content earlier in the design process, for better, more informed design decisions. Applying industrial UAVs to continuously survey existing conditions of a project and provide engineering-ready digital context throughout planning, design, and construction, the BIM process can be further industrialized, by automating both surveying and construction workflows, and providing visibility into the path of construction, virtually.

Digital engineering models represent an accumulated intelligence—the "digital DNA"—developed throughout the design/engineering process. Leveraging digital DNA in both construction and operations is made possible by aligning that data in a connected data environment (CDE) to be securely accessible for reuse by relevant stakeholders. The digital components and digital context within the CDE can be geo-coordinated for immersive visibility into project delivery and asset performance, leading to more informed decision making and improved outcomes.
To create a digital twin with the fidelity needed to be useful for either project delivery or asset operations requires 1) the mirroring of the physical reality of the site’s or asset’s existing conditions—the digital context—2) the aligning of the virtual engineering data—the digital components—to make that “dark data” available for analytics, and 3) the synchronization of that data to reflect the continuous change intrinsic to every project or operating infrastructure asset.

Bentley’s infrastructure digital twin advancements converge the digital context that can be continuously surveyed with ContextCapture, and the digital components that are digitally aligned through our ProjectWise and AssetWise, comprising our Connected Data Environment. Finally, our iTwin Services provide the change synchronization necessary to maintain the data integrity of the digital twin.

Requirements:

1. Reality...? Mirror Existing Conditions
   “Digital Context”

2. Veracity...? Align Engineering DNA
   “Digital Components”

3. Fidelity...? Reflect Continuous Change
   “Synchronization”

Solutions:

1. Reality...!
   Reality Modeling
   Context Capture

2. Veracity...!
   Connected Data Environment
   ProjectWise & AssetWise

3. Fidelity...!
   Cloud Services
   iTwin Services

Web access for immersive visualization and analytics visibility!

Whether one is deploying a project digital twin, a performance digital twin, or any fit-for-purpose-curated digital twin, the unique benefits come from the immersive visualization that becomes securely accessible to authorized stakeholders via a web browser interface and the analytics visibility that opens up the “dark data” of engineering processes for advanced insights through machine learning and big data analytics. In addition, Bentley’s unprecedented delivery of the iModel.js technology as an open source library, will enable a broad ecosystem of user- and third-party-developed applications to address an unlimited number of use cases for the infrastructure digital twin.
In project delivery, the “dark data” contained in engineering files from various sources can be “opened up” in our secure Connected Data Environment to become data that is query-able and change-synchronized for the stakeholders in the project delivery ecosystem.
Inspectioneering is a digital workflow bringing as-operated, and continuously surveyed, engineering-ready digital context into engineering environments enabling engineers to virtually inspect and evaluate infrastructure assets from any location. The use of drones makes possible the detailed survey of assets too inaccessible or dangerous for field inspections, with UAV-mounted digital photography, scanning, thermography, and electromagnetic sensors gathering a rich set of digital information relevant to inspection. Machine learning can apply the resultant reality meshes for digital component classification and condition assessment.

Conceptioneering is a digital workflow that facilitates the process of creating multiple iterations of a conceptual design model and providing a streamlined evaluation and comparison of design alternatives. Digital context plays a key role in conceptioneering as it leverages a reality mesh to bring immersive existing conditions and 3D engineering-ready context to the design environment. Digital components bring pre-defined, engineering-ready, intelligent 3D "building blocks" into the conceptual design process to build robust conceptual models with enough detail to produce preliminary cost estimates for feasibility studies.

Constructioneering is a digital workflow that enables engineering data to be brought directly from software applications to the field to inform construction workflows and enable the use of GPS-connected, machine-controlled construction equipment. Constructioneering also provides the capability to bring UAV-captured, continuously surveyed digital context into the engineering environment for design development and construction progress monitoring. Digital components used in constructioneering contain relevant intelligence to automate fabrication and construction processes.

Operationeering is a digital workflow that can integrate digital engineering models, the as-operated and continuously surveyed digital context of the infrastructure asset, and IoT data generated by sensors on the operating asset, to improve operational performance, reliability, compliance, and safety, and to facilitate predictive maintenance. The digital context, in the form of a reality mesh, connected with IoT data and dashboards and, augmented with digital components from the engineering models, can provide an immersive 3D environment offering, enabling remote operations and operational visibility for better decision support.

**Extending engineering’s Business Value...**
Success Plans help organizations to implement and realize maximum value from their Bentley applications more quickly, with improved results, and with minimized risk. By developing a going digital strategy with help from Bentley experts, organizations can see a 5 to 15% improvement in design efficiency through better leveraging the capabilities of Bentley’s technology.

As part of their Success Plans, organizations can learn, automate, and institutionalize proven digital workflows and industry best practices through Bentley Institute’s Digital Advancement Academies.

Digital Advancement Academies
Digital Advancement Academies partner with industry leaders as a catalyst for thought leadership and knowledge exchange, helping to better align all stakeholders involved in the design, construction, and operation of infrastructure assets. With their process-focused approach, Academies provide opportunities for participants to define and explore desired industry outcomes and best practices.

- Digital Advancement
- Construction
- Constructioneering (in partnership with Topcon Positioning Group)
- Process Industries (in partnership with Siemens)

Digital Advancement Research
The Digital Advancement Research Team collaborates with government, university, and industry visionaries to demonstrate innovative solutions for future infrastructure needs.

Learn more: www.bentley.com/services
Bentley and Siemens introduced PlantSight, a jointly developed digital solution to enable as-operated and up-to-date digital twins, which synchronize the physical plant and its engineering data. Because process industries are characterized by ongoing capital projects, the effectiveness of digital twins depends upon the integrity and accessibility of continuously updated, as-operated data. With PlantSight, every process plant owner-operator can realize the benefits of as-operated digital twins – consistent operational readiness, improved reliability, and better efficiency – without disruption to their existing physical or virtual environment.

At the Mobile World Congress 2019 in Barcelona, Bentley presented SYNCHRO XR, its app for immersively visualizing 4D construction digital twins with the new Microsoft HoloLens 2. Selected as a Microsoft mixed reality partner representing the architecture, engineering, and construction (AEC) industry, Bentley demonstrated how with SYNCHRO XR for HoloLens 2, users can interact collaboratively with digital construction models, using intuitive gestures to plan, visualize, and experience construction sequencing.

Bentley Institute and Topcon have established the Constructioneering Academy to provide opportunities for learning best practices in constructioneering, a digital workflow that enables engineering and survey data to be used to inform construction workflows and improve project delivery. Since its launch, the Constructioneering Academy has offered sessions in North America, Australia, and the U.K. Also, as part of an ongoing constructioneering initiative, Bentley and Topcon are working together to integrate the Topcon point cloud and 3D mesh service, MAGNET Collage Web, with the Bentley ContextCapture Cloud Processing Service to enable fast generation of 3D engineering-ready reality meshes and digital surface models.