



WE
ARE
THERE

2018/2019/2020
Corporate Report

**DS DASSAULT
SYSTEMES**

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**DS DASSAULT
SYSTEMES** | The **3DEXPERIENCE**® Company



P. 02	EDITORIAL	WE ARE WHERE	
P. 06	GOVERNANCE	P. 22	SCIENCE PROTECTS LIVES
P. 08	PROFILE	WE ARE WHERE	
P. 10	STAKEHOLDER VALUE-CREATION MODEL	P. 40	CITIES TAKE SHAPE
P. 12	2020 PERFORMANCE	WE ARE WHERE	
P. 14	OBJECTIVES AND OWNERSHIP STRUCTURE	P. 52	THE FUTURE TAKES OFF
P. 16	CSR COMMITMENTS	WE ARE WHERE	
P. 18	COVID COMMITMENTS	P. 66	MAKING HAS MEANING
		P. 80	WE WILL BE THERE TOMORROW
		P. 88	ADDITIONAL INFORMATION

Because experience is human, experience is about enjoying art, science and technology to imagine and create a better world for all. And this world must be sustainable.

Dassault Systèmes builds on imagination, knowledge and know-how to make a lasting contribution for the benefit of all. To achieve this strategy, we will focus on developing our leadership in Life Sciences & Healthcare alongside two other strategic sectors of the economy: Manufacturing Industries and Infrastructure & Cities.

We stand at the threshold of a new world, where industry will need to create new landscapes in terms of what we offer, decide between use case scenarios and transform the art of production. We'll only be able to tackle these challenges by balancing all the dimensions of what it means to be human at once: an industrial being, a social being and a living being. The ability to imagine, the passion to learn, the willingness to dare, and the art of how we make it happen will be crucial. In this brave new paradigm, virtual will be the vital link between the imagination, the useful and the sustainable.

WE ARE WHERE

SCIENCE PROTECTS LIVES,
CITIES TAKE SHAPE,
THE FUTURE TAKES OFF,
MAKING HAS MEANING.

WE WILL BE THERE TOMORROW.

// This unprecedented period has been a challenging, educative and revealing experience all at the same time.



2020 PERFORMANCE AND STRATEGY

(All figures are non-IFRS and in constant currencies)

by **BERNARD CHARLÈS**
Vice-Chairman of the Board
and CEO

and **CHARLES EDELSTENNE**
Chairman of the Board

How would you describe the way Dassault Systèmes went through 2020?

This unprecedented period has been challenging, educative and revealing, all at the same time. We overcame the challenge with all our employees by learning new working methods, of course, but also by paying close attention to all the situations created by the crisis among our customers, our distributors, our suppliers and our employees. This crisis also played a revealing role and accelerated a number of trends. It revealed the critical importance of our role in collaborative innovation across the three sectors we serve as a strategic partner in value creation. Through close engagements, we helped our clients run their operations during the pandemic – especially for businesses in the manufacturing industries. At the same time, our innovation platform also enabled our clients to prepare for the future and advance their next-generation portfolios for sustainable development.

Summarizing our performance during 2020, we achieved our objectives, revised in April due to the pandemic, with revenue increasing 12% to €4.5 billion. Our financial results underscored our recurring revenue resiliency, representing 80% of our total software revenue. We delivered 2020 diluted net earnings per share (“EPS”) of €3.77, up 5%. Finally, cash flow from operations increased 5% to €1.24 billion.

We enter 2021 with significant momentum in Life Sciences anchored by MEDIDATA, which enters this year with 94% coverage of its annual target revenue thanks to significant progress achieved in 2020: MEDIDATA expanded its customer base by 16%, signed record multi-year renewals for Rave EDC in clinical trials, expanded product line attach rates, and experienced significant traction with Patient Cloud.

Underscoring our platform offer for Life Sciences, we signed our first large transaction, combining engagement using on the one hand, MyMedidata and

Rave with manufacturing operations and, on the other hand, supply chain process optimization provided by other Dassault Systèmes’ brands.

For small-and medium-sized enterprises, we are expanding our levers of growth with SOLIDWORKS, 3DEXPERIENCE WORKS, and CENTRIC PLM. During 2020, SOLIDWORKS welcomed over 20,000 new customers, reached 230,000 paid subscription Draftsight users and saw progressive traction with 3DEXPERIENCE WORKS. Centric PLM delivered a strong recovery in the fourth quarter, underscoring its market leadership in PLM for Home & Lifestyle.

Finally, with large industrial companies, we delivered a significant number of 3DEXPERIENCE “go lives”, which in most cases, were performed remotely. We also signed a good number of significant transactions, demonstrating our market leadership and positioning us for improved performance in 2021.

What are Dassault Systèmes’ strategic prospects?

Our strategy consists of helping in the transformation of the three major sectors of the economy: Manufacturing Industries, Life Sciences & Healthcare, and Infrastructure & Cities. As we look to the next five years, we believe we are poised to accelerate Dassault Systèmes’ contribution to those three sectors leveraging industry platformization and data intelligence. The Manufacturing Industries sector is accelerating its sustainable innovation initiatives thus creating demand for data modeling, simulation, and eco-design, a sweet spot for Dassault Systèmes.

For example, we are working with clients to redefine the future of mobility, enabling an end-to-end perspective of the customer experience from conception to engineering to new mobility services. For our clients, our solutions are critical to enable them to be the first to market, responding to changing consumer behaviors across many aspects of their lives. In the Life Sciences & Healthcare sector, we are working with industry participants to move toward



a patient-centric perspective. Finally, we are advancing initiatives with multiple industries, government entities and new emerging disruptors to reinvent Infrastructure & Cities to create a sustainable future.

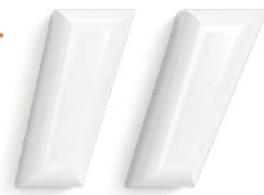
Overall, we believe that market opportunities for Dassault Systèmes are significant. Our underlying five-year plan includes revenue growth of about 10%, with an operating margin improvement, together leading to a circa 13% four-year CAGR for EPS. Our revenue initiatives will likely drive our Cloud footprint up significantly, representing about €2 billion in potential cloud software revenue by 2025. Thus, we are positioned to achieve another doubling of our EPS to about €6 per share in 2024, driven by 3DEXPERIENCE adoption by our installed base and the expansion of our customer base.

At the outset of 2020, we expanded Dassault Systèmes' multi-decade ambition – challenging ourselves to help enable the virtual twin experience of humans. Adding to our current capabilities to serve three sectors, with a leading market position in two of them – Manufacturing Industries and Life Sciences & Healthcare – we believe that this represents a potential available market of \$100 billion, which we are addressing with our Research & Development initiatives.

How are the Company's strategic developments structured around environmental, social and governance issues?

If the year 2020 taught us anything, it is the importance of building a more sustainable, resilient world. To that end, we announced the launch of Dassault Systèmes' sustainability strategy for 2025 and beyond. This is an important milestone in our journey to become the world's #1 partner for sustainable innovation.

// Dassault Systèmes can be a significant lever for sustainable innovation.



As a purpose driven company, we are convinced that Dassault Systèmes can be a significant lever for sustainable innovation to meet current challenges. To create a better world, we must propose solutions to explore the realm of the possible and to imagine the future, and not just use the methods of yesterday or today. With Accenture, we have co-authored a study, revealing the critical role of Dassault Systèmes' virtual twins, bringing \$1.3 trillion of economic value and an estimated 7.5 Gt CO₂ emissions reductions between now and 2030 for five use cases selected in the study. Our handprint is essential and, if we are a digital transformation enabler, we also are critical for energy transition thanks to our ability to manage the end-to-end lifecycle of products.

At the company-level, we are committed to reducing our footprint and operate our activities in a more sustainable manner. We, therefore, set an ambitious target for reducing our CO₂ emissions to 5 tons per employee by 2025, and we will announce our reduction target this year as part of the Science Based Targets initiative (SBTi).

We are members of the United Nations Global Compact and the European Union's Green Digital Coalition. Within the Company, a leadership team directing our environmental initiatives is comprised of a dedicated Board Director, a member of the Operations Executive Committee, and the Chief Sustainability Officer.

From a social perspective, we are committed to maintaining our global people resources, with no outside governmental support throughout the crisis, as we did previously in 2009 during the global economic downturn. Moreover, we continue to invest in expanding our Research & Development teams, adding critical resources around our data science initiatives, as our Research & Development is about helping our clients develop the innovation of tomorrow.

What is Dassault Systèmes' outlook for 2021?

Assuming a gradual recovery in the business environment in 2021, we are targeting a revenue growth of 9 to 10% for 2021 and anticipate recurring software revenue to increase by 8 to 9%, with license and other software revenue growth of 13 to 15%. We are very progressively transitioning to a cloud and subscription model, but not at the expense of growth. In 2020, our operating initiatives enabled us to sustain a stable organic operating margin,

only the dilution related to the acquisition of MEDIDATA explaining the decrease of our margin to 30.2%. In 2021, we are aiming for a 60 basis points improvement, to reach a margin of 30.8%. Our EPS range is €4.10 to €4.15, growing 13 to 14% excluding currency headwinds. Hence, we see a year of good organic revenue growth in 2021 and are confident in our mid-term growth drivers thanks to our Industry Solutions, to our talented teams and to our partners' ecosystem across the globe.

In closing, none of us could have imagined 2020 in advance, but despite the difficulties, we became closer as a company. We sincerely want to extend our thanks to our colleagues, partners and our customers. Moreover, we will not forget the trust and support we received from financial analysts and investors. ✕



GOVERNANCE



BERNARD CHARLÈS
Vice-Chairman of the Board of Directors
and Chief Executive Officer



DOMINIQUE FLORACK
President



Around **PASCAL DALOZ**, the Operations Executive Committee, from left to right:

- ELISA PRISNER**, Vice-President Business Platform Transformation
- SAMSON KHAOU**, Executive Vice-President, Asia-Pacific
- PHILIPPE LAUFER**, Executive Vice-President, 3DS Global Brands
- THIBAUT DE TERSANT**, Senior Executive Vice-President, General Secretary
- FLORENCE VERZELEN**, Executive Vice-President, Industry, Marketing & Sustainability
- PASCAL DALOZ**, Chief Operating Officer & Chief Financial Officer
- ERIK SWEDBERG**, Executive Vice-President, Americas
- FLORENCE HU-AUBIGNY**, Executive Vice-President, Research & Development
- LAURENCE BARTHÈS**, Executive Vice-President, Chief People & Information Officer
- OLIVIER RIBET**, Executive Vice-President, EMEAR
- VICTOIRE DE MARGERIE**, Vice-President Corporate Equity, Marketing & Communications

PROFILE

We roll out our strategy by calling on our strategic operational elements: Brands, Industries and Geos. Dassault Systèmes' Brands create great user experiences and build vibrant user communities and develop the apps that power the 3DEXPERIENCE platform.

Our Industries develop Solution Experiences, which are industry-focused offerings that deliver specific value to companies and users in a particular industry. Our twelve Geos are responsible for making Geos the driving force for the development of our business and drive the implementation of our customer-centric engagement model.

MANUFACTURING INDUSTRIES DOMINIQUE FLORACK



LIFE SCIENCES & HEALTHCARE TAREK SHERIF



INFRASTRUCTURE & CITIES SYLVAIN LAURENT



TRANSPORTATION & MOBILITY

Laurence Montanari



AEROSPACE & DEFENSE

David Ziegler



MARINE & OFFSHORE

François-Xavier Dumez



INDUSTRIAL EQUIPMENT

Philippe Bartissol



HIGH-TECH

Olivier de Percin



HOME & LIFESTYLE

Philippe Loeb



CONSUMER PACKAGED GOODS & RETAIL

Philippe Loeb



LIFE SCIENCES

Claire Biot



ENERGY & MATERIALS

Thomas Grand



CONSTRUCTION, CITIES & TERRITORIES

Rémi Dornier



BUSINESS SERVICES

Taherah Kuhl



3DEXCITE Tom Acland CENTRIC PLM Christopher Groves ENOVIA Stéphane Declée



SOLIDWORKS
Gian Paolo Bassi



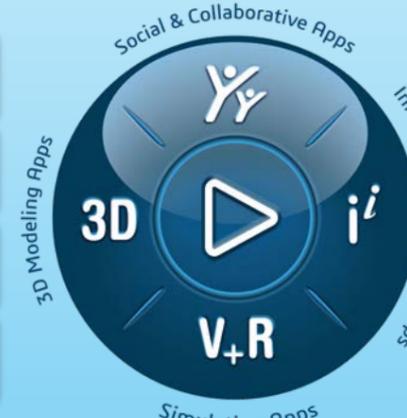
CATIA
Olivier Sappin



GEOVIA
Michelle Ash



BIOVIA
Jason Benedict



NETVIBES
Morgan Zimmermann



MEDIDATA
Tarek Sherif
Glen de Vries



SIMULIA Philippe Laufer DELMIA Guillaume Vendroux 3DVIA Vincent Picou

DASSAULT SYSTÈMES VALUE-CREATION MODEL

OUR RESOURCES



OUR BUSINESS



OUR SHARED VALUE (IMPACT)

INTELLECTUAL CAPITAL

- 12 technology portfolios serving the full innovation cycle
- 40 years of accumulated industry knowledge
- €935.4M R&D investment (+26.8%)

HUMAN CAPITAL

- 19,789 people from 133 countries
- 41% working in R&D

SOCIAL CAPITAL (ECOSYSTEM)

- 12,260 people in our ecosystem of commercial partners (VaRs & CSI)
- 150+ scientific and research partners
- €33.4M in research grants

FINANCIAL CAPITAL

- Long-term and stable shareholders structure
- x1.8 adjusted net debt / EBITDAO
- €1.241 M operating cash flow

NATURAL CAPITAL

- 65,657 MWh of energy (43.9% renewables)
- 26,982 tCO₂-eq in purchase capital goods

OUR PURPOSE

- To provide business and people with 3DEXPERIENCE universes to imagine sustainable innovation capable of harmonizing product, nature and life.

SERVING 3 KEY SECTORS

- Manufacturing Industries
- Life Sciences & Healthcare
- Infrastructure & Cities

DIVERSE CLIENT BASE

- 290,000 customers ranging from entrepreneurs to multinationals in 11 industries.

GEOGRAPHIES

- 12 Geos drive the development of our business in 180+ countries.



3DEXPERIENCE®

HUMAN INDUSTRY EXPERIENCES

- Dassault Systèmes is a scientific company serving science and technology for a sustainable society.

FLEXIBLE SOLUTIONS

- Delivering roles, processes, and solutions on public/private cloud or on premise, via license or subscription, and accompanied by consulting and services.

MULTI-CHANNEL ENGAGEMENT

- Reaching clients and new markets via direct, indirect and online channels.

INTELLECTUAL CAPITAL & CUSTOMER RELATIONSHIPS

- 44 filed patents
- 53 granted patents
- 25 years average length collaboration with our TOP 20 clients

HUMAN CAPITAL (Employees)

- 87.6% employees trained
- 82.5% level of employee pride and satisfaction
- 99% of employees under permanent contracts

SOCIAL CAPITAL (Society)

- €160.8M in income tax expenses (24.9% ETR)
- 38 projects supported via our foundations
- 6 million students using 3DEXPERIENCE Edu solutions

FINANCIAL CAPITAL (Shareholders)

- €3.77 earnings per share (Non-IFRS)

NATURAL CAPITAL (Environment)

- 39% CO₂ emissions reduction (incl. COVID-19 impacts)
- 88.3% of main sites offer recycling of ordinary waste (+5% versus 2019)

2020 IN A SNAPSHOT

+12%
Revenue growth⁽¹⁾

30.2%
Operating margin⁽¹⁾

+5% EPS
at €3.77

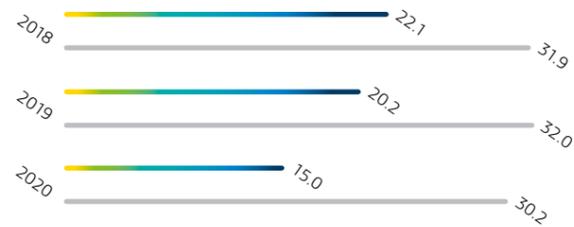
+5%
Net cash provided by operations

1.8x
Adjusted Net Debt / EBITDAO ratio

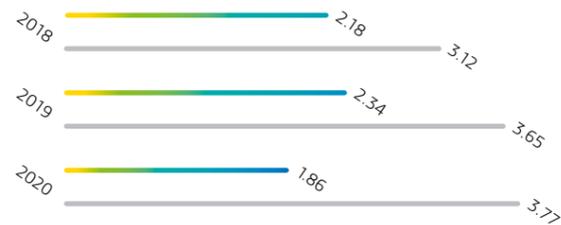
ORGANIC AND ACQUISITION-RELATED GROWTH OF +12%⁽²⁾ OF REVENUE (M€)



DILUTION IMPACT OF ACQUISITIONS OFFSET IN PART BY OPERATING MARGIN ORGANIC IMPROVEMENTS (%)



DILUTED EPS⁽¹⁾ (€) UP +5% IN 2020



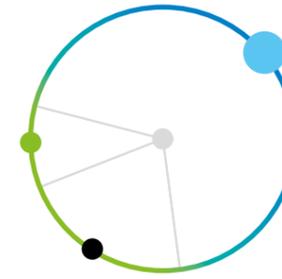
NET CASH PROVIDED BY OPERATIONS⁽²⁾ (M€) INCREASED IN 2020



DELEVERAGING ADJUSTED NET DEBT / EBITDAO RATIO⁽³⁾

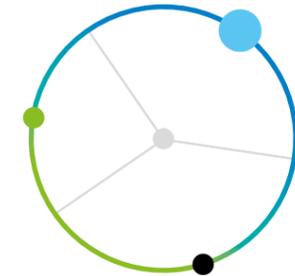
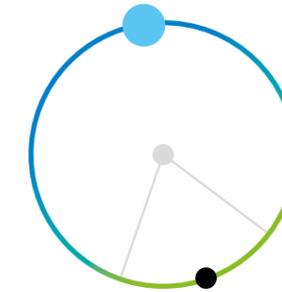


(1) Non-IFRS, growth figures in constant currencies.
 (2) All financial information is reported according to IFRS. In addition, the Company has provided supplemental non-IFRS financial information, which excludes the effect of adjusting the carrying value of acquired companies' deferred revenue, share-based compensation expense and related social charges, amortization of acquired intangible assets and of tangible assets revaluation, lease incentives of acquired companies, other operating income and expense, net, including the payment of goodwill and acquired intangible assets, certain one-time financial revenue items and the income tax effects of these non-IFRS adjustments.
 (3) The Adjusted Net Debt corresponds to the net financial debt position (borrowings net of cash, cash equivalent and short-term investments) adjusted of IFRS 16 lease liabilities. The IFRS EBITDAO corresponds to the IFRS operating income adjusted of amortization, depreciation and impairment expense of intangible and tangible assets and of non-cash share-based payment expense (excluding related social charges).



3 STRATEGIC SECTORS⁽¹⁾

- 69% Manufacturing Industries
- 21% Life Sciences & Healthcare
- 10% Infrastructure & Cities

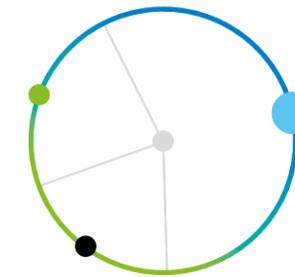
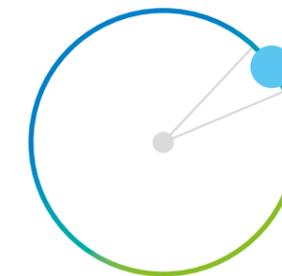


EXCELLENT PERFORMANCE IN AMERICAS AND ASIA PROGRESSING WELL

- 37% Europe⁽²⁾
- 38% Americas⁽²⁾
- 25% Asia⁽²⁾

PREPONDERANCE OF RECURRING SOFTWARE REVENUE

- 80% Recurring Software⁽¹⁾
- 20% Licenses and Product Development⁽¹⁾



LEADING PRODUCT LINES SERVING OUR USERS⁽¹⁾

- 57% Industrial Innovation⁽³⁾
- 20% Life Sciences⁽³⁾
- 23% Mainstream Innovation⁽³⁾

A LARGE INSTALLED BASE WITH 290,000 CUSTOMERS

- More than 20,000 new customers

(1) As % of non-IFRS software revenue.
 (2) As % of non-IFRS revenue.

(3) Our new product line financial reporting includes: 1) *Industrial Innovation* software revenue, comprised of our CATIA, ENOVIA, SIMULIA, DELMIA, GEOVIA, NETVIBES/ EXALEAD, and 3DEXCITE brands; 2) *Life Sciences* software revenue, comprised of our MEDIDATA and BIOVIA brands; and 3) *Mainstream Innovation* software revenue, comprised of our SOLIDWORKS brand as well as CENTRIC PLM, 3DVIA and our new 3DEXPERIENCE WORKS family.

2020 REVISED OBJECTIVES AND UPDATING OUR MULTI-YEAR GROWTH PLAN

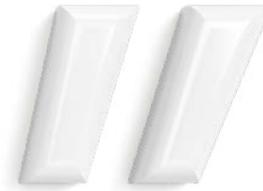
(All figures are non-IFRS and in constant currencies)

2020 demonstrated the resilience of our business model and solid execution, as we delivered on our revised objectives, mitigating the impact of the pandemic. Revenue increased by 12%, with recurring revenue representing 80% of our total software revenue. Software revenue was well-balanced on a global basis thanks to our geographic diversification efforts: Asia now joins the Americas and Europe regions, crossing the €1 billion milestone of software revenue. Hence, we reached a non-IFRS EPS of €3.77, up 5% at constant currency.

Thanks to the **3DEXPERIENCE** platform and the dynamism in Life Sciences with MEDIDATA, Dassault Systèmes is well positioned going into 2021. We are targeting total revenue growth of about 9% to 10%, with EPS growth of about 13% to 14%. Our financial objectives take into account what we currently perceive as a complex and volatile economic environment.

Our multi-year plan includes a revenue growth of around 10%, driven by the adoption of **3DEXPERIENCE** by our installed base and new customers. With an expansion of the operating margin, the EPS CAGR would approximately be 14% between 2020 and 2024 to reach €6.

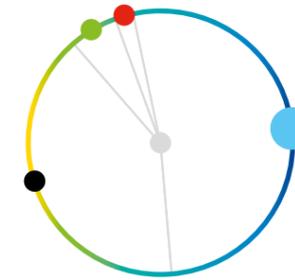
PASCAL DALOZ
Chief Operating Officer
and Chief Financial Officer



2018-2024 NON-IFRS EPS OBJECTIVE

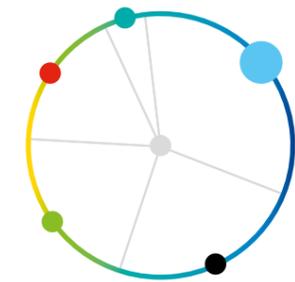


SHAREHOLDERS' INFORMATION



SHAREHOLDERS' COMPOSITION (CONTROLLED CAPITAL)

- 52% Free float
- 40% Groupe Industriel Marcel Dassault
- 6% Charles Edelstenne
- 2% Bernard Charlès



SHAREHOLDERS' COMPOSITION (FREE FLOAT)

- 33% North America
- 24% France
- 21% UK & Ireland
- 17% Continental Europe (excluding France)
- 5% Rest of world

SHAREHOLDERS' CONTACT

Tel.: +33 (0)1 61 62 69 24
E-mail : investors@3ds.com
<https://investor.3ds.com/>

DASSAULT SYSTÈMES STOCK DATA

Listed on NYSE, Euronext Paris and traded on the American OTC market

Member of CAC 40

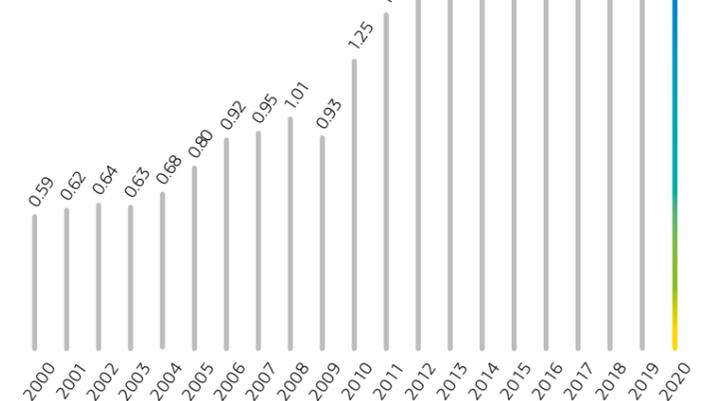
Share price 12/31/2020
● €166.15 ● \$202.48

Market capitalization
● €43.91 B ● \$52.64 B

Comparison of the 1-year stock performance
● Dassault Systèmes +13%
● CAC 40 - 7%
● NASDAQ + 44%

Daily volume of stock traded on Euronext Paris
● 336,989 shares

STEADY NON-IFRS GROWTH (€)



KEY 2021/2022 EVENTS

Wednesday, April 28, 2021 Release of first-quarter earnings
Wednesday, May 26, 2021 Annual shareholders' meeting
Tuesday, July 27, 2021 Release of second-quarter earnings
Thursday, October 28, 2021 Release of third-quarter earnings
Thursday, February 3, 2022 Release of fourth-quarter earnings

ENABLING SUSTAINABILITY WITH VIRTUAL TWIN UNIVERSES

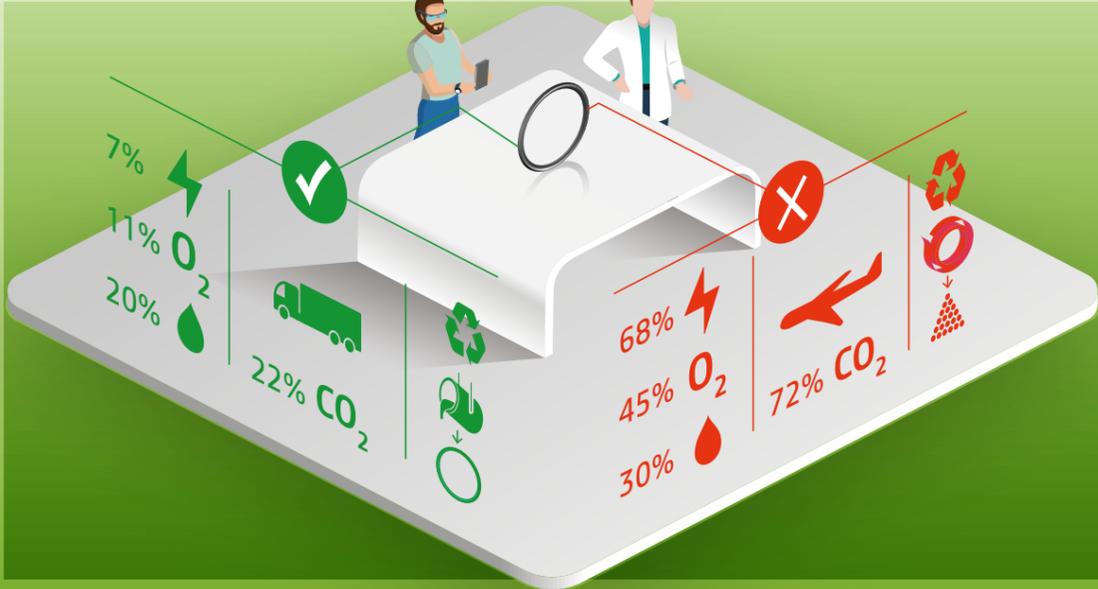
At Dassault Systèmes, we strongly believe that virtual universes will be a key enabler for our customers – and the world – to imagine, design, and test the radically new products, materials, and manufacturing processes needed in tomorrow’s more sustainable economy. However, we know that being a leader in sustainable technology solutions also means being a sustainable technology company ourselves. It’s not only about what we sell, but who we are.

In a whitepaper published in collaboration with Accenture, we found that virtual twin technologies can unlock combined additional benefits of \$1.3 trillion of economic value and 7.5 Gt CO₂ emissions reductions between now and 2030. This technology will be a key enabler for our customers – and the world – to imagine, design, and test the radically new products, materials, and manufacturing processes of tomorrow’s sustainable economy at the fastest possible speed.

In Construction, Cities and Territories for example, virtual twins can help reduce energy consumption in buildings by 30 - 80% by optimizing day-to-day activities.

In Consumer Packaged Goods, design decisions can be linked to 80% of a product’s environmental impact. Using virtual twin technologies at this critical stage of product development can help significantly reduce a product’s footprint.

The growing problem of e-waste in High-Tech could be solved through the use of virtual twin technologies, which can increase overall e-waste recycling rates by making information available to value chain participants downstream on material and chemical content of specific products.



SUSTAINABILITY PERFORMANCE

Dassault Systèmes not only provides customers with sustainable technology solutions – we also strive to be a sustainable company ourselves. We are committed to improving the impact of our environmental, social and corporate governance practices.

KEY 2020 RESULTS

98.4%
of employees have completed Ethics & Compliance training

38.5%
of women in the Executive Committee

4.1 teqCO₂
per FTE of carbon intensity, down 39% from 2019 (includes COVID-19 impacts)

82.5%
employee pride and satisfaction rate measured by an internal annual survey

KEY RANKINGS

#33
Forbes Top 50 World’s Best Employers (2020)

AA
MSCI ESG Ratings (2020)
Company’s resilience to long-term, financially relevant ESG risks

#2
Fortune Future 50 Sustainability All Stars (2019)

#21
Corporate Knights Global 100 Most Sustainable Corporations in the World (2020)

#2
in its peer group (Software and Related)

TAKING CARE OF PEOPLE AND ENGAGING WITH THE WORLD, DASSAULT SYSTÈMES' INITIATIVES TO COMBAT COVID-19

From the beginning of the pandemic, Dassault Systèmes undertook to provide practical solutions to its customers, its partners, its employees and the communities in which it operates.



FOSTERING BUSINESS CONTINUITY

The **3DEXPERIENCE** cloud platform helped customers keep their operations running remotely. The COVID-19 pandemic also highlighted the vulnerability of certain supply chains, whereas our platform provides an end-to-end solution for defining, planning and executing supply chain processes, from manufacturing to last-mile delivery. **EXALEAD-NETVIBES** provides an organization and management solution for critical assets (p. 71).



SUPPORTING SCIENTIFIC RESEARCH

Dassault Systèmes' solutions played a major part in helping to make vaccines available so rapidly. For example, **BIOVIA Discovery Studio's** modeling and simulation techniques allow users to explore the nuances of protein chemistry (p. 33), and the Moderna vaccine was developed on **MEDIDATA's** cloud platform (p. 35), which also hosted the Migal Galilee Research Institute's study of virus mutations (p. 35).



KEEPING PEOPLE SAFE AND SECURE

The **3DEXPERIENCE** platform made a vital contribution, helping to guide the pandemic response, plan ahead for and manage trends across the regions of France (p. 45). It helped to assess virus dispersion in a Wuhan hospital study (p. 46) and simulated virus circulation in all facilities open to the public (p. 47 and 49). The platform also is used to design and manage hospitals specially adapted to combat COVID-19 and provide local disinfection facilities.



MAINTAINING TRAINING

Dassault Systèmes offered secure virtual classes on the **3DEXPERIENCE** platform with special access for teachers. Under the Always on program, it also provided access to **CATIA** and **SOLIDWORKS** licenses for students learning remotely.



HELPING ENTREPRENEUR AND EDUCATIONAL COMMUNITIES

The **3DEXPERIENCE** Lab provided support to over 150 teams under the Open COVID-19 Community and helped accelerate the development of their projects by connecting them to an open community of 300,000 designers, manufacturers and specialists (p. 82). **La Fondation Dassault Systèmes** launched an emergency initiative providing support to hospitals and medical research centers (p. 83).



REALIGNING INTERNAL ORGANIZATION

Lastly, Dassault Systèmes used its platform to roll out collaborative working for all its professional processes in order to encourage interactions, data sharing and collective design. The reopening of buildings around the world were managed to a high degree of precision, with occupancy levels in each office planned on a daily basis using the **3DEXPERIENCE** platform.

THE ONLY PROGRESS IS HUMAN

/// Dassault Systèmes’ “The Only Progress is Human” initiative, launched in February 2020, aims to raise awareness of today’s social and environmental challenges and to encourage the use of virtual tools to promote sustainable innovation. It involves a series of ten challenges. With its second act – entitled “Water for Life”, which addresses challenges related to water and its consumption – Dassault Systèmes is contributing to the UN’s Water Action Decade initiative. It is taking action in three areas to enable manufacturers, and not just institutions, to take part in the initiative.

As part of this effort, Dassault Systèmes is proposing, through the use of virtual worlds, to help measure and minimize companies’ water footprints, to support the development of sustainability-driven innovation and to better prepare future generations in terms of their knowledge of this key resource. With Mike Horn, a world-renowned explorer who is committed to preserving our planet, Bernard Charlès launched this second act with a video that combines the virtual and real worlds.

Overconsumption of fresh water is one of the greatest threats facing the world today. The irresponsible use of water when producing consumer goods and services threatens the availability of resources, which is why several of the UN’s Sustainable Development Goals relate to water, sanitation and aquatic life. Dassault Systèmes wants to help its clients gain a better understanding of their impact on water resources, and to work to create more sustainable approaches to water consumption throughout their products’ lifecycles.

Simply consuming less water is not enough to resolve these issues. We also need to innovate and find sustainable solutions. This is what Dassault Systèmes wants to encourage through its **3DEXPERIENCE** Lab, an open innovation incubator that encourages creators and enthusiasts developing practical solutions to major issues. One of the Lab’s most recent partners is OceanHub Africa, an organization whose mission is to help young companies that want to protect the oceans, whether directly or indirectly.

Changing our approach to water also means changing the mentality and skills of future generations. Dassault Systèmes is committed to education through its **3DEXPERIENCE** Edu department, which gives five million students access to Dassault Systèmes solutions every year, and helps professionals hone their skills throughout their lives. In addition, La Fondation Dassault Systèmes, which is supporting efforts to drive change in the fields of education and research, has made the ocean the central theme of its Mission Ocean education program.

Victoire de MARGERIE
Vice-President Corporate Equity,
Marketing & Communications



Act II & III **WATER FOR LIFE** How can we consume smarter and protect our most precious resource?

We urgently need to safeguard water resources given the world’s growing population. A number of global initiatives are set up to encourage companies, governments and communities to come together to drive positive change. Dassault Systèmes decided to make water, and the ways in which consumption affects water resources, the new focal point of its “The Only Progress is Human” campaign. “Water for Life” is showing how virtual worlds are powerful accelerators, helping companies to measure and minimize their water footprints, supporting the development of sustainability-focused innovation and educating future generations about safeguarding this essential resource.

Act I
EMOTION
How can virtual worlds change the way we experience emotions?

Act IV
CITIES
How can cities adapt to our ever-growing urbanization?

Act V
ENERGY
How can we create an energy-positive world?

Act VI
MOBILITY
How can we reduce our footprint as we move through the world?

Act VII
NATURE
How can we learn from Nature to innovate sustainability?

Act VIII
HEALTH
How can we create preventive healthcare tailored to each patient?

Act IX & X
HERITAGE & FUTURE
How can understanding the past help us better navigate the future?



WE
ARE
WHERE...

Our solutions supported the healthcare sector amid the COVID-19 pandemic as specialists pushed ahead with research, clinical development and then the production of vaccines in record time. We consistently helped smooth the design and development process for medical and surgical solutions tailored to individual patient needs.

SCIENCE
PROTECTS
LIVES



2020 and the COVID-19 crisis proved the wisdom of Dassault Systèmes' acquisition of Medidata, which was completed in late 2019. This acquisition – the largest in Dassault Systèmes' history – fits perfectly with our long-term strategy, at a time when life sciences are undergoing major transformation. The combination of virtual technologies, analytics and artificial intelligence is a powerful tool when seeking to visualize the molecular structure of a virus or to achieve innovation in clinical trials. The patient-centric healthcare model requires a better understanding of the human body's complexity, from DNA to cells, tissue, organs and the organism as a whole. In addition, surgery is entering the era of digital simulation. The virtual twin of humans is becoming a reality to help prepare for procedures and design the medical devices that a patient needs – make in order to prevent illness, provide care, target treatments and repair damage where necessary.



The virtual twin of healthcare to help people live healthier lives

Throughout 2020 and all around the world, we saw healthcare systems come under enormous pressure. The COVID-19 crisis also showed us how much virtual twins have revolutionized the whole sector, from carrying out research to caring for patients. The life sciences industry's response was unprecedented. It worked in a collaborative and rapidly adaptable way, which is why it was possible to produce vaccines in only nine months, whereas it usually takes 15 years. 2020 was also the year in which Bernard Charlès revealed our ambition of moving "from things to life". What difference is there between a manufactured object and life? Life is not made up of spare parts, it cannot be standardized, it's personalized by its very nature.

In healthcare, it's crucial to have a relevant model, calibrated by real-world data. Because to understand the human body, whether it's in good or poor health, we need to bring together a set of very different scientific and medical disciplines, taking a holistic approach to individuals, their experience and their context. Our aim is to get all of these disciplines working together, so that we can visualize, understand, test, and predict what cannot be seen – from the way drugs affect a disease to surgical outcomes – before a patient is treated. We want to improve the patient's overall experience, and this is made possible by the Dassault Systèmes and Medidata innovation platform, the only business and science-based platform to power the innovation cycle end-to-end.

With the **3DEXPERIENCE** platform, our aim is to serve the whole healthcare ecosystem. Together, we are bringing together knowledge and know-how, we are disseminating medical best practice, we are visualizing and predicting responses to particular treatments and interventions. Naturally, patients are central to this vision and so we must address matters of trust, ethics and personal data protection. With the combined power of brands such as MEDIDATA (which is involved in 60% of the world's COVID-19-related clinical trials), BIOVIA, SIMULIA, CATIA, SOLIDWORKS, DELMIA and NETVIBES, we are powering access to vaccines and therapies all around the world, for everyone.

To deal with future crises, however, the industry needs to become more agile. We have a wonderful opportunity to transform it: in the world of precision medicine,



the patient is at the center and every aspect – from how a therapy is designed to how it's administered – must be reconsidered. Current systems are not set up to deal with the complexity of the production process, or the need to make adjustments very rapidly.

Dassault Systèmes' 4,000 life sciences and healthcare professionals are united in pursuit of that objective, and have the unique advantage of being able to combine the power of virtual worlds – using modeling and simulation technologies – with advanced analytics and data (clinical & real-world). Just as there was a time before and a time after the Boeing 777, there will be a time before and a time after the virtual twin of the human body.

Tarek SHERIF
Co-founder and co-CEO, Medidata
Chairman of the Life Sciences & Healthcare Board

“ The way we provide knowledge to practitioners will be influenced by the quality of the data, greater engagement and artificial intelligence. ”





PATIENTS PLAY AN ACTIVE ROLE IN CLINICAL TRIALS WITH MYMEDIDATA

myMedidata is a new platform that can acquire data from various sources, from treatments as well as from direct interactions with practitioners, and so can play a major role in patient-centric research. myMedidata comprises all Patient Cloud tools and the Rave platform, both of which comply with current regulations. myMedidata also includes eConsent, an electronic system for obtaining patients' consent to take part in clinical trials; eCOA (electronic Clinical Outcome Assessments), a tool for assessing the results of clinical trials; ePRO, which is used to integrate results obtained electronically from patients; wearable sensors, which collate data collected by biosensors and wearable tech and virtual trials.

	Subject	Consent	Screening 24 Jul 2020	Visit 1 24 Jul 2020	Visit 2	Visit 3	End of Study	Supply Accountability Log	Imaging Summary Data	Sensor Data
Subject	●									
Subject Consent Status		○								
Consent Document Status		○								
Visit Date			●	●	○	○	○			
Demographics			●							
Pregnancy Test			●							
Imaging Assessments			○							
Medical History			○							
Physical Examination			○				○			
Vital Signs			●	●	○	○	○			

More than **23,000** clinical trials have already been carried out using MEDIDATA solutions

More than **40%** of clinical trials around the world rely on MEDIDATA solutions

A new dawn and mobilization around healthcare

Although MEDIDATA initially focused on processing data produced by clinical trials, we also use data from other sources. In 2020, hundreds of millions of patients and thousands of researchers had active, simultaneous access to more than 30 terabytes of raw data, generated from sources that are updated daily, within the MEDIDATA environment. The system uses billions of documents, and we are proud to be part of this new era for the whole of society and the mobilization around healthcare in general.

New methods and tools will emerge in all therapeutic areas. Before COVID-19, everything worked on the assumption that the caregiver and patient would be present in the same room. That's what happens when a patient volunteers to take part in an on-site clinical trial or, even more frequently, when a patient consults his or her doctor. But this was not the right assumption. We are now seeing a wave of innovation around virtual trials and new ways of thinking about research.

Precision medicine originated in the field of oncology, based on analyzing the molecular and genetic characteristics of tumors. Research has shown how genetic damage occurs within normal cells, triggering the processes that lead to cancer, which vary from patient to patient. Progress with genome sequencing has allowed us to develop molecular tests and therapies that target these cancer-causing phenomena. These are examples of a convergence of biological and digital domains.

“The transition to genuine precision medicine will transform the way we carry out research and the way we think about data.”



However, precision medicine creates a paradox. Precision medicine means, almost by its very nature, that there will be a decreasing number of patients benefiting from the therapies it produces. The more precision we achieve, the more closely we define the patient population, the more data we need to collect, and the harder it is to collect them and generate the evidence required. The transition from therapies based on large cohorts to genuine precision medicine will transform the way we carry out research and the way we think about data. And when I talk about convergence, I'm also thinking about how we can represent the various therapies on a Venn diagram, with one set corresponding to molecules, another to medical devices and another to digital therapies. Convergence means that the intersections between these various sets will increase. Finally, we must ask questions about access to care: How do we offer therapies to patients in a fair way, regardless of their socioeconomic circumstances and geographical situation?

Glen DE VRIES
Co-founder and co-CEO,
Medidata



When data save lives

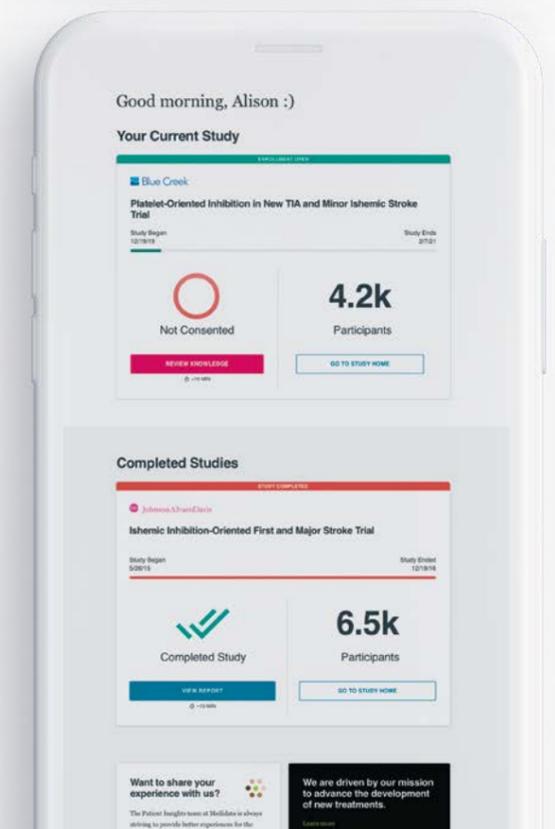
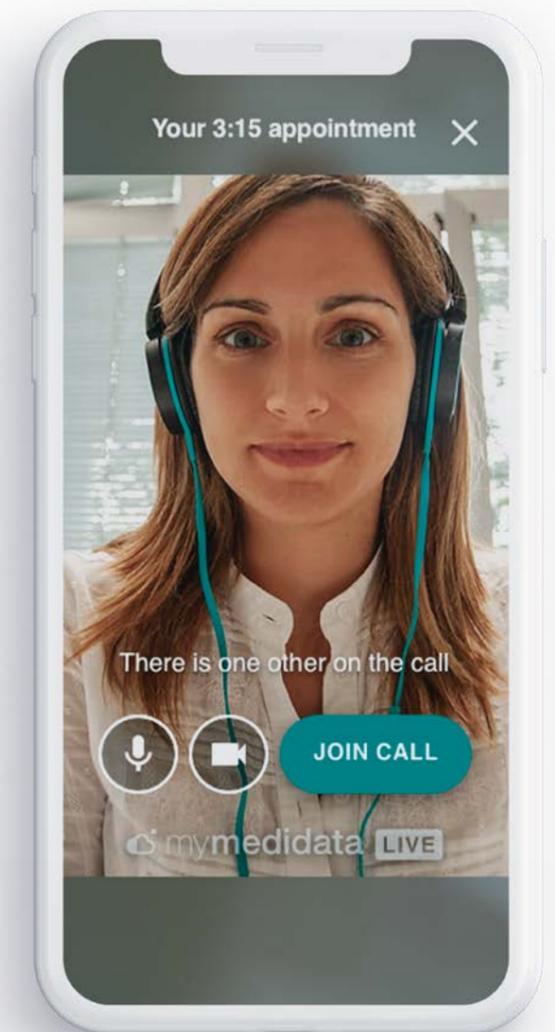
Using data that come from various and sometimes heterogeneous origins, sources (and formats, and which are generally not in a coherent, combined form) represents a very promising area of medical research. When these data are restructured and cross-referenced, mutual enrichment takes place and they become a real asset when seeking to make therapeutic progress. When studying COVID-19, for example, researchers used databases consisting of reimbursement requests made to insurance companies and demographic and lifestyle-related data produced by credit institutions and governments. These data, alongside those produced by laboratories, have been and are still being used to support studies of how COVID-19 affects specific groups of people and to predict hospitalization rates.



However, when we talk about the widespread use of cross-referenced, restructured and aggregated data, we immediately run into the question of confidentiality. Data do not consist of abstract figures but are intimately linked to the experiences of patients and citizens. The use of personal data must be clearly circumscribed; but if the rules are too strict, this will prevent effective use of the data; for example, if rules prevent singularization, correlation and inference. Singularization means the ability to identify, within a group, the person to which the data refer. Correlation means the ability to connect data from various sources to a single person. And inference means the ability to deduce something about a person simply because he or she is part of a group. Even if the person in question cannot be named, the data set cannot be regarded as anonymous if any of these three elements is possible.

Maintaining medical secrecy and confidentiality

In addition, pharmaceutical and IT companies are working on solutions that allow people to take part in studies remotely or from home. As a result, new issues are raised around obtaining patient identification and consent, as well as maintaining medical secrecy and confidentiality. Remote services must take place with the same level of confidentiality as if they were happening face-to-face behind closed doors in the doctor's office or clinic. Complete segregation of the data, involving both physical and logical separation, is probably part of the solution. When carrying out clinical trials, major pharmaceutical companies send personal data around the world, for example, in order to submit data to regulators and to comply with legislation. After marketing authorization has been obtained, data from several countries must be assessed for pharmacovigilance purposes. As a result, legal ways of transferring data, for example from the European Union to the United States, are needed.



MYMEDIDATA ECOA

- Online eCOA
- Patients connect to myMedidata to fill in all necessary patient data forms
- Patients can access their personal assessments

MYMEDIDATA ECONSENT

- Online consent allowing patients to sign up virtually for a new trial
- Video guide and appropriate consent documents provided before virtual signature

RAVE ECOA

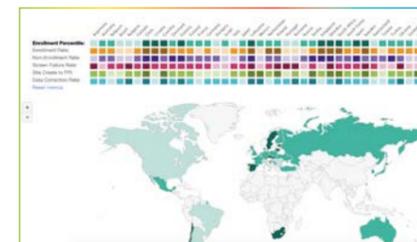
- Account access during the clinical trial
- Electronic assessment of clinical results (Clinical Outcome Assessment)
- Patients fill in forms online

SENSOR CLOUD

- Rapid integration of medical-grade sensors and devices
- Incorporation and analysis of data from any digital health technology
- Standardization of data via a common model

MYMEDIDATA LIVE

- Direct videoconferencing with clinical trial staff
- Alternative to scheduled on-site meetings
- Data input into Rave EDC by the clinical research team



Processing and using data

MEDIDATA subsidiary Acorn AI uses unparalleled clinical data, advanced analytics and deep human expertise developed over 20 years to propel life sciences companies growth by accelerating insights and speed to market. In particular, the Intelligent Trial solution provides cross-industry, real time operational clinical trial data, enabling customers to gain a competitive edge as they execute clinical trials with increased agility. Synthetic Control Arm®, MEDIDATA's external control arm solution, uses historical, cross-industry patient-level clinical trial data to replace or supplement control arms, especially in diseases lacking clinical equipoise. Thus, Synthetic Control Arm can speed clinical development in situations in which traditional randomized controlled trials are not feasible, or impose undue patient burden.

After acquisition and processing, the use of synthetic control arm also requires special expertise in the data. MEDIDATA Detect is a centralized statistical analysis tool whose algorithms help researchers assess clinical data by focusing on their quality and patient safety. In particular, the solution allows data to be standardized, aggregated and collated from different, complex user experiences and from disparate and heterogeneous sources. MEDIDATA has simplified these advanced analyses by adopting a platform approach, with data being transferred automatically to the cloud, without it being necessary to extract or upload data.

Informed patient consent

When patients take part in a clinical trial, they go through several stages, starting with the informed consent process. Thirty-five percent of potential patients refuse to take part in a clinical trial because they say that they cannot understand the information provided to them. Patients using paper-based consent systems show a lower rate of understanding than those using electronic consent systems, which allow information to be provided via various modes of communication.

With eConsent – the electronic, remote consent solution developed by MEDIDATA – patients spend more time finding out about the clinical trial and gain a better understanding of the aims, advantages and risks of a study and of their own rights and responsibilities. This means that eConsent improves both patient education and patient commitment, and also leads to greater compliance and retention rates during the study.

// The European Data Protection Board sets out the legal bases on which we can rely for the data processing.



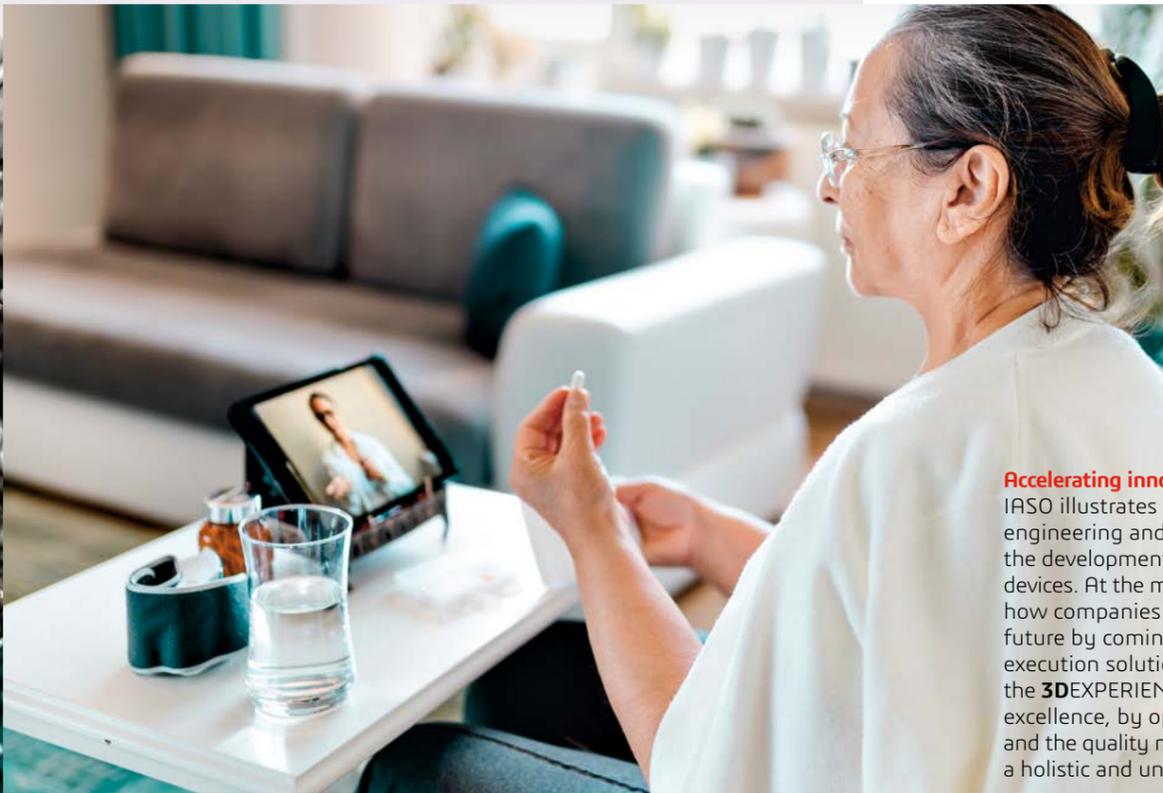
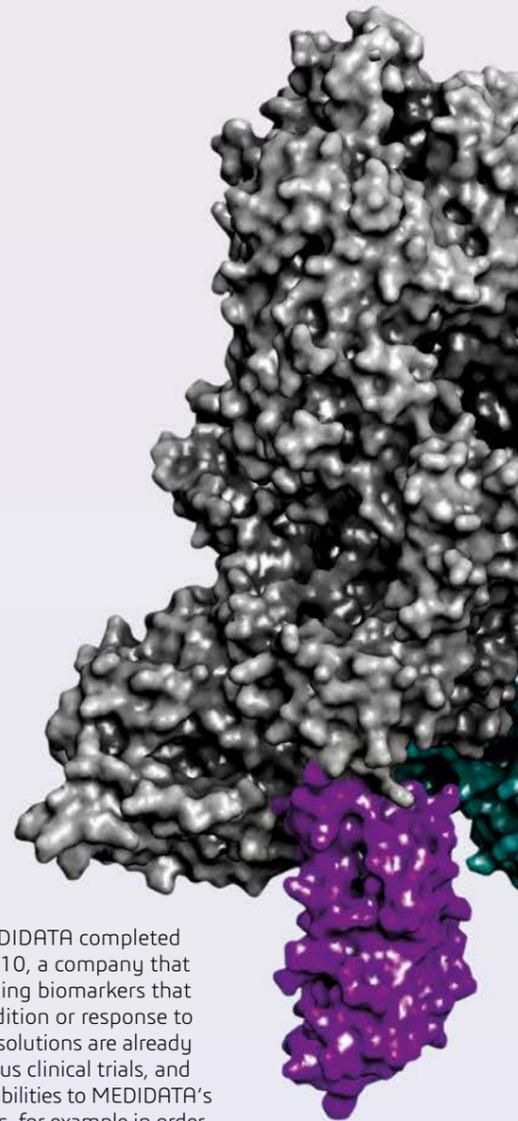
Translational medicine, targeted therapies and omics sciences

Dr. David Fajgenbaum has changed the way Castleman disease is understood and treated. He had been diagnosed with a form of the orphan disease itself (idiopathic multicentric Castleman disease), and is now in remission because of a precision treatment he identified. He set up and runs a foundation called the Castleman Disease Collaborative Network, which aims to accelerate research and development of treatments for this illness through a collaborative network approach, using both translational medicine and targeted therapies. This has become a model for other rare diseases. The approach integrates patient perspectives to guide high-impact research and identify treatments that can be repurposed for Castleman disease. Omics sciences – such as genomics, proteomics, transcriptomics and metabolomics – have made it possible to develop new technologies, such as biosensors, diagnostic tools and treatments. As Dr Fajgenbaum says, “integrating clinical data using the MEDIDATA Omics platform has genuinely transformed our analysis and interpretation of proteomics data.” The approach has saved his life, and the lives of thousands of other patients.



In October 2020, MEDIDATA completed the acquisition of MC10, a company that specializes in developing biomarkers that show a patient’s condition or response to a treatment. MC10’s solutions are already being used in numerous clinical trials, and add new analysis capabilities to MEDIDATA’s Patient Cloud solutions, for example in order to enrich data provided by patients (ePRO) and to assess clinical trial results (eCOA). This will provide the healthcare industry with even more ways of managing clinical trials virtually. When data taken from the real world can then interact with the real world, for example through medical devices, they become much more powerful.

As part of the research on devices, IASO, which takes its name from the Greek goddess of recuperation from illness, is a showcase that illustrates the lifecycle of a biological product combined with an auto-injector platform, intended for the oncology market. It shows the value that the 3DEXPERIENCE platform can add for those seeking to innovate in the field of medicine or life sciences combined with medical devices.

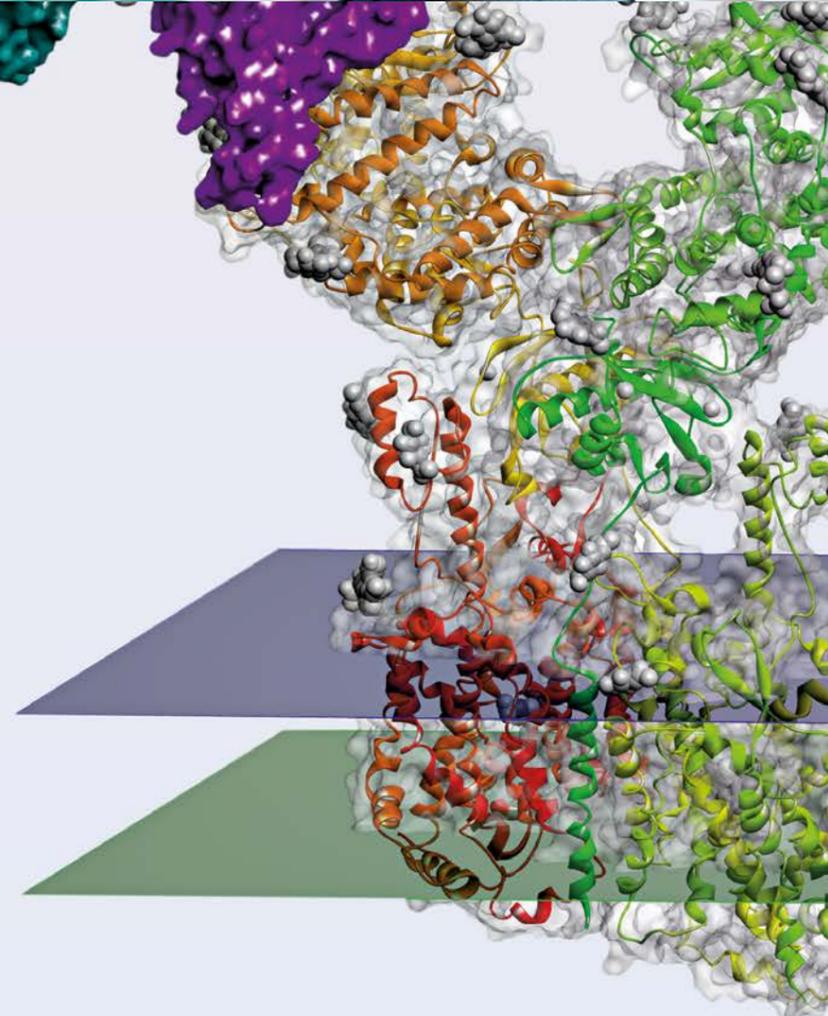


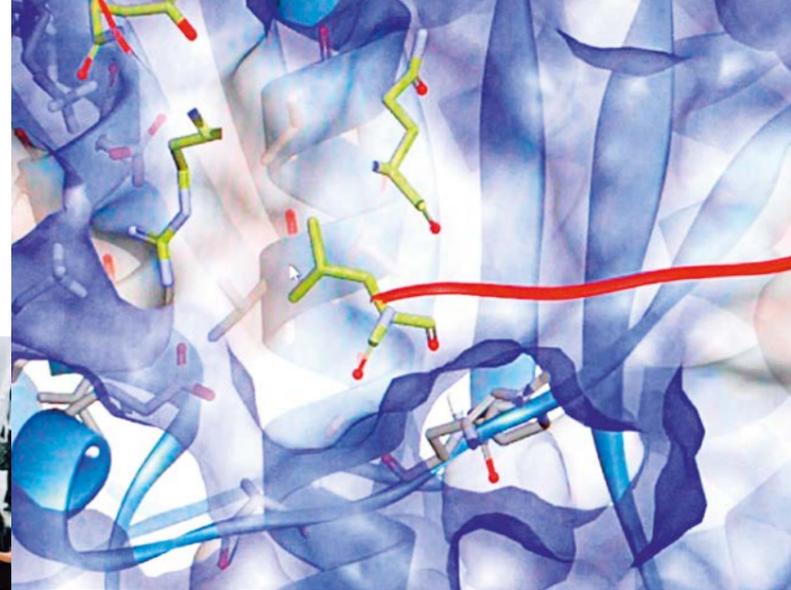
Accelerating innovation with *in silico* experimentation

IASO illustrates how 3D design, collaborative engineering and digital simulation advance the development of drug candidates and medical devices. At the manufacturing stage, IASO shows how companies can develop the plant of the future by coming up with new planning and execution solutions. Finally, IASO shows how the 3DEXPERIENCE platform promotes operational excellence, by optimizing regulatory activities and the quality management system and by providing a holistic and unified view of the patient experience.

Using physical experiments alone is not economically viable, particularly in a rapidly evolving situation like COVID-19. Scientists need a better understanding of how antiviral therapies and vaccines work. To help scientists identify molecules with new properties, BIOVIA has developed BIOVIA Discovery Studio, a modeling and simulation environment that provides a full set of tools, including biological product design and analysis methods, traditional simulations, structure- and fragment-based drug design and virtual screening. The solution also allows users to simulate a drug’s pharmacokinetic properties (absorption, distribution, metabolism and excretion or ADME) and predict its toxicity.

This model was built with BIOVIA Discovery Studio using PDB structure 6M17 (Human ACE2 receptor in complex with RDB domain from Sars-CoV-2 Spike protein) and 7DK4 (Sars-CoV-2 Spike protein in pre-fusion stabilized conformation with two RBD domain up) and superimposing both structures on the common RDB domain.





Modelisation of a molecular research for the COVID-19 vaccine by the Migal Galilee Research Institute

500,000 people are likely to be enrolled in longitudinal COVID-19 studies in the United States.

30,000 patients have taken part in Phase III trials of Moderna's COVID-19 vaccine.

Producing usable scientific information

The Migal Galilee Research Institute in Israel has been using BIOVIA solutions for four years as part of multidisciplinary research in projects to develop vaccines against avian coronavirus. When COVID-19 became a pandemic, this university research center – specializing in plant science, precision agriculture, environmental sciences, information technology, nutrition and biotechnology – started using these applications and calculation tools to study mutations in COVID-19. The Institute uses a digital approach to managing experiments. Researchers can quickly analyze data collected over the last four years and model the behavior of viral proteins. Using this method, they can better understand new trial results with reference to previous research, and decide which strategies to use in future. More specifically, the BIOVIA Pipeline Pilot solution with its machine learning capabilities can streamline the research innovation cycle by supporting the rapid deployment of data science workflows, accelerating the production of usable scientific information. At the same time, BIOVIA Discovery Studio offers comprehensive modeling and simulation techniques that allow scientists to explore the nuances of protein chemistry, helping them discover and develop therapies based on large and small molecules.

Data captured by patients

When carrying out trials on its messenger RNA COVID-19 vaccine, Moderna used MEDIDATA's Rave Clinical Cloud platform. Working with the urgency required to address the global pandemic, Moderna's teams used MEDIDATA's cloud platform across the various stages of development. The clinical trial is one of the largest ever to integrate data captured directly by patients, which meant that attendance at medical centers was reduced. In addition, virtualization allowed participants to use their own devices, avoiding the need to carry a device provided by the medical team. Moderna has used several of the Rave platform's

technologies, including Rave EDC for electronic data capture, Rave eCOA for the electronic assessment of clinical results, and Rave Detect for centralized statistical analysis.

Using these methods, future clinical trials will maximize patients' chances of quickly obtaining a revolutionary and successful therapeutic solution. Because in the end, all of these advances are pursuing the same objective: improving the patient pathway in terms of medical treatment, whatever it may be, but also surgery and prosthetics.



|| We are using BIOVIA Discovery Studio and Pipeline Pilot to extend our research and enrich our IT tools.

Itai BLOCH
Computational chemist,
Migal Galilee Research Institute



A prosthetic leg allowing people to continue doing what they love

The core aim of BioDapt is to develop ever more effective high-performance prostheses for athletes and people practicing outdoor sports, to develop ever more effective and resilient high-performance prostheses. For as long as he can remember, CEO Mike Schultz has loved motorsports, motocross and snowmobile racing. He eventually achieved his childhood dream of becoming a professional snowmobile racer, but in 2008, during an international competition, he suffered a major leg injury. The only way of saving it was to amputate around four inches above the knee.

In the spring of 2009, Schultz stood up on his first prosthetic leg. A few months later, he realized that he would need a more elaborate prosthesis if he wanted to resume practicing the sport he loved. And he was confident that he could design it himself. He knew better than anyone how his body needed to perform if he was to become an elite sportsman again. He also knew how the suspension and mechanical components of his vehicles worked. The leg he designed using these twin insights allowed him to win the silver medal in the supercross event in the Summer X Games, seven months after his accident.

It was then that Schultz understood that his prosthesis could help other amputees. In early 2010, he founded BioDapt, a company aiming to create the most high-performance lower-limb prostheses in the market, intended for use in action sports and motorsports. "SOLIDWORKS makes the process so much easier and quicker and allows us to do so many more things," Schultz enthuses. "We can build the assemblies virtually and then digitally test them with SOLIDWORKS Simulation to see where the weak points are." The solution also allows the BioDapt team to design collaboratively, both in the office and while traveling, which Schultz often is.

His wife, Sara, has seen the joy that these prostheses give to patients: "You see them light up because now they have the opportunity to do what they love to do, and they tell Mike, 'You have changed my life.'" In the 2018 Winter Paralympics, all nine athletes who made it onto the podium in one of the snowboarding events – winning a total of 11 medals between them – were using BioDapt equipment. Today, the company's Moto Knee can be used for snowboarding, skiing, cycling, motocross, driving all-terrain vehicles, strength training, horse-riding and watersports. And the list is continuing to grow as BioDapt's research and development progresses.

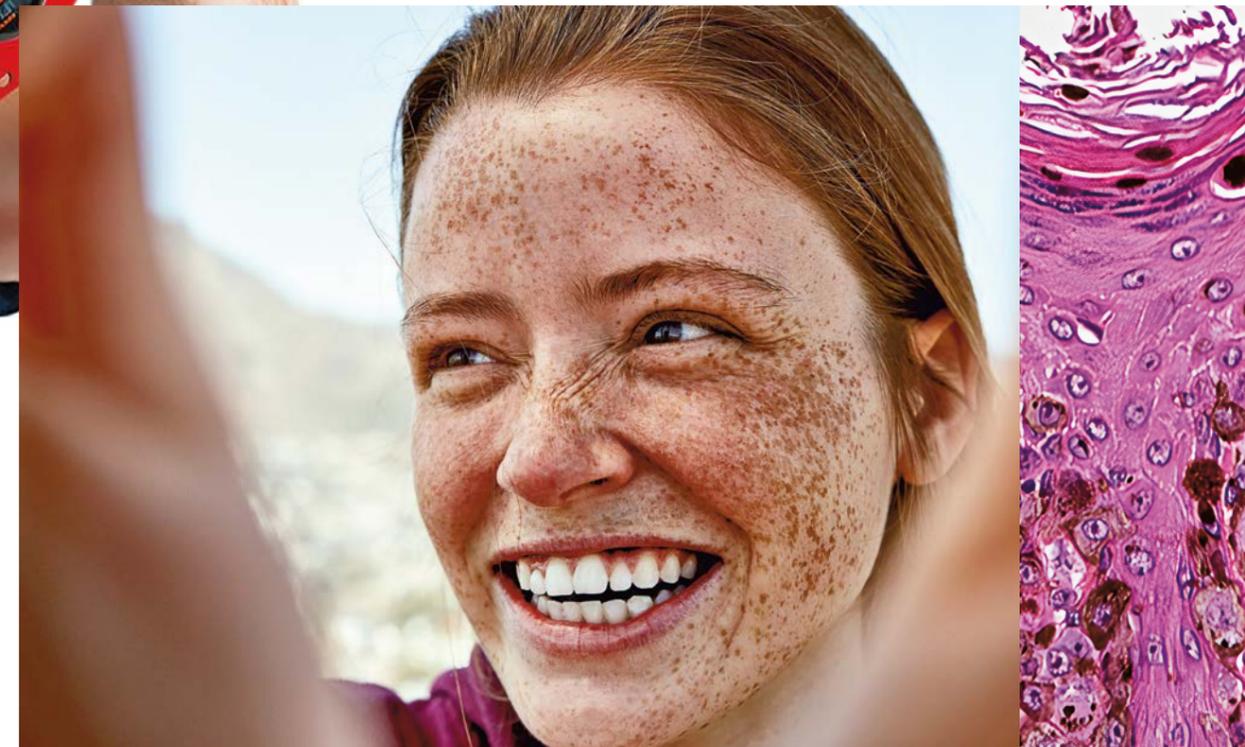


SEEING BEYOND APPEARANCES WITH DAMAE MEDICAL

Skin cancer is the most common form of cancer, and exists in two forms: carcinoma and melanoma, with the latter being the most serious. Late diagnosis reduces the chance of survival, and every year more than 10,000 people die of skin cancer in Europe. The incidence of melanoma in the general population has been rising for several decades: since 1945 it has doubled every 10 years. DAMAE Medical helps diagnose skin cancer at an early stage and in real time. The company has developed a new portable imaging device that allows non-invasive 3D imaging of cutaneous tissue. Just placing the device on the skin allows it to generate



real-time images very similar to traditional histological images. The portable device uses a patented approach that combines optical coherence tomography (OCT) and reflectance confocal microscopy (RCM), called LC-OCT (Line-field Confocal OCT). This French startup has been supported by Dassault Systèmes' 3DEXPERIENCE Lab program since November 2019.



LUCID IMPLANTS AND 3DEXPERIENCE

LUCID Implants uses the 3DEXPERIENCE platform to design personalized implants and carry out immersive surgical planning. The platform is also used for the cloud quality management system, particularly for the in situ monitoring of machines, data capture and part traceability, and for inventory and logistics management, sales management and financial reporting. LUCID Implants has been supported by the 3DEXPERIENCE Lab program since March 2020.



No two individuals have the same facial anatomy

LUCID Implants is an Indian medical technology company that provides personalized surgical solutions. Its teams design, develop, manufacture and sell craniomaxillofacial and neurosurgical implants that are custom-made and individually fitted to adapt precisely to each patient's specific anatomy. LUCID's complete solution includes virtual planning for 3D presurgical simulations, personalized anatomical models for evidence-based simulated assessments, patient-specific preoperative surgical guides to ensure absolute precision and customized implants for a perfect fit.

No two individuals have the same facial anatomy, whereas all conventional implants are mass-produced. Often, the surgeon tries to adjust the patient to the product rather than the other way around. In traditional facial reconstruction procedures, the practitioner must choose a commercially available implant, such as titanium mesh, or harvest an autologous bone graft taken from the patient's own body with a size and shape that the surgeon thinks will work best for the patient. These solutions lead to problems such as increased risk, poor aesthetics and low patient quality of life. LUCID's personalized solutions also allow full control over the surgical procedure and the value chain, minimizing tissue damage, the length of hospital stays and the cost of care.



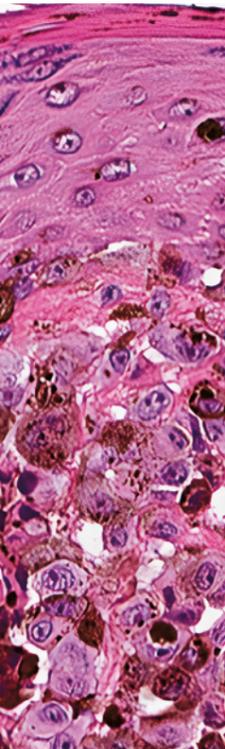
REPAIRING A CHILD'S HEART

Dr. David Hoganson, a cardiovascular surgeon at Boston Children's Hospital, was born with a congenital heart defect that required cutting edge open heart surgery. After working several years as an engineer, he pursued cardiovascular surgery before further specializing in pediatric cardiac surgery. As a surgeon, he does innovative work with newborn babies and children with congenital heart disease, often adapting procedures intended for use in adults. In particular, Dr. Hoganson developed revolutionary transplantation therapies and lung tissue engineering protocols.

Further he has pioneered the use of a patient's virtual twin to model complex cardiac configurations prior to treatment, allowing the surgical team to simulate various surgical scenarios in silico. For example, Dr. Hoganson's team can simulate how blood flow will change depending on different repair

or reconstruction approaches, helping them select the most effective surgical option. In complex cases, synthetic patches can be designed and tested on the virtual twin to precisely match the patient's morphology and ensure optimal outcomes. He is also revolutionizing the patient experience by combining virtual twins and virtual reality to help patients and their families better understand the condition and participate in the treatment plan.

By combining his personal experience, engineering background and medical training, Dr. Hoganson is creating new possibilities for complex treatments, giving hope to many families whose children may now thrive when otherwise they might not even survive.



WE
ARE
WHERE...

Digital innovations are helping city planners rethink the built environment and embrace a more sustainable and resilient urban universe. These solutions help engineers, architects and local authorities to design, build and manage efficient, eye-catching and open structures and urban systems, helping to safeguard the quality of life for future generations.

CITIES
TAKE
SHAPE

Most creativity is converging around the city of the future. Two thirds of humanity will be living in cities in 2050, so urban settings will be the focal point for most creation, both imaginative and practical. This is where our future lies: one that must be sustainable, where products, nature and life exist in harmony.

The challenge is significant, because cities are the most complex of human creations. We cannot treat them simply as objects. They are the venues of an entire life experience: material flows (transport, energy, waste etc.), a balance between resources and spaces of various kinds, and of course life scenarios that include health, work, housing and safety. Improving our infrastructure and our cities means rising to the major challenges that will determine the quality of life, attractiveness and leadership of a community. It means working on all parts of our economies.

A community is a system. It's multi-disciplinary, multi-level. From mining to construction, from the design of innovative materials to the work done by local authorities, we must think of a community as a system that includes services, resource management and planning, driven by usage flows and virtual models, in a data economy. Communities represent new value networks, new business models, new knowledge. We can see this clearly in value networks that involve new energy infrastructure. Transformation must be supported by fresh innovation, using all the tools that science and engineering have to offer.

For 40 years, Dassault Systèmes has been pushing back the boundaries of complexity in innovation when it comes to aircraft, production systems, even the human heart. We also are rising to this challenge with communities. It's clear that the future of infrastructure and cities depends on virtual universes and collaborative platforms. Tomorrow, no one will think about or manage any community without taking into account its virtual twin.

As well as using technology, we must bring citizens, governments and businesses together to develop solutions that allow sustainable urban development and a better quality of life, addressing regulatory, educational and scientific needs. With its **3DEXPERIENCE** collaborative innovation platform, Dassault Systèmes allows users to design, simulate, plan, develop, analyze and manage the communities of tomorrow. Virtual twin experiences (dynamic digital models), fed by a huge set of geometric, topological, demographic and climate data, allow users to simulate scenarios and create experiences, and eventually to find sustainable solutions to all these challenges.

For example, by making a building off-site, we can reduce construction time as well as the building's carbon and materials footprint, while also offering a viable business model for both consumers and the building industry. Also, the positive impact of an electric vehicle can be increased by integrating it into a smart grid, increasing the proportion of intermittent renewable energies accepted by the grid.

In the experience economy, the infrastructure of tomorrow is determined by uses. Let's invent the uses of tomorrow.

Sylvain LAURENT
Executive Vice-President,
Chairman of the Infrastructure & Cities Board



MODELING AND MANAGING POWER GRIDS

ModeliScale is a collaborative and innovative project led by Dassault Systèmes, at the place where the worlds of academia and industry meet. The project plan is to create a virtual twin of an entire energy system, covering generation, transmission, supply and use. The aim is to simulate scenarios in order to plan the scale of the facilities required and how they will be managed at the building, district or city level. Power grids are increasingly decentralized and are involving more participants and consumers. The gradual inclusion of new sources of power generation and consumption is changing the architecture of these grids. The use of vehicle batteries to store power means that the future energy mix will have to be managed with great precision, requiring new modeling and simulation capabilities. ModeliScale is rising to the challenge by using CATIA Systèmes' ModSim (modeling and simulation) solutions, with support from Bpifrance and Région Île-de-France.



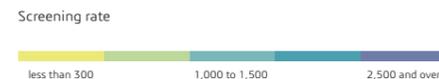
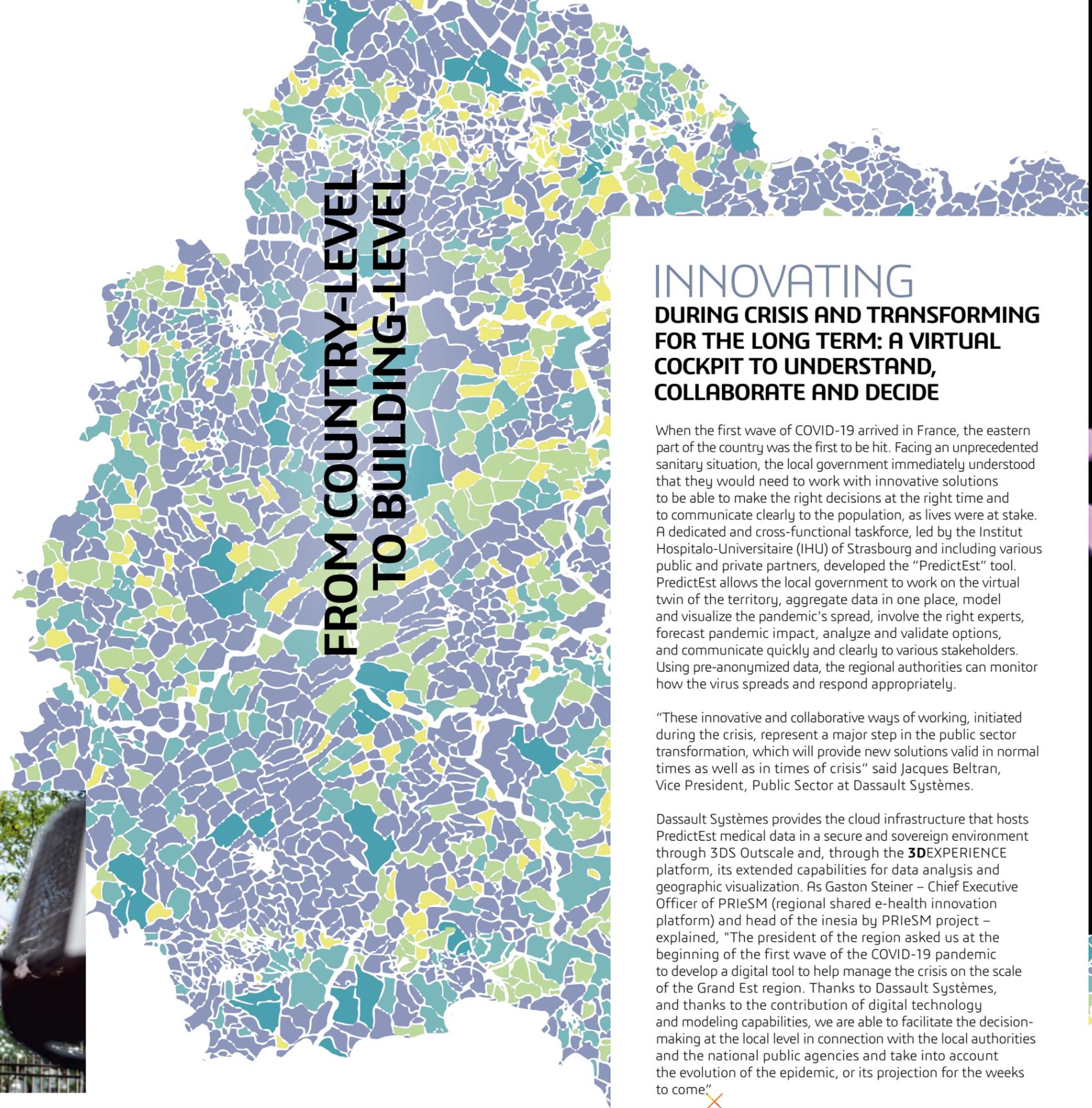
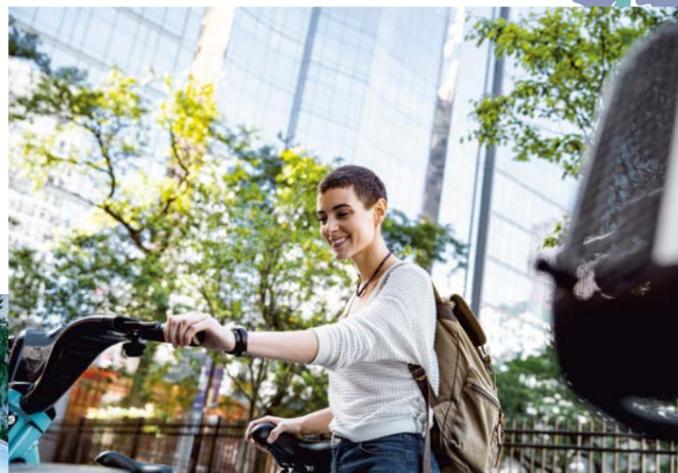


ANTICIPATING THE CITY OF TOMORROW

The sustainable growth of cities has entered a new era, facing up to new challenges and pressures arising from population growth, regulatory developments and climate change. Municipalities and regions are now the driving forces behind a global sustainability effort, and must address people's desire for a better life in cities that are more resilient, digital and attractive. Creating smart cities does not just involve installing digital interfaces in traditional infrastructure or streamlining operations. It involves rethinking cities, defining stronger, more integrated policies in order to provide people with a better quality of life, while keeping costs under control.

The introduction of construction virtual twin technology at the whole-building level will radically transform the construction sector. It will make it easier to minimize waste, achieve energy efficiency, use bio-sourced materials and calculate carbon footprints. Although information of this kind is already being disclosed, in future it will be produced and documented with precision. The first imperative in terms of sustainability is to build structures that are more energy-efficient. The **3DEXPERIENCE** platform allows users to take a multidisciplinary, modular approach when designing a building instead of one based on individual trades, helping to create new, highly customizable experiences and interactions that improve quality of life in its various areas.

More broadly, as cities expand and become denser, planners must anticipate their transformation and rethink their infrastructure to keep up with rapid, complex change, particularly regarding transport. Dassault Systèmes is working with city authorities to consider that transformation from the angle of energy flows and mobility. By anticipating flows and addressing sustainability criteria, we can visualize the city of tomorrow, with virtual twins allowing us to consider various scenarios and encouraging collaboration among designers, construction companies and municipal authorities to regulate, consider, structure and guide development plans in the most effective way. Virtual twins make it possible to share data, work collaboratively and monitor the implementation of all projects, all in one place. They enable city planners to carry out better thinking in the virtual world, in order to achieve more effective change in the real one. ✕



INNOVATING DURING CRISIS AND TRANSFORMING FOR THE LONG TERM: A VIRTUAL COCKPIT TO UNDERSTAND, COLLABORATE AND DECIDE

When the first wave of COVID-19 arrived in France, the eastern part of the country was the first to be hit. Facing an unprecedented sanitary situation, the local government immediately understood that they would need to work with innovative solutions to be able to make the right decisions at the right time and to communicate clearly to the population, as lives were at stake. A dedicated and cross-functional taskforce, led by the Institut Hospitalo-Universitaire (IHU) of Strasbourg and including various public and private partners, developed the "PredictEst" tool. PredictEst allows the local government to work on the virtual twin of the territory, aggregate data in one place, model and visualize the pandemic's spread, involve the right experts, forecast pandemic impact, analyze and validate options, and communicate quickly and clearly to various stakeholders. Using pre-anonymized data, the regional authorities can monitor how the virus spreads and respond appropriately.

"These innovative and collaborative ways of working, initiated during the crisis, represent a major step in the public sector transformation, which will provide new solutions valid in normal times as well as in times of crisis" said Jacques Beltran, Vice President, Public Sector at Dassault Systèmes.

Dassault Systèmes provides the cloud infrastructure that hosts PredictEst medical data in a secure and sovereign environment through 3DS Outscale and, through the **3DEXPERIENCE** platform, its extended capabilities for data analysis and geographic visualization. As Gaston Steiner – Chief Executive Officer of PRISM (regional shared e-health innovation platform) and head of the inesia by PRISM project – explained, "The president of the region asked us at the beginning of the first wave of the COVID-19 pandemic to develop a digital tool to help manage the crisis on the scale of the Grand Est region. Thanks to Dassault Systèmes, and thanks to the contribution of digital technology and modeling capabilities, we are able to facilitate the decision-making at the local level in connection with the local authorities and the national public agencies and take into account the evolution of the epidemic, or its projection for the weeks to come." ✕

AIR QUALITY: A KEY ISSUE FOR THE CITY OF TOMORROW



SIMULATING AND ASSESSING VIRUS DISPERSION IN A WUHAN HOSPITAL

At the start of the COVID-19 pandemic, people all around the world saw many pictures of the Leishenshan modular field hospital in Wuhan, China, which was built in only 14 days. Engineers used the 3DEXPERIENCE platform to simulate how the virus could spread through the hospital's ventilation system. This helped the designers prevent unplanned risks and avoid infection in neighboring areas, particularly by minimizing cross-infection within the hospital, and preventing any virus repercussions in the surrounding communities. SIMULIA's CFD solution, XFlow, was able to simulate internal airflow to ensure optimal removal of contaminated air from negative-pressure isolation rooms protecting hospital staff as effectively as possible. XFlow also simulated the impact of aerosol and gas emissions into the external environment near the hospital, helping to determine the design and location of the modular hospital. ✕



ENSURING SAFETY IN COMPANY CANTEENS

German company GEA is a major player in plant engineering, providing technologies and machines in the food, beverage, and pharmaceutical sectors. For its factory in Oelde, North Rhine-Westphalia, the company contracted Dassault Systèmes' Engineering Services organization to simulate airflows in the cafeteria, which is used by the site's 1,900 staff members, with the 3DEXPERIENCE platform.

By using SIMULIA CFD / Fluid solutions, along with key technologies that included PowerFLOW, Dassault Systèmes was able to achieve precise modeling of airflows and the ways in which particles move and are deposited on surfaces in complex environments. The site closed in March 2020 because of the pandemic, and GEA needed a comprehensive risk assessment for the potential re-opening of the cafeteria. In particular, GEA asked Dassault Systèmes to study the way in which the virus spreads in the air, but also the ways in which it can contaminate surfaces such as plates, trays and tables; the virtual twin showed potential areas where unexpectedly high levels of the virus could accumulate.

GEA used the simulation results to identify and implement an effective strategy to create a safer working environment; it made changes to entrances, exits and seating arrangements, created a separation between the kitchens and the dining room, and adjusted the ventilation system. The simulation results and 3D renderings have the additional advantage of enabling a far more effective communication regarding the protection measures adopted. ✕





REDUCING RISKS OF AIRBORNE CONTAMINATION IN PUBLIC AREAS

The COVID-19 crisis has put the spotlight on how viruses circulate in the air. In order to be able to maintain public areas safely open or to re-open them when economic and social activity resumes, Dassault Systèmes solutions enable simulating scenarios and identifying efficient mitigation measures. This is true for a wide range of venues, including hospitals, administrative buildings and office spaces, cultural and tourism venues, transportation and more.

During the pandemic, Dassault Systèmes initiated collaboration with several French hospitals (AP-HP) to simulate airborne particle flows and the deposit or carriage of pathogens. These projects were essential to confirm the scientific value of simulations deployed around patients, their environment and the risk of contamination within the hospital. The pooling of medical and field expertise of the AP-HP team, plus the simulations performed by Dassault Systèmes, allowed a new approach for scientific understanding. These projects provided outputs immediately exploitable by the hospitals to confirm or adapt the mitigation actions they were planning to adopt: As an example, the simulations performed enabled Bichat Claude-Bernard AP-HP hospital to reorganize a trauma room by optimizing the orientation of patient beds, understanding surface contamination and adding air filtration systems in the ceilings over COVID-19 patients.

Dassault Systèmes' SIMULIA teams also assessed, with "La Pitié-Salpêtrière" hospital in Paris, the adequacy of reorganizing a post-intervention monitoring room, which could be occupied to modifications. Together, they ran different scenarios inside this room, which could be occupied by a dozen infected or healthy patients, to define the best arrangements for both medical staff and patients' security. "We must continue to take a proactive approach in helping minimize the impact of this virus on our fellow citizens and healthcare systems," said Claire Biot, Vice President, Life Sciences Industry, Dassault Systèmes. "Simulation can be used to improve safety in hospitals, nursing homes and specialized clinics, as well as to optimize the floor plans of hospitals that have not yet been built. This collaboration is all part of our mission to harmonize product, nature and life, and make the world a better, safer, healthier place."

Thanks to the expertise developed with hospitals, Dassault Systèmes also helped La Philharmonie de Paris, the French capital city's philharmonic landmark, prepare to safely reopen its largest concert hall. With a capacity of 2,400 seats, the Grande Salle Pierre Boulez features an enveloping configuration that immerses the concert hall audience in the music, and a unique ventilation system in each seat that quietly introduces fresh air and regulates its direction and speed. Equipped with data provided by the Philharmonie de Paris, Dassault Systèmes created a model of the concert hall at full capacity in 3D, and simulated the airflow from the uppermost balconies to the orchestra floor, in order to assess the impacts of mask-wearing and airflows on virus-particle dispersion. Simulation was used to experience and understand how air circulates within the space, evaluate the effectiveness of the Philharmonie de Paris' preventive measures, and identify new ones if necessary.

"Safety is non-negotiable, for our public, artists and staff. This is why we decided to partner with Dassault Systèmes. Thanks to their cutting-edge simulation technology, we are prepared to reopen our concert hall in the best possible conditions." — Laurent Bayle, Managing Director, La Philharmonie de Paris.

"Our collaboration with the Philharmonie de Paris is part of our ongoing efforts to help organizations simulate, visualize and analyze existing conditions, evaluate the impact of 'what-if' scenarios, and identify solutions to open and operate safely," said Florence Verzelen, Executive Vice President, Industry, Marketing and Sustainability, Dassault Systèmes. "There are no rehearsals in life. As the real world struggles to emerge from pandemic-related lockdowns, the virtual world allows for experimentation to reveal these unknowns" ✕

REAL ESTATE CONSTRUCTION IN TRANSFORMATION



ABC building
in Grenoble, France
(Autonomous
Building for Citizens)

After an initial phase of digitalizing and automating its processes, Bouygues Construction – a long-standing partner of Dassault Systèmes – is embarking on the second phase of its digital transformation. The aim is to make construction more affordable, to build more sustainably and to improve health and safety. Bouygues' Integrated Built Environment and Creative Building Design (ABC) solutions are based on a systemic approach to project management, involving integrated and collaborative models that use virtual twin technology. The approach is also used to pursue an ambitious climate strategy, in order to reduce the carbon footprint of buildings. For example, Bouygues Construction uses more and more timber, which stores more carbon than it emits. This involves changes across the whole sector, including architects, suppliers, manufacturers and contractors. The 3DEXPERIENCE platform is also helping the company create a database of components, so they can be reused in other structures. Finally, Bouygues Construction and Dassault Systèmes are supporting the environmental transformation of cities using bioclimatic design features such as solar and wind power generation, the collection and reuse of rainwater and wastewater, and the development of urban farms. ✕



WHEN ROBOTS PUSH THE BOUNDARIES OF POSSIBILITY

Today, agriculture requires large-scale investment in machinery, but generates relatively limited revenue. In addition, to meet environmental requirements, farmers must spend more time on certain tasks, like removing weeds mechanically instead of by spreading chemicals. Robots can help farmers by performing this time-consuming and low-value-added work. French company Agreenculture, supported by the 3DEXPERIENCE Lab, aims to make environmentally friendly techniques affordable, using a common agricultural platform that allows equipment to be shared, rather than each type of crop having its own specific robot and processes. The company is using the 3DEXPERIENCE platform for modeling and simulation purposes, helping it to turn its novel idea into a finished product more quickly. Agreenculture has developed an exclusive system that allows centimeter-level accuracy, along with a cloud access box that allows the agricultural robots of partner companies to connect to a guidance and positioning system that uses artificial intelligence technology. ✕

WE
ARE
WHERE...

More fluid, simpler, quieter and more energy-efficient transport solutions are taking shape as a result of virtual universes facilitating the design, modeling and simulation of new mobility experiences. On land, on the sea, in the air and even in space.

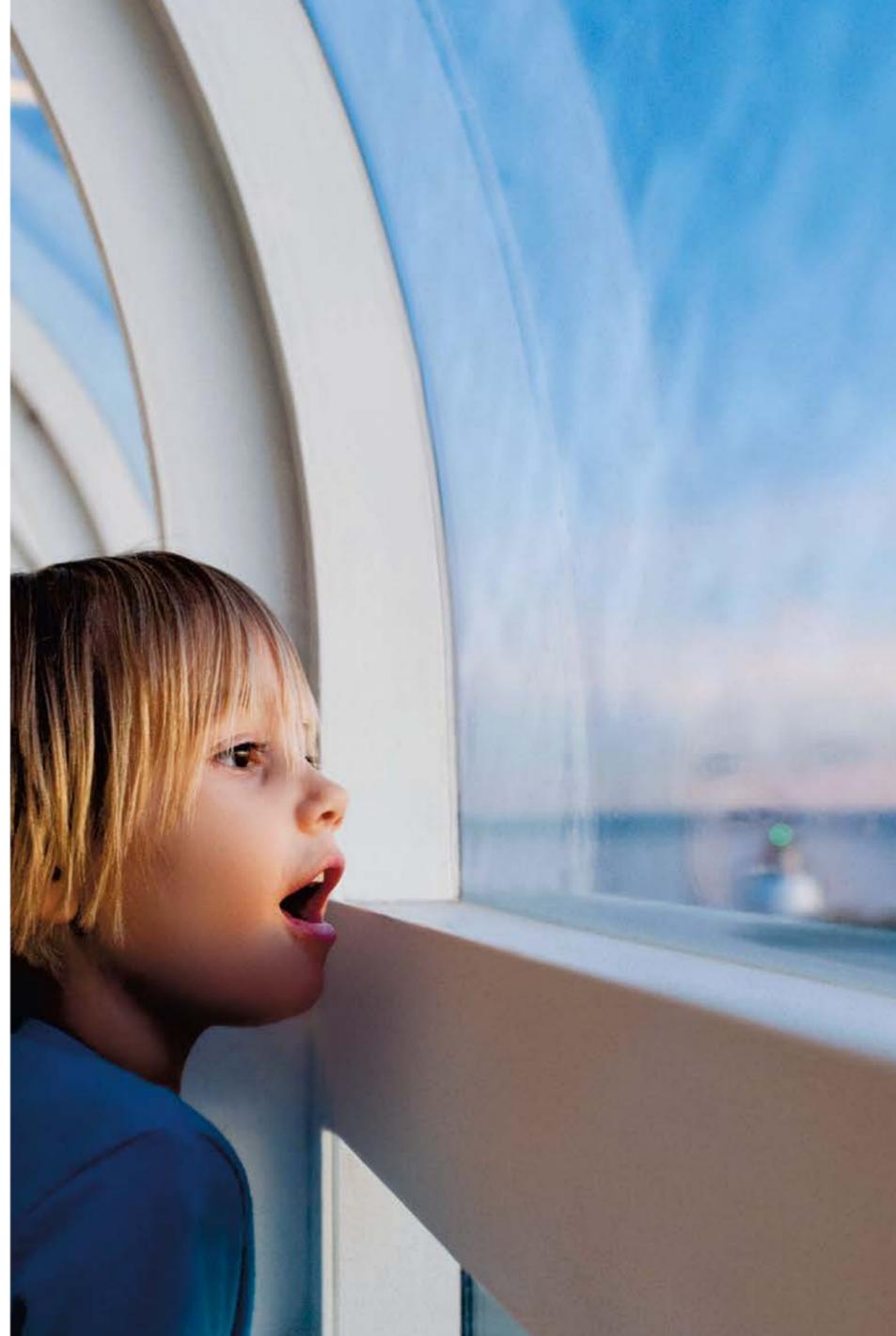
THE FUTURE TAKES OFF



To make journeys safer, simpler and ensure more sustainable mobility, the aerospace industry is reinventing itself continuously, backed by its long history and culture of innovation. For companies in this sector, environmental priorities are closely connected with vital, long-standing historical objectives that include efficiency, profitability and regulatory compliance. To achieve them, mobility players build virtual twins of their vehicles, covering the complete lifecycle: carrying out initial analysis, defining requirements, creating 3D models, obtaining certification and producing the vehicle. This system-of-systems approach takes engineering complexities arising from the interaction of mechanical, electrical and software components and simplifies them by using a standard language. This allows engineers to optimize a design by assessing thousands of hypotheses and finding the configurations that best meet the various requirements.

INTERSTELLAR

The Interstellar Lab research group, split between France and California, builds and tests experimental, bio-regenerative stations that aim to be self-sufficient. On the Moon, on Mars and on Earth.

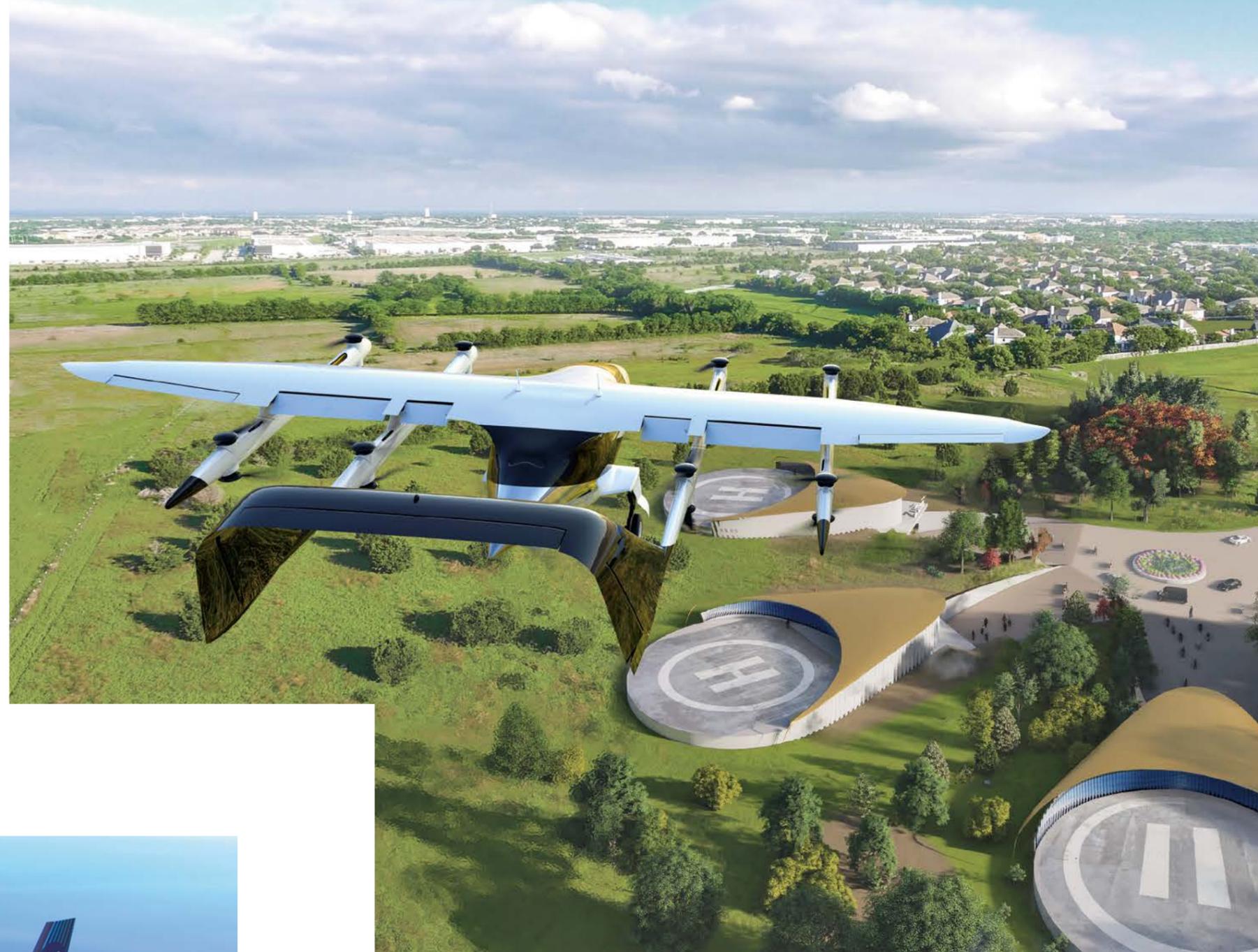


VERTICAL AEROSPACE

Vertical Aerospace, a UK-based startup, is about to launch the world's first certified eVTOL (electric Vertical Take Off and Landing) vehicle, which could see its first commercial flights in 2024.



ZURI
 On its eVTOLs, Czech company Zuri has adopted a combination of fixed wings for cruising and rotary wings for take-off and landing.



XSUN
 French company XSun has designed, tested and demonstrated the capabilities of its long-range, solar-powered drones.

Using the technologies of interstellar travel to support a more sustainable lifestyle

In 2023, the Moon is due to become the first staging post for space travel to more distant destinations, beginning with Mars. Inspired by the potential for humans to live on the Moon or on Mars, the Interstellar Lab startup, with operations in France and California, builds and tests experimental, bio-regenerative stations, modular, space-ready stations that can be configured as villages or even cities, featuring closed-loop, controlled-environment systems that aim to be self-sufficient. Virtually everything within these stations is recycled, making water, air and food as renewable as possible. This reduces the amount of land needed to feed their residents by more than 99%, while ensuring a steady, year-round supply of fruit and vegetables using 98% less water. Interstellar Lab brings together the expertise of NASA, SpaceX, Airbus, Safran, Saint Gobain and Dassault Systèmes, whose **3DEXPERIENCE** platform and Reinvent the Sky solution provides a space in which many different specialists contribute their skills: biologists, aerospace and aeronautical engineers, specialists in control systems and materials science, architects and mathematicians. Using a parametric design approach, the platform allows Interstellar Lab's team of engineers and architects to perform iterations and simulations to refine and optimize the design and production of the EBIOs stations and their modules, the BioPods. The station's virtual experience twin will become hugely valuable as Interstellar Lab moves toward making and operating its modules. Because the solution is in the cloud, teams have secure access to it at all times from any location.

Reinventing mobility with electric vertical take-off and landing aircraft

eVTOL (electric vertical take-off and landing) aircraft are quiet, efficient and have zero carbon emissions, representing a disruptive solution for traveling within and between cities in the near future. One of the pioneers in this sector, UK company Vertical Aerospace, is set to build one of the world's first certified passenger carrying eVTOLs, the VA-X4, which could see its first commercial flights in 2024. The aircraft is quieter and less expensive to run than a helicopter, and aims to address the market for travel between locations poorly served by high-speed trains and regional airlines. To ensure that its processes are fully operational when fleets of its aircraft are in service, particularly regarding the traceability of components, Vertical Aerospace is using the **3DEXPERIENCE** platform. "By working in the cloud, we can make sure that the company is resilient and that we can continue to work whatever the circumstances," says Eric Samson, Head of Engineering at

NEW SPACE A NEW FRONTIER

"For the first 60 years of the Space Age, the space industry was dominated by major government programs. Now, private-sector companies are playing an increasingly important role, launches are more frequent and the number of operational satellites orbiting the Earth – currently numbering 3,400 – could rise to several tens of thousands in the next 30 years. The industry is now being inspired and invigorated by a wave of entrepreneurs pioneering groundbreaking, new technologies. With the **3DEXPERIENCE** platform, companies in the space industry can develop innovative engineering, manufacturing and operational

solutions by modeling virtual missions, which will be front and center to sustainability in space and on Earth. The evolving landscape of international regulations, geo-politics, and the constant stream of new technologies and business models sets the background not just for the proliferation of satellites but also the challenge of managing space debris in orbit. Currently estimated at over 28,000 objects, this debris threatens the sustainability of space activity. Space traffic management will be key to today's industry renaissance in space."

Jeff SMITH
Aerospace & Defense Strategy
& Innovation, Dassault Systèmes

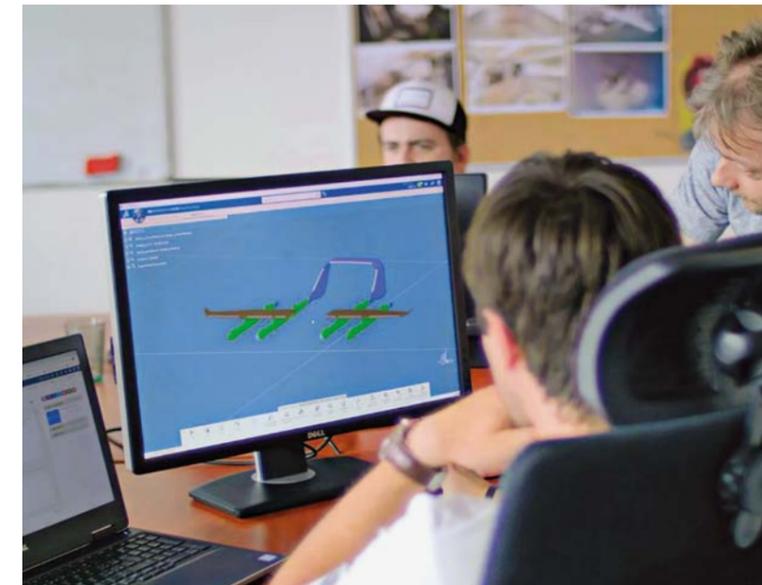
Vertical Aerospace. "We have built an aircraft from scratch. So not only do we have to organize our current processes, but we need to establish them firmly for the future." The solution offers a full set of functions enabling engineers to design and validate composite structures. Engineers also use the platform to find the best way of manufacturing each component from start to finish.

The platform brings together all teams, and solutions can be accessed using the web application. As the company expands its network of partners and suppliers, it will use its enhanced 3D model to send digital data and specific instructions to each participant in the supply chain. Finally, the **3DEXPERIENCE** platform provides full traceability, which will help the company certify through the CAA (Common Aviation Area) and obtain DOA (Design Organization Approval) certification from EASA, the European Aviation Safety Agency.

The noise reduction enabled by Vertical Aerospace's eVTOLs make them 100 times quieter than a traditional helicopter.

Combining fixed and rotary wings

The VTOL aircraft developed by Czech company Zuri combines rotors and wings for on-demand, door-to-door mid-range flights. Multicopters are generally designed to travel short distances within cities and are ideal for vertical take-off, but are not effective for cruise flights. Wing-borne Zuri is ideal for covering distances of 200-700 km (124-435 miles), which is a sweet spot where VTOLs are faster than both cars and big airliners (when considering the time spent in airports). From the start of its project, Zuri used CATIA to handle initial analysis, aerodynamics and measurement tasks, and the company is now exploring the potential of the **3DEXPERIENCE** platform in the cloud.



All its teams can work on the platform from any internet-connected device, with each individual contributing his/her own expertise, while gauging the end user's experience with virtual-universe experiences. With ENOVIA, the platform also allows Zuri to reuse shared processes and components, bringing its aircraft to market more quickly. To test and certify its aircraft, Zuri uses integrated safety processes and full traceability to comply with various regulations. It applies virtual twin technology to test and check its digital prototype before beginning physical construction, to manage and maintain the aircraft throughout its lifecycle and to offer an immersive experience to investors, as well as existing and prospective customers.

A double-wing, solar-powered drone observing the Earth

French company XSun is committed to designing, testing and showing the capabilities of solar-powered, long-range drones that can conduct surveillance, research and environmental-protection missions. Economical to produce and run, its latest model offers a greater range, increased endurance and improved sustainability. In an endurance test carried out in 2020, XSun's drone flew for 12 hours and covered 600 km (373 miles), with no carbon emissions. Making extensive use of composite materials, it weighs less than 25 kg (55 pounds), is more than 4.5 meters (nearly 15 feet) wide and has a payload capacity of 7 kg (15.4 pounds). The team aims to increase its endurance from 12 hours to 20.

Possible applications include monitoring oil and gas pipelines and railways, observing fauna and flora in forests, carrying out large-scale military surveillance at sea, and detecting oil spills and illegal discharges. The idea is that autonomous drones will eventually perform work currently done by space satellites. XSun's double-wing machines also can accommodate twice as many solar panels as single-wing designs. The concept, developed using the **3DEXPERIENCE** platform, also offers certain advantages in terms of aerodynamic performance. Double-wing design has traditionally been ignored by the aerospace industry, which has until now been dominated by single-wing designs.



Faster and more reliable certification process for Pipistrel

Pipistrel Vertical Solutions, a subsidiary of Slovenian Pipistrel Group, specializes in designing innovative electric and hybrid aircraft and battery-based propulsion systems. It has used Dassault Systèmes solutions to speed up the performance-testing process and to assess the reliability of materials before physical prototyping. For certification, full-scale testing is required to determine the aircraft's natural frequencies and associated structural energy absorption – typically a long and costly process. To accelerate the process of performance tests, Pipistrel has opted for SIMULIA Abaqus to simulate and assess the structural behavior of its new Virus SW Electro 128 aircraft in a virtual environment, accelerating the pace of certification, securing the first-ever Type Certificate for an electric airplane.

Instead of using physical measurements before starting test flights, Pipistrel has proven, with the positive results of virtual tests, that its structural design is reliable and robust. The EASA has recognized the test process and results, allowing Pipistrel to achieve final confirmation of the newly developed aircraft's structural integrity more quickly, resulting in significant cost and time savings.

Digital and Sustainable – The next milestone in shipbuilding transformation

Some of the main principles of shipbuilding were adopted back in the 17th century. However, driven by intense competition and the compelling sustainability imperative, a wave of innovation is currently carrying the industry to develop transformative approaches.

NAVAIS: setting the course for next-generation European shipbuilding

Building on Damen's proven standardization experience, one of its divisions, Damen Shipyards Gorinchem, is coordinating the New Advanced Value Added Innovative Ships (NAVAIS) program in close cooperation with Netherlands Maritime Technology (NMT), Dassault Systèmes, Bureau Veritas, Delft University of Technology, MARIN (The Maritime Research Institute Netherlands) and 10 other partners.

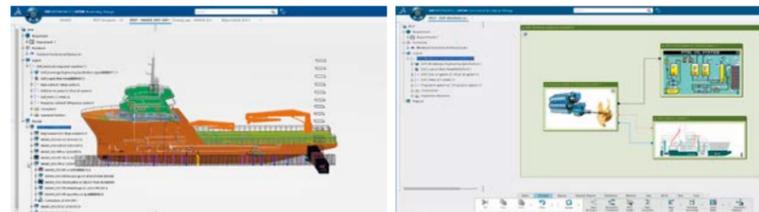
Co-funded by Horizon 2020, the biggest EU Research and Innovation program ever conceived, NAVAIS aims at finding new shipbuilding methods to maintain the European shipbuilding industry's global leadership in complex vessels, while also making sustainability more integral to new projects, from the design stage onward.

NAVAIS is developing guidelines and KPIs for low-impact ship design and operations, reducing or, preferably, eliminating emissions (exhaust emissions, oil, ballast water, as well as airborne and underwater radiated noise) to the environment. To increase efficiency in vessel design and flexibility in production networks, NAVAIS explores standard and modular design and production principles. Leveraging a Model-Based Systems Engineering (MBSE) approach, NAVAIS is developing a

THE MBSE APPROACH DECODED

Model-Based Systems Engineering (MBSE) is inseparable from the ever-growing sophistication of products across industries. The Marine & Offshore industry is no exception. Marine assets are complex systems that involve multi-disciplinary teams dealing with mechanics, electronics, software, telecommunication, cyber-systems, chemicals, batteries, hydro-dynamics and more. Consequently, MBSE methodology, which focuses on creating and using multi-physics 3D as the primary means of exchanging information between engineers, as opposed to documents, is being gradually adopted across the naval and commercial shipbuilding segments to cut through the complexity.

platform-based modular product family supported by the **3DEXPERIENCE** platform, focusing specifically on e-ferries and workboats. The program will profoundly change the way in which new shipbuilding projects are approached. Traditionally, these projects involve an engineering-to-order business model, where specifications are defined and design work is carried out on the basis of the customer's needs and vessel's intended purpose. The new approach involves an assemble-to-order business model, resulting in shorter lead times, consistent quality, reduced design and production costs and improved supply chain integration, while ensuring the continued focus on clients' specific needs.



To achieve this, users define related groups of products that share characteristics, components, subsystems, interfaces and manufacturing processes; these groups meet a wide array of customer requirements, and various modules are created with the required attributes to fulfill the various functions of a vessel's structure. It also involves defining the modular design process and the library of modules that can be reused: design and production data, business rules, documents and spatial information are stored in the library, allowing users to standardize production and propose multi-user environments to create models, test behavior and centralize information using a MBSE approach. NAVAIS is defining a completely new class-approval procedure, where pre-engineered product modules are approved to support an evolution to an assemble-to-order business model. Bureau Veritas also simulates the vessel's energy efficiency within the **3DEXPERIENCE** platform. The manufacturing plan can be simulated for each production module, and the process plans for various modules can be combined to create the main process plan for the vessel as a whole. NAVAIS is scheduled to complete its work in June 2022 and demonstrate the feasibility of these concepts for shipbuilding.

A paperless shipyard, thanks to virtual twin technology

CSSC Jiangnan Shipyard, one of China's largest shipbuilding companies, builds, repairs and converts commercial ships. Founded in 1865, it has a solid reputation in complex vessels. After decades of development, the company wanted to strengthen its competitiveness, focusing on higher-value vessels that include gas carriers, large container ships and scientific vessels and moving away from volume production of low-value ships such as bulk carriers. In 2015, Jiangnan Shipyard selected the **3DEXPERIENCE** platform to lead the digital transformation of the CSSC Group and take China's shipbuilding industry to the next technological level.

The transformation meant moving from a traditional shipyard organization based on 2D documents and plans to a paperless shipyard, putting the 3D model at the center of its design and production processes. To ensure digital continuity and have a solution based on 3D models that factor in all of its processes end-to-end, Dassault Systèmes helped Jiangnan Shipyard to define, share and monitor key performance indicators based on typical use cases. The first vessel ever designed and built using this 3D model-based approach is the Haixun 160. Jiangnan Shipyard did not use a single piece of paper for its design or construction, which required only three months for the engineers and workers to build the various parts of the ship and assemble them. On site, teams no longer have to look at often-complex 2D blueprints. Each detail of the ship can be closely examined directly on the 3D model, and a laptop or a tablet is all that is required to access all of the detailed information.

Some of the key benefits include:

- Avoiding error-prone interpretation during manufacturing, thanks to direct usage of 3D, which provides a perfect match between the real and virtual world, with a reliable end-to-end digital thread.
- Using Virtual Twin technology with VR and ergonomics, the **3DEXPERIENCE** platform can simulate on-board crew actions such as walking, operations, and maintenance. This helped the shipyard to detect issues early in the design phase, effectively control and manage construction cost, shorten cycle time, and improve build quality.
- Using 3D models instead of drawings led to a reduction of errors, thanks to better understanding.

Jiangnan Shipyard plans to further advance its processes, leveraging the virtual twin to help ship owners with maintenance throughout the ship's lifecycle. ✕

WE
ARE
WHERE...

The industrial revolution is powered by global communication, interconnected machines, the internet of things, the cloud, artificial intelligence, big data analysis and machine learning. It can deliver new experiences that are more meaningful and longer-lasting for everyone.

MAKING HAS MEANING

In the last two centuries, the manufacturing industry has imagined, developed and made the useful products that societies and economies have needed, as well as products that we have all dreamed of for ourselves. Manufacturers have also made constant efforts to make products accessible to the largest number of people, as quickly as possible. As the world's population grows, we have become aware that the manufacturing sector plays a vital role in serving the global community and, at the same time, that the Earth's resources are scarce and precious.

The manufacturing sector has always been about balance, but it has not historically paid due attention to human beings or nature. At Dassault Systèmes, we are convinced that the fundamental purpose of the 21st century's Industry Renaissance is to achieve harmony between products, nature and life. The zero-carbon ambition is a key aspect of that revolution.

In the 21st century, industry involves a new way of seeing the world, of inventing, learning, producing and selling, one that combines the virtual and real worlds. It is a horizontally integrated network of creation, production and sharing of experiences. Many companies such as Tesla offer new solutions in new markets and show us that the new economy, which is fundamentally use-based, is creating much more value – use value – than the industries of the last century. The “factory” of tomorrow will not make products but experiences, new uses requiring

ecosystems that are very different from the supply chains of the past in terms of their structure and associated business models.

Today's economy is organized around marketplaces that reconcile supply and demand, global and local. Virtual experience platforms are the infrastructure of the 21st century and are already transforming commerce (just look at Amazon!), distribution, transport and tourism. Industry is next. Today's digital realm – with its virtual experiences, augmented reality and realistic simulation capabilities – is what the printing press was to the renaissance in the 15th century. Virtual models – digital twins – will revolutionize our relationship with knowledge and know-how which, when combined with data, distinguishes true innovators from those content to automate existing processes. Manufacturers, including startups and SMEs, will get to grips with usage data from virtual experiences, even before data from real experiences, will be able to develop new offerings that add large amounts of value.

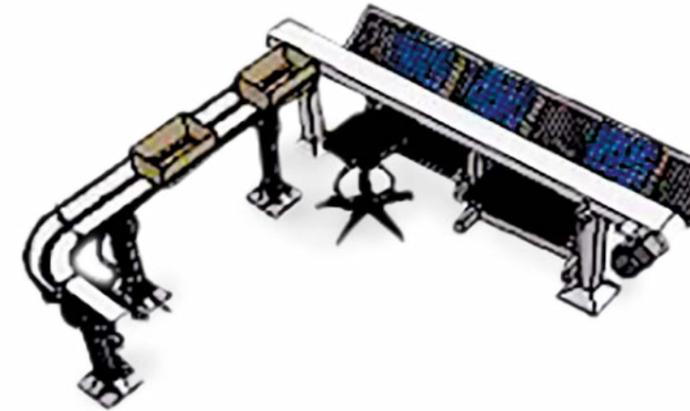
To sum up, the manufacturing industry's virtuous revolution is the key to a sustainable future. It involves what we call harmonizing product, nature and life. The ambition of our 3DEXPERIENCE platform is to provide a digital collaborative environment – an innovation platform, an operations platform and a marketplace at the same time – that is needed for the networks of the future, based on sustainable values, to emerge and develop.

Dominique FLORACK
President,
Chairman of the Manufacturing Industries Board

INSIGHTS INTO THE REALITY OF PRODUCTION GAINED FROM OBSERVATION AND ANALYSIS

INTERPRETING AND ORGANIZING TEXT DATA WITH ONTOLOGIES AND AI-DRIVEN SEMANTIC ANALYSIS

In 2020, Dassault Systèmes strengthened its data science capabilities by acquiring French company Proxem, which specializes in advanced (or artificial intelligence (AI)-driven) semantic processing based on natural language processing (NLP) and machine learning. Proxem's solutions and know-how help users turn textual data into ontologies and actionable insights for businesses. By combining AI-powered semantic modeling and data services applications, users of the 3DEXPERIENCE platform will be able to leverage knowledge buried in requirements, regulations, client and reseller feedback, after-sales service reports, contracts, scientific publications, research reports and clinical trial results, thus enriching their virtual twin experiences. This will provide unprecedented opportunities for collaboration, encouraging innovation and the creation of new products and services, while facilitating planning and execution throughout the extended enterprise.



PREVENTING MUSCULOSKELETAL DISORDERS IN THE L'OCCITANE FACTORY

MyHealth@Work is a Dassault Systèmes service based on the DELMIA solution, developed with L'Occitane en Provence as the pilot client. L'Occitane wanted to prevent the occurrence of musculoskeletal disorders among staff members working on the factory floor. The solution works by capturing the real situations and operational procedures of each workstation, performing an analysis using the workstation's virtual twin, and shows its risk level. This assessment – which method engineers would not have had the time or resources to perform – was carried out very quickly in L'Occitane's factory, analyzing tasks performed in the production and packaging workshop. Method engineers now have access to a MyHealth@Work dashboard based on the Ergonomic Workplace Design solution, which combines two algorithms: Smart Posturing Engine, which automatically positions a virtual manikin, and Ergo4All, which ergonomically assesses the manikin's posture to determine the risk of joint or musculoskeletal problems. Using an objective, mathematical model makes all participants in the occupational health ecosystem more accountable. It changes the work done by method engineers, who are now able to spend more time on prevention: together, the virtual twin of the workstation and the associated virtual manikin represent a powerful educational tool to raise operators' awareness and give them information regarding their own health.



STREAMLINING MANUFACTURING FOR MORE SUSTAINABLE DEVELOPMENT



APPLYING CIRCULAR ECONOMY PRINCIPLES IN THE FIELD OF MANUFACTURING

The circular economy represents a systemic shift that builds long-term resilience, generates better growth opportunities and provides environmental and societal gains; the principles consist of eliminating waste, keeping materials in the loop and powering the industry through renewable energy. Applying these principles will result in significant progress in five key areas of manufacturing: cement, aluminum, steel, plastics and food. Circular manufacturing also makes the business case for sustainability, where multi-stakeholder value is created. New business opportunities arise, but they also bring significant complexity. It is no longer about one unit of analysis in the supply chain – it is about the entire value network and ecosystem; suppliers, production plants, the marketplace, consumers and retailers. Navigating this complexity to create innovative and sustainable experiences is a challenging task; it requires a diversity of knowledge and know-how with an empowered workforce and the need to connect the dots between people, ideas and data inside and outside the company. Virtual worlds enriched with modeling, simulation, optimization, collaboration and business process execution and performance enable us to push our imagination boundaries; they allow us to empower people to test infinite possibilities for innovation towards a sustainable future. ✕

REVOLUTIONIZING AUTO BODY PAINTING WITH SMART PAINTSHOP

Italian-Japanese company Geico Taikisha is a world leader in automated body painting systems and has been a partner to carmakers around the world for more than 50 years. It is now about to revolutionize its industry. The company's collaboration with Dassault Systèmes will give carmakers more flexibility in their production, at a time when mass personalization is increasingly important. Modularity is also a focus, as many customers need to manage multi-car platforms and new product introduction. DELMIA's solutions are unleashing the potential of Geico Taikisha's Smart Paintshop, which is designed to be the car paintshop of the future, with smart, connected solutions to improve efficiency, safety, quality and cost – while at the same time working towards ambitious sustainability goals. The 3DEXPERIENCE platform manages communications between processes and end-user systems, complemented by an IoT system and technologies that facilitate energy and design management.

The Paintshop Execution System is fully adapted to match the requirements of its specific environment, and DELMIA Apriso helps to create deep insights throughout the entire car painting process. The Smart Paintshop system manages, guides and documents each step with pinpoint precision. This innovation allows Geico Taikisha to provide its automotive customers with an end-to-end solution that will help them adapt to increasing demand for high-quality, low-cost products and high levels of customization.

ENSURING RESILIENT SUPPLY CHAINS

The COVID-19 crisis starkly highlighted the fragility of some supply chains. In many industries, however, securing the upstream supply chain has long been identified as crucial to a company's survival. The 3DEXPERIENCE platform provides a comprehensive solution for designing, planning, simulating and continuously optimizing overall supply chain processes in a virtual environment. It starts with managing supplier-related costs with ENOVIA solutions. Approving and qualifying each new component before introduction into a product is extremely important to ensure component reuse, introduce parts from preferred suppliers and minimize validation costs. When the supply chains gets disrupted, the first step in the recovery process is to collect and interpret data in order to understand the existing supply network before it can be optimized or redesigned, if necessary. By connecting enterprise, suppliers, customers and market data into the 3DEXPERIENCE platform, NETVIBES offers supply networks monitoring solutions able to detect and help reduce the impact of disruptions. Should a supplier be at risk, the procurement department can consult PartSupply on the 3DEXPERIENCE Marketplace to find an alternative supplier of a similar product part. From sourcing to distribution, the 3DEXPERIENCE platform helps design more efficient supply chains, plan agile production and secure a comprehensive downstream supply chain. ✕



DESIGN FOR LIFE: MEANINGFUL ACTIONS FOR TODAY'S WORLD

Since 2016, Dassault Systèmes has run a program called Design for Life, focusing on innovative practices and processes for sustainability by design. In 2020 Dassault Systèmes gathered powerful testimonials from forward-looking designers and architects whose work lies at the crossroads of technology, science and nature — for a radically positive impact on today's world. This initiative was led in collaboration with *Dezeen*, the influential design and architecture magazine.



ANNE ASENSIO

VICE-PRESIDENT, DESIGN EXPERIENCE,
DASSAULT SYSTÈMES

Using simulation to understand what is possible

“Designers use technology as a catalyst for thought, particularly as part of a new relationship with nature, our living conditions and our environments. They question the ways the world is changing. Digital technologies such as simulation are more generally used by engineers to understand and reduce the risks inherent to industrial projects, weight management, logistics impact (i.e. to gain control over what could be). For designers, however, the aim is to perform simulations of their creative scenarios as a leap into the unknown, to explore possibilities in an imaginative way, to ponder and judge the relevance their work.

Technology brings objectivity to a design project. And even if it is not used to enhance performance or optimize processes, it allows us to gain a systemic perspective from the sustainability point of view, as a way of measuring design's impact. Technology is becoming a new raw material for designers, allowing them to exercise judgment alongside their subjective sensibilities and intuitions. Digital technologies allow us to make projections and representations, and we can use those to make a critical assessment of how industrial design over-relies on consumerism, revealing the true purpose of the design process: design for people's wellbeing.

In the design world, projects are developed in “action-research” mode within vibrant, connected communities. Virtual co-creation spaces, such as those of the **3DEXPERIENCE** platform, give designers the ability to reinvent the way they work and to learn by doing so. The Design for Life initiative shows how we can represent the imaginary as tangible and realizable elements, and how we can be inspired by the structures of living things. Our imaginations become representations of the world.”



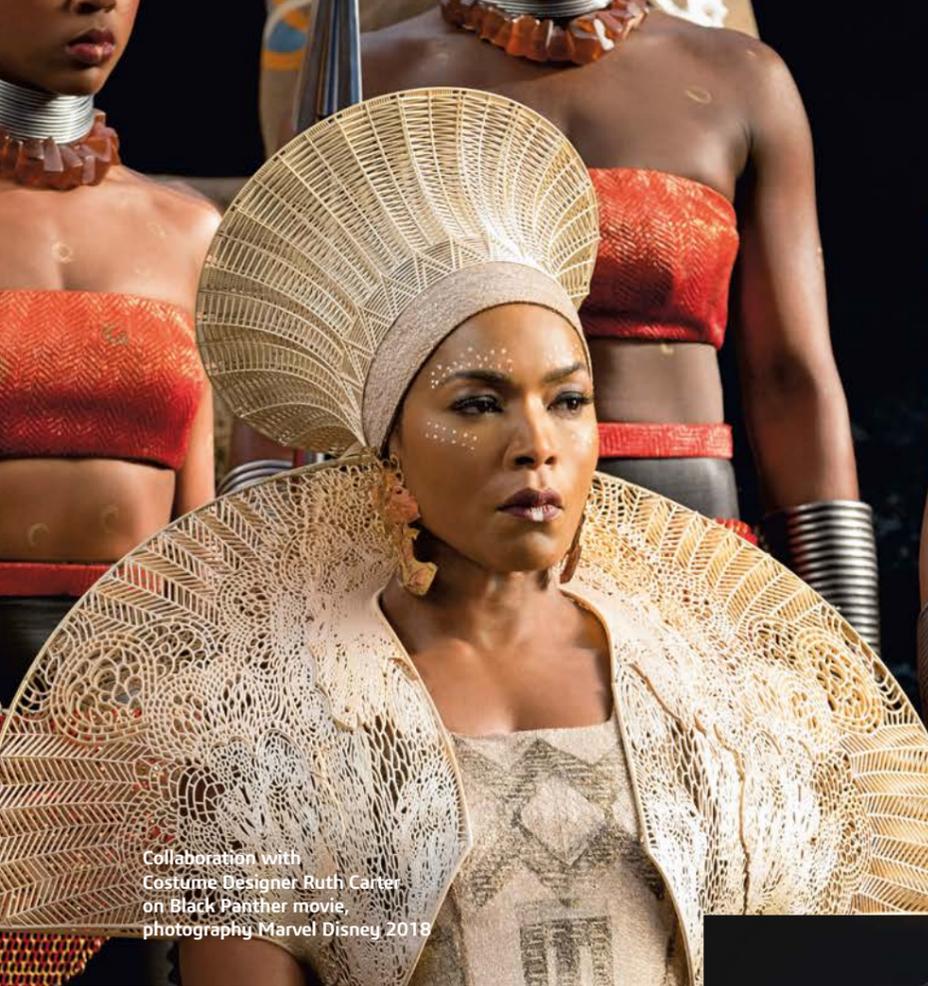
ARTHUR MAMOU-MANI

ARCHITECT

Sustainable design based on natural processes

Arthur Mamou-Mani is interested in architecture that is designed and produced digitally. His firm believes in innovation, craftsmanship and the role of architecture in society. In his London office, he creates sustainable designs based on natural processes, and brings his projects to life in an integrated Fab Lab. He works iteratively as part of a conceptual-empirical loop, learning constantly through trial and error. His firm's beliefs regarding the circular economy are illustrated by one installation in particular. Designed using the XGen solution, which allows parametric models to be created within the 3DEXPERIENCE platform, the installation is made up of a dynamic grid of 3D-printed modules, and cascades through the space as if it was taken by the wind. The modules are 3D-printed on site using a material called polylactic acid (PLA). PLA is a bioplastic made from fermented sugar, and comes in pellet form. The installation also features a crusher, demonstrating how recycling can be done on a very small scale. The crusher breaks down the printed modules into pellets, which can immediately be reused to print new modules. According to Arthur Mamou-Mani, "it's very important that designers start thinking beyond the timeframe of their project. They need to start thinking of where the material came from, where is it going, how can it be reconfigured – the entire lifecycle of a project needs to be taken into consideration."





Collaboration with Costume Designer Ruth Carter on Black Panther movie, photography: Marvel Disney 2018

JULIA KOERNER DESIGNER

Textiles that draw inspiration from butterfly wings

The work of Julia Koerner, a designer based in Salzburg and Los Angeles, blurs the boundaries between architecture, fashion and product design. She makes extensive use of 3D printing, and draws inspiration from natural shapes. Her most recent feat was designing the impressive regal attire for the film Black Panther – directed by Ryan Coogler and part of the Marvel Cinematic Universe. Her designs explore the possibilities of biomimicry; for example, using close-up photographs of butterfly wings that she digitized, processed using an algorithm and turned into 3D models. After turning the photographs into thousands of pixels mapping the butterfly's wings and colors, she reproduced the motif using 3D printed bristles on a flexible fabric that moves and flows organically, coming alive with each movement.



MICHAEL PAWLYN ARCHITECT

Exploring the infinite possibilities of biomimicry

Michael Pawlyn is a British architect known for his interest in biomimicry and innovation inspired by nature. His firm, Exploration Architecture, uses this approach to rethink construction and develop solutions that use resources in a much more sustainable way. "Complex organic structures, like shells, are incredibly efficient, and with computational design and 3D printing, it's getting much easier to mimic that level of complexity and efficiency," he explains. For example, by modeling a bird's skull, enlarging its structure and 3D printing it, Pawlyn has created a model of an incredibly light pavilion structure that is robust and highly efficient in terms of materials. As in shells and feathers, very thin surfaces are transformed into solid structures by folding and bending them. By bringing together science, art and computational design, it is possible to get closer to the way organic forms work in order to create structurally efficient architecture that produces no pollution.

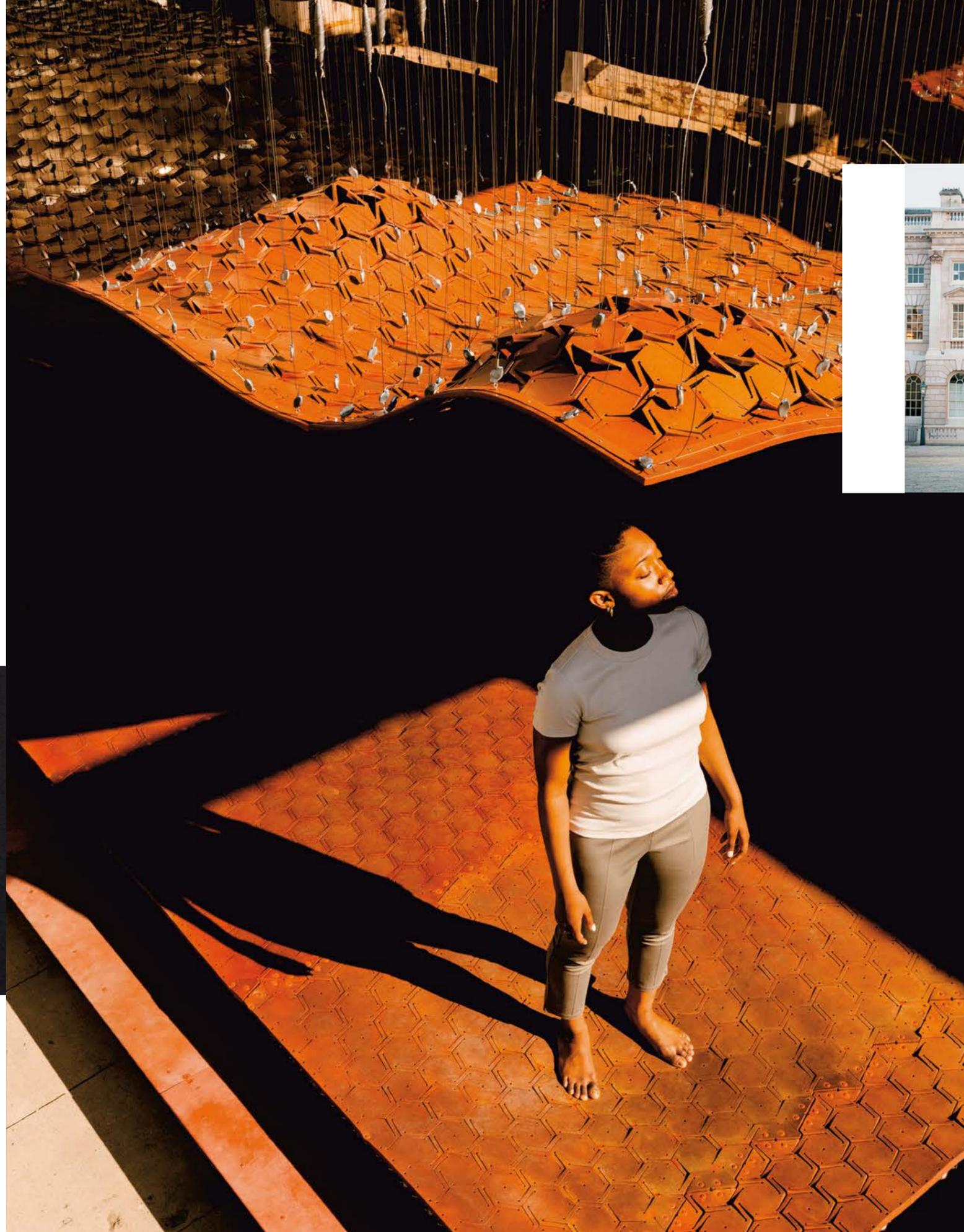


THIERRY MÉTROZ

HEAD OF DESIGN,
DS AUTOMOBILES

Reviving a legend with the DS Aero Sport Lounge

In *Mythologies*, when considering the DS, the legendary car designed in France in 1955, Roland Barthes wrote: "I think that cars today are almost the exact equivalent of the great Gothic cathedrals; I mean the supreme creation of an era, conceived with passion by unknown artists, and consumed in image if not in usage by a whole population which appropriates them as a purely magical object." In 2009, the PSA group revived the DS brand, which symbolizes a combination of French elegance and technological progress, condensed into a very modern form. Thierry Métroz, head of design at DS Automobiles, explains that the DS Aero Sport Lounge concept car was initially inspired by the tradition and avant-garde spirit of the original DS, and features numerous technical innovations, both in the car itself but also its design process. "80% of our design process is digital," he explains. The team of designers uses parametric modeling to create the initial shape of the car, resulting in benefits such as reduced wind resistance. The design is then reviewed and refined using immersive virtual reality software. ✕



NASSIA INGLESSIS

DESIGNER, ENGINEER
AND ARTIST

Creating interaction

Nassia Inglessis is a designer, engineer and plastic artist. She is the founder of experimental design studio Studio INI, which has offices in London and Athens and creates immersive experiential environments. *Urban Imprint* is an installation that reinvents the urban landscape, creating a malleable, flexible environment around its inhabitants: a flexible floor depresses around their feet, causing an equivalent movement in the ceiling. *Disobedience* is a 17-meter kinetic wall that visitors can walk through, with flexible walls that bulge open around them as they pass through the installation. A steel spring flexes open in response to the weight of a person's step, causing the walls – made of recycled plastic – to change shape. The design tools and processes Inglessis uses allow Studio INI to move very quickly from the digital to the physical realm by testing complex designs. "We always have one hand on the computer and one hand on the material," she says. ✕

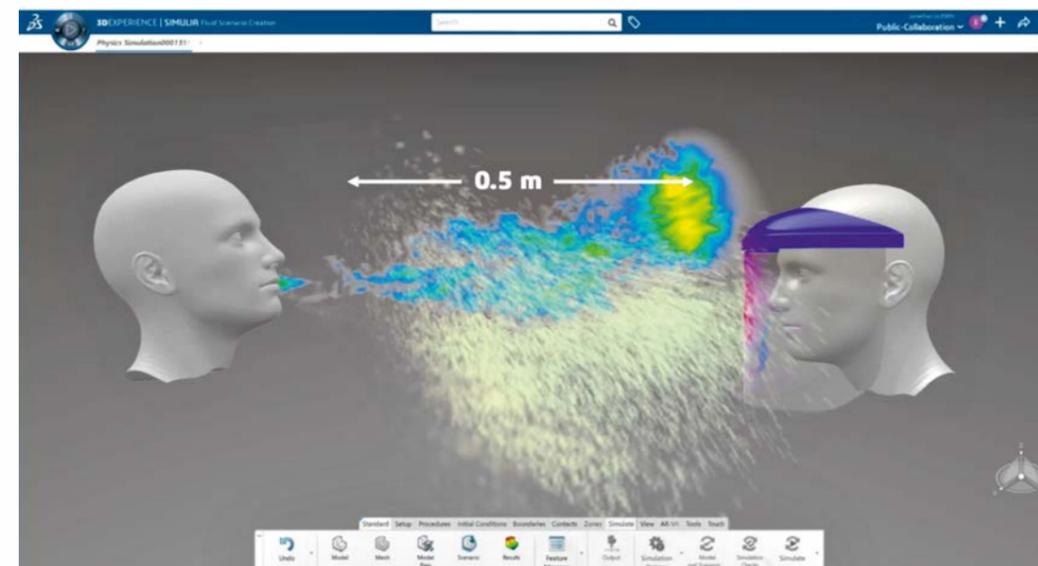
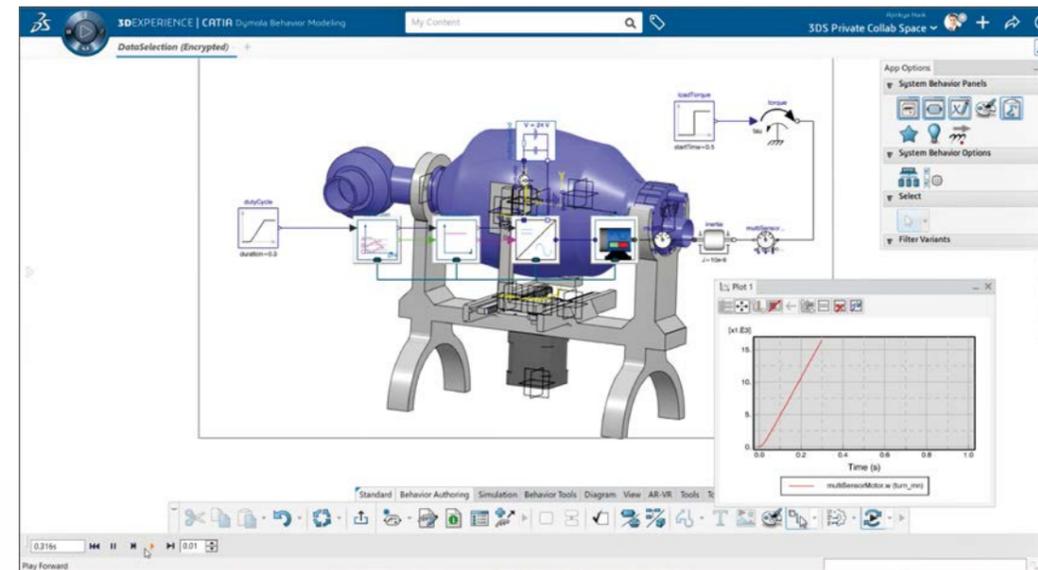
WE WILL BE THERE TOMORROW

Because today's world demands collective intelligence, innovation and creativity that will require new talents to face the challenges of the future, we are championing initiatives to open up new horizons.

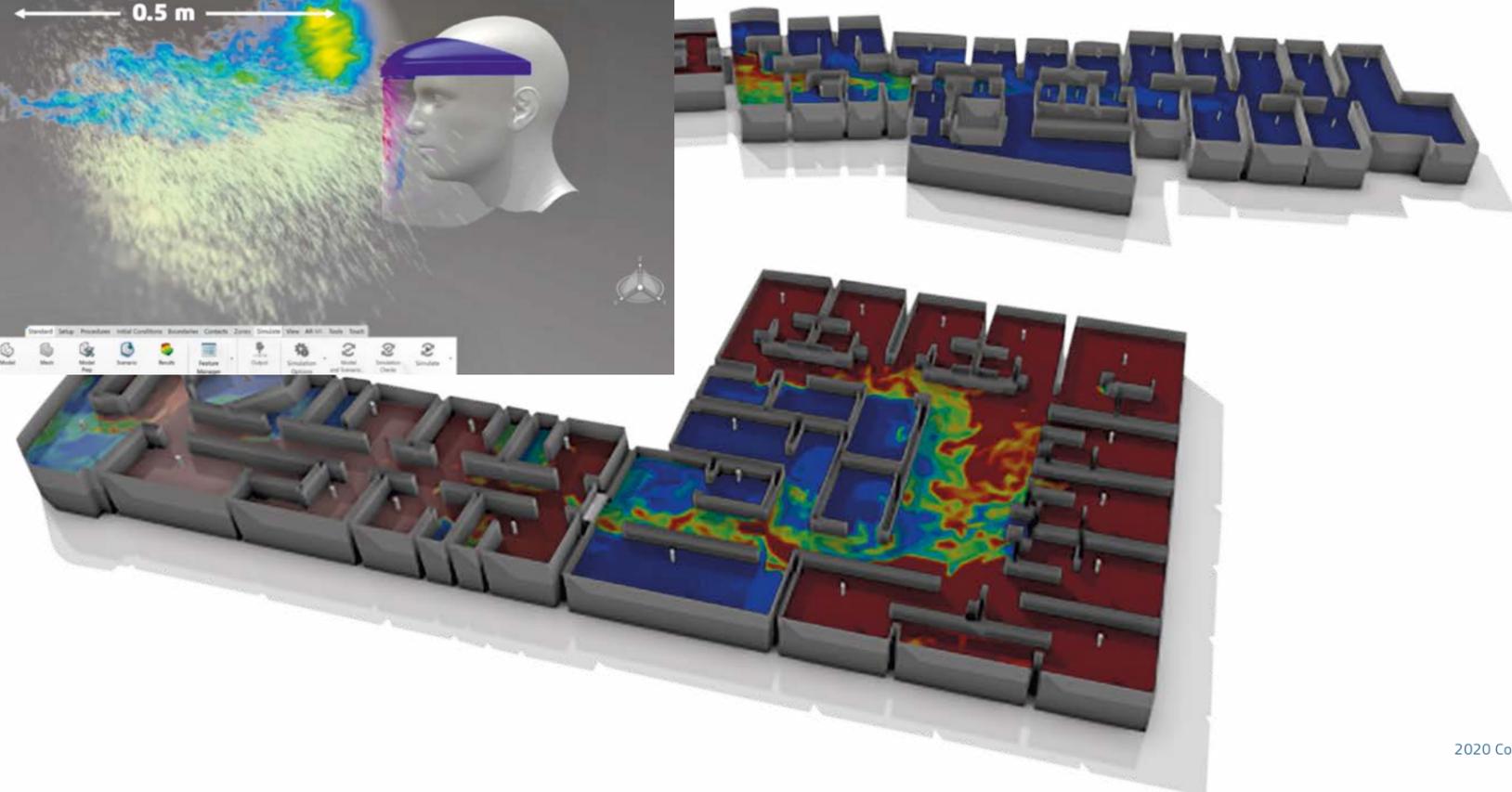
HARNESSING COLLECTIVE INSIGHTS TO DEFEAT COVID-19

As soon as the pandemic began spreading, the **3DEXPERIENCE** Lab identified needs and difficulties arising and found that many people working on COVID-19-related projects were doing so in isolation. The Lab team brought together these designers, engineers, scientists and decision-makers to pool their energy, harness collective insights and share needs and solutions; in turn the team classified and supported the projects. The Open COVID-19 community created an effective way of gaining an overview of efforts to combat the pandemic, aggregating the latest information concerning pharmaceutical and scientific advances, ventilators, face shields, and progress by manufacturers and labs. Over 150 projects received backing, including design and production of face shields in Fab labs, digital simulations of virus dispersement into the air when a patient coughs or sneezes, airborne propagation simulations, ventilators, etc.

Three projects really stood out: in India, the Inali Foundation startup, which had already made a name for itself by creating an artificial arm for people with disabilities, built a prototype smart ventilator. It took just eight days thanks to the support provided by the **3DEXPERIENCE** Lab's team in India and input from mentors and designers from around the world via the cloud. In the United States, the Lab guided the design process for face shields via the network of Fab labs, with support from US-based teams of **3DEXPERIENCE** and **SOLIDWORKS** experts. Geolocation data was used to put these Fab labs in contact with nearby hospitals and healthcare professionals. In France, the **SIMULIA** team helped simulate air flows in the Saint-François hospital in Marange-Silvange, to rapidly identify the safest way of accommodating COVID-19 patients and to show the way forward to have optimal air flows.



From top to bottom:
Inali's virtual prototype of its smart ventilator, a simulation of face shield protection and another one of the premises of Saint-François hospital in Marange-Silvange



SUPPORTING RESEARCH AND EDUCATION DURING THE PANDEMIC

La Fondation Dassault Systèmes rapidly deployed its teams as the COVID-19 pandemic spread and lent its support to various initiatives driving change in education and research by harnessing the power of 3D technology and virtual universes. It made a donation to the Institut Gustave Roussy (Villejuif, Paris) for its research into the effects of SARS-CoV-2 on cancer patients. Through a second donation to the BREATHE Center at the University of California, Riverside School of Medicine, its support furthered work on identifying engineering solutions to mitigate damage caused by artificial respiration and helping improve patients' condition. The Foundation also established a partnership with Ecodair, an association promoting community employment, to provide computers to students at the Apprentis d'Auteuil home for young workers in Versailles (France), so they could continue taking their classes online. Lastly, ConnectNext, a program launched in 2020 to forge closer ties between academia and industry in India, connected 16,000 students, teachers and industry professionals during the lockdown period. The Franco-Indian chamber of commerce gave this initiative a CSR Award.



DEVELOPING RURAL AREAS AND NURTURING TALENT IN INDIA

La Fondation Dassault Systèmes India supported a number of projects in 2020 championing the development of rural areas. Photovoltaic solutions powering irrigation pumps, spraying devices and water purification systems play a key role in this program. Solar energy is also used in new pasteurization, dehydration and portable refrigeration systems for transporting drugs. The ultimate goal is to make villages self-sufficient in both energy and food by implementing innovative, sustainable and local fruit and vegetable production strategies. The foundation for a circular ecosystem will be laid through a shift from managing waste to recycling useful materials. Water-related issues are the focus for two of the other projects supported by the Foundation — a floating

system that collects the waste from lakes and rivers, and another that curbs pollution on waterways. **La Fondation Dassault Systèmes** India also took its talent development initiative to the next level. The “Made in 3D” program introduced by **La Fondation Dassault Systèmes** in Europe in 2016 to inspire students to become future innovators and entrepreneurs was successfully adapted to India in 2020. Lastly, the ConnectNext initiative introduced a new form of collaboration and interaction between industry and academia in India, giving businesses the opportunity to spot talent while allowing students to showcase their skills and abilities through webinars and virtual events.



TRAINING FUTURE GENERATIONS OF ENGINEERS IN AFRICA

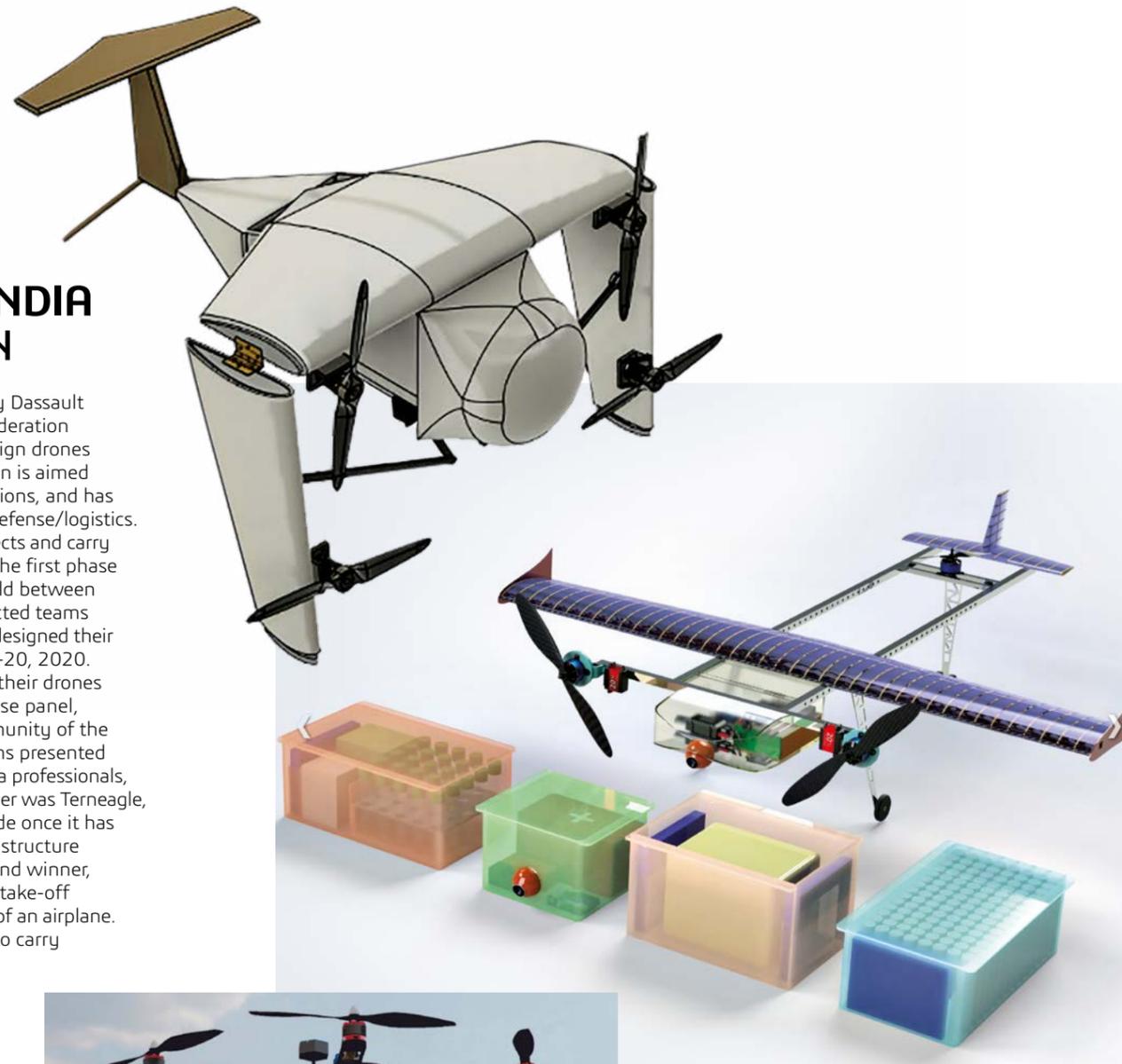
InnoTechLab, which was established with support from **La Fondation Dassault Systèmes**, is a tech innovation lab held a launch event in October 2020 in Yaoundé (Cameroon) in the presence of the minister for employment and professional training and the minister for small and medium-sized enterprises. The center will foster experimentation with and training in digital technologies and 3D simulations. Dassault Systèmes employees will share their knowledge under a skills-based volunteering program and help to train a new generation of African engineers. Industrial engineering, urban planning, energy, agriculture, logistics, mobility, life sciences and connected health are fields covered

by this initiative. InnoTechLab is also the cornerstone of a strategy for upskilling young engineers across Africa. In parallel, the Haile-Manas Academy has initiated a plan to build an innovative school at Debre Birhan thanks to support from **La Fondation Dassault Systèmes** US. It will educate 400 talented students from across the country. They will receive high-caliber teaching spanning multiple disciplines and will gain professional skills through access to a “makers” space. The teachers will be trained in how to support and guide students in extra-curricular workshops during which they will learn the basics of 3D design and engineering technologies.



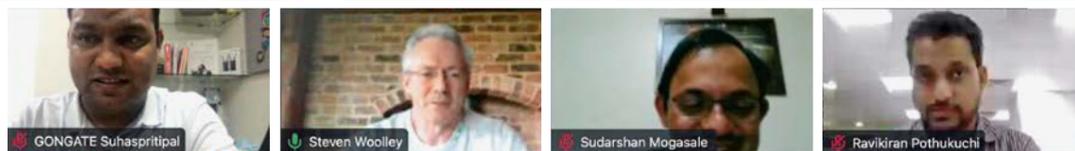
PURSuing SUSTAINABILITY IN INDIA WITH DRONE-A-THON

Drone-a-thon is a virtual hackathon organized by Dassault Systèmes 3DEXPERIENCE Lab and the Drone Federation of India to encourage students and others to design drones using the 3DEXPERIENCE platform. Drone-a-thon is aimed at universities, startups and non-profit organizations, and has four categories: agriculture, city, healthcare and defense/logistics. Participants use the platform to design their projects and carry out simulation and systems engineering work. The first phase involved a challenge that narrowed down the field between October 19-31, 2020. In the second phase, selected teams received training in how to use the platform and designed their drones as part of a hackathon from November 9-20, 2020. In the third phase, 10 selected teams presented their drones to Dassault Systèmes employees and an in-house panel, and five were selected through a vote by a community of the platform's users. In the final phase, the five teams presented their concepts to a panel of industry and academia professionals, and three winners were selected. The overall winner was Terneagle, a quadcopter drone that can switch to glider mode once it has reached a certain altitude, since its aerodynamic structure is compatible with both types of flight. The second winner, Pegasus, a tilt-rotor VTOL, combines the vertical take-off capability of a helicopter with the cruising speed of an airplane. Finally, Agro-Raptor is a robust drone designed to carry heavy loads.



SPEAKING THE LANGUAGE OF INNOVATION AT THE PURDUE CENTER

"The language of innovation in the future will be simulation," said Dr. R. Byron Pipes at the opening of the 3DEXPERIENCE Education Center of Excellence in Advanced Composites. Dr. Pipes, Distinguished Professor of Engineering and Executive Director of the Composites Manufacturing & Simulation Center (CMSC) housed at Purdue University's Indiana Manufacturing Institute, is a world-renowned specialist in the field of composite materials. "The knowledge base we've created currently resides in books, magazines and academic papers. Eventually, it will reside in simulation tools. This is where the future is going," he added. The aim of the Center of Excellence is to create a learning environment for research into the manufacturing and performance of advanced composites and the engagement of all levels of students, in order to develop the knowledge required for Industry 4.0. Dassault Systèmes' center is located within the Indiana Manufacturing Institute at Purdue Research Park. One of the materials being developed there, a new thermoplastic composite, could help drive development in urban air mobility, drones and aerospace platforms. By giving designers a way of trying out innovative new materials and manufacturing processes virtually, the aim is to speed up the creation of new systems with the students of today and generations to come.



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