

EDGE

AN R&D DIGITAL STRATEGY PUBLICATION



digital
strategy

SENIOR LEADERSHIP

Featured columns from
Athina Kanioura
Rene Lammers

Modeling & Simulation
Digital Twin
Virtual Packaging.

CELEBRITY CAMEOS

VIRTUAL DEVELOPMENT ISSUE

Preparing R&D To Be A Virtual-First Powerhouse.

NOVEMBER 2021

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ATHINA KANIOURA

A welcome letter from Athina Kanioura, our Chief Strategy & Transformation Officer.



RENE LAMMERS

Rene Lammers gives us questions to think about as professionals in science, research and technology.



JAMES YUAN

James Yuan talks about how virtual development is R&D's new innovation reality.



VIRTUAL DEVELOPMENT

Explore the world of ViD through the PepsiCo lens, and become grounded in basic terminology.



MODELING & SIMULATION

These terms are often used, yet they mean different things. Learn the basics of M&S, how they are used and leveraged at PepsiCo.



VIRTUAL PACKAGING

Max Rodriguez and team explain how digitization has changed the way bottles are made.

VIRTUAL DEVELOPMENT



CELEBRITY CAMEOS

What's learning if it isn't fun? Join Cedric the Entertainer and other renowned celebrities as we build our glossary of terms.



MEASUREMENT SCIENCE & DATA SCIENCE

Jo Hunt, Prabhakar Kasturi and Jason Parcon give us an inside look at work they are currently performing.



DIGITAL TWIN

Sean Eichenlaub shares how Cheetos uses machine learning and process automation to produce the perfect snack, every time.



ROBERT NOLAN

Jake del Campo completes a Q&A session with the Ana Tech Director and answers your questions about 'the cloud.'



FEEDBACK

Letters from EDGE readers to the publishers.

A hand holding a white pen is visible on the right side of the image, pointing towards a complex network diagram. The diagram consists of numerous nodes (small circles) connected by thin lines, forming a web-like structure. The nodes are colored in shades of blue, white, and purple. The background is a blurred, light-colored surface, possibly a whiteboard or a screen, with some faint, larger circular shapes. The overall aesthetic is clean and professional, suggesting a focus on technology, data, or strategic planning.

FORESIGHT



DIGITALIZATION IS THE WAY FORWARD

Athina Kanioura

EVP, Chief Strategy & Transformation Officer



Hello R&D!

Since I joined PepsiCo last fall, I've been focused on finding ways to leverage technologies and build capabilities to help PepsiCo win and thrive in the market. Digitalization is the way we'll do this. Over the past several months, I've had the pleasure of meeting many of you and have come away impressed with your digital strategy and vision to become a virtual-first R&D powerhouse.

Of course, digital transformation does not happen overnight. We are looking at all aspects of how digitalization can help us achieve our goals - it is not just about

getting the right data into the right systems, or even applying digital capabilities to generate new insights. While these efforts are fundamental, people and culture are critical components to any successful transformation effort. Luckily, in R&D, we have some of the most talented scientists and thought leaders here at PepsiCo.

With your partnership, I believe the future is bright. I look forward to the journey ahead. Together, we can digitally transform PepsiCo and become Faster, Stronger, Better!





TREMENDOUS GOOD COMES FROM COLLABORATION, TECHNOLOGY & SCIENCE

RENE LAMMERS

Chief Scientific Officer

"Science may set limits to knowledge, but should not set limits to imagination"

-Bertrand Russell

I've always enjoyed this quote by the British philosopher and mathematician, Bertrand Russell. For all of us in R&D, it accurately summarizes how our work can change PepsiCo for the better, just through our imagination. If we dream big, it only motivates us.

As we strive to deepen our organizational knowledge, our end goal is

to ultimately win in the marketplace, through differentiating capabilities like digitization. This is what makes us stand out from the competition, giving us world-class designation. When you read through an issue of EDGE, you get to see your colleagues doing just that, fulfilling our digitization goals as outlined in the Digital Strategy.

As an R&D organization, we've adopted new ways of working, then implemented them globally. This is, by no

means, a small feat. It is, however, a testament to the tremendous good that comes from collaboration, technology and science. Just think, we're just getting started. Because of you, billions of lives around the world will be positively impacted. That's something to get excited about!

When you read through this issue, here are thoughts for you to consider:

- Are we advancing science and technology?
- Are we being bold in our pursuits?
- Are we enabling a culture of experimentation and learning?
- Are we celebrating success?
- How well are we collaborating, externally and internally?

We are living in a time that our children and our grandchildren will be studying and remembering for decades to come. How fortunate we are to be working in science, technology and research! As I've said, its our opportunity to impact lives for the better.

I look forward to sharing these moment with you.





James Yuan

Sr. Director - Data Science & Analytics

Virtual Development is the New Norm of R&D Innovation

It's imperative in the all-digital ecosystem, our experiences are going to be driven by digital experiences. We will provide more personalized experiences to our consumers and customers to bring more smiles. We will innovate with virtual-first driving force and that'll be our new norm of working and Virtual Development will be our digital ecosystem.

So what's it like with Virtual Development as our new norm? Let's image 5 years from now, it's 2026. Imagine Market Insight predicts healthy premium beverage with super fruit will lead the trend, this information feeds into our product intelligence model to predict Dragonfruit flavor will be the hit and suggest 3 top flavors from 500+ available variances. Our product developers use AI-based flavor creation model to project potential flavor attributes and run simulation model to create optimal combinations in the beverage's matrix, and identify our best opportunity is green tea. Then process engineers and packaging engineers conduct computer modeling and virtual experimental design to come up with best process/packaging option for the new beverage, then Marketing run the simulation to virtually test product market performance and consumer feedback; and results are great.

So commercial engineers run the simulation model to identify the best manufacturing facilities to make the product, and logistics analyst runs the simulation model to find the best channel to deliver products to consumers' hands. All above activities are completed in virtual environment in one business day. This is not a fantasy, but a vision we have for our digital transformation journey, and Virtual Development is the critical enabling capability to achieve our vision.

To be clear, virtual development is not to replace our physical lab activities, but to make our SME's to be more efficient and effective because they will test much fewer variants to reach the finish line.

Also want to address the **importance of us**, the people in this digital ecosystem.

Good AI or simulation models need good data and good data needs humans in the loop to identify and tackle the most challenging scientific problems. So when we talk about 3 foundational elements to build digital ecosystem: People, Process and Technology; People will always be first, and we will be together to lead the change and accomplishing our digital vision!



Don't Miss These 3 Videos:

- ▶ **R&D Virtual Development Executive Summary**
- ▶ **Beverages - R&D Virtual Development Vision**
- ▶ **Foods - R&D Virtual Development Vision**





virtual development



A NEW DAY
FOR R&D

let's explore the possibilities

Welcome to the World of Virtual Development

Everything in the food and beverage industry is changing. Our consumers demand new products tailored to their sensory preferences, with improved nutritional and environmental profiles.

To sustain PepsiCo's success, R&D needs new ways of working to define, design and deliver food and beverages faster, with less resources, while meeting complex compliance requirements for all countries and regions. This innovator's dilemma is a great challenge and digital transformation is an important part of the solution.

We are re-imagining R&D to become a ***virtual-first*** powerhouse in a food and beverage industry where R&D data is digitized, connected, shared, and fully utilized in a way

that this quality data can be used for all relevant product decisions and new data is generated only when necessary.

To build this level of data maturity, we are investing in interoperable software and hardware technology platforms to deliver consumer centric innovation faster with greater resource efficiency.

In a world as complex as data science and analytics, it is important to ground ourselves in basic terminology commonly used.


First things first. . .

To ensure that all EDGE readers are on a level playing field, we asked a few celebrities to assist us with this glossary of terms.

Cedric the Entertainer

api

application programming interface is a connection between computer programs. It is a type of software interface, offering a service to other pieces of software.

A close-up portrait of Taylor Dayne, a woman with long, wavy, blonde hair, wearing a black lace top. She is looking slightly to the right of the camera with a neutral expression. The background is a plain, light color.

Taylor Dayne

cloud

software and services that run on the internet, instead of locally on your computer. Cloud computing is the delivery of services - including servers, storage, databases, networking, software, analytics and intelligence over the internet to offer faster innovation, flexible resources and economies of scale.

The Sklar Brothers



digital twin

a digital twin is a virtual representation of an object or system that spans its life-cycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision making.

machine learning

the use and development of computer systems that are able to learn and adapt without following explicit instructions, by using algorithms and statistical models to analyze and draw inferences from patterns in data.

virtual development

the practice of research, developing and prototyping products in a completely 2D or 3D environment.

Lisa Loeb



A person is shown in profile, wearing a VR headset and holding two VR controllers. The background is a blurred laboratory or office environment with blue lighting. The overall tone is professional and technological.

M&S

Modeling & Simulation

FEATURING

Frank Brenkus
Abdullatif Tay
Jenna Wang
Lei Zhao

VIRTUAL FIRST

Modeling and **Simulation** carries different meanings by different industries at different times throughout history.

For our purposes at PepsiCo, we use models as a basis for simulations to develop data utilized to assist us in our decision-making process. As such, R&D teams voiced a need for a central technology platform to unify ongoing and future modeling and simulation projects.

Through the R&D Digital Strategy, a number of vendors were identified and vetted. We are pleased to announce that **Dassault 3DX** has been

How Modeling & Simulation Will Increase Our Speed to Market, Keeping Us Efficient, Competitive & Relevant

selected as the core technology for the R&D Modeling & Simulation Platform.



R&D POWERHOUSE

”

**IF WE CONTINUE
TO DO THIS RIGHT,
WE CAN UNCOVER
THE UNKNOWN,
UNKNOWN.
THAT IS HUGE!**

”

JAMES YUAN

VIRTUAL PACKAGING



”

**Through the use of
Virtual Development,
the
Advanced Engineering
& Design Team
is driving a
transformation in
packaging innovation**

”

Max Rodriguez

FASTER, STRONGER BETTER

Max Rodriguez

Advait Bhat

Rebekah Pendrak

Thangthip Tekanil

Ellie Vineyard

**HOW PERFORMANCE
SIMULATION,
DATA DEMOCRATIZATION,
RAPID PROTOTYPING &
ADVANCED SYSTEM
CAPABILITIES IMPACT US**

PepsiCo Packaging R&D Digital Transformation combines a consumer centric design approach with advanced digital tools, resulting in streamlined development, right the first-time results, and a 50% reduction in development time!

The three pillars of this digital transformation consist of: performance simulation and democratization, rapid prototyping, and advanced system capabilities. Each pillar impacts the product development cycle, empowering advanced engineering and design to work Faster, Stronger and Better.

Performance Simulation is a digital-first approach which emphasizes virtual testing BEFORE engaging in more costly and time-consuming physical tests. The Virtual Lab simplifies the validation process, reducing the expertise needed and the time

PERFORMANCE SIMULATION

required to optimize designs. Through this virtual platform, iterations now take hours or 1-2 days, not weeks or months, meaning our engineers can pursue multiple designs simultaneously with greater efficiency. Early adoption has validated its value and soon our entire global R&D team will have these tools at their disposal, fully democratizing our digital capabilities.

While virtual testing enables our Digital Transformation, the importance of physical prototypes cannot be understated. In the past, PepsiCo has relied on 3rd parties for prototypes, which meant increased cost and long lead times. Now, PepsiCo has brought rapid prototyping capabilities in-house. Our new Stratasys J55 printers can quickly print full-color prototypes for evaluation, bringing impactful consumer feedback sooner than ever before. The Modular Mold Kit, a PepsiCo internally developed technology, creates molds capable of producing 10,000 shelf-ready prototypes. R&D teams can now go from CAD to scale in as little as 48 hours, giving us full ownership of prototyping!

Our Advanced System Capabilities are all about getting it right the first time and reducing the need for physical trials. This involves creating Hybrid Tests where simulations are run in advance of physical tests, reducing trial failure rates, allowing

RAPID PROTOTYPING

projects to clear the development cycle in record time at lower cost to the business. On the production floor, our group is developing a Smart Controller for Blow Molder recipes, which allows for real-time equipment and material adaptations. A 3rd party process that once took days will be completed in-house in under an hour. PepsiCo has brought this digital mindset to our customer focused teams through augmented reality tools like the CAVE system, a headset free digital shopping experience that brings more agility to consumer testing. Multiple functions across the organization are embracing these advanced digital systems to improve capabilities and reduce product development time.

Through the 3 pillars of our Digital Transformation, PepsiCo will bring better products to market sooner, providing our customers with a more refreshing experience! Join us as Advanced Engineering and Design accelerates into the Digital Transformation, working Faster, Stronger and Better.

Team Photo (from left to right):

Thangthip Tekanil, Max Rodriguez, Ellie Vineyard, Advait Bhat and Rebekah Pendrak



A top-down view of a white ceramic bowl filled with bright yellow, C-shaped snacks, likely cheese puffs or corn curls. The bowl sits on a white surface, and several more snacks are scattered around it. The lighting is bright and even, highlighting the texture of the snacks.

AI

DIGITAL TWIN & MACHINE LEARNING



DIGITAL TWIN

“#Twinning” is one of the most popular hashtags used in social media. While photogenic influencers and Tik Tok darlings are liked and engaged by audiences for dressing alike or acting the same, scientists and engineers have explored the idea of digital twin long before it arrived on the pop culture scene. But what in the world is it?

In plain language, a digital twin uses data and data modeling to tell us everything we need to know about the current and future performance of a physical asset.

“A real, *online digital twin*, meaning, all the live data, live sensors, live status of that physical asset will be captured live. You’ll know exactly any moment, any time, any history, of what happens on the line in terms of performance, productivity, scheduling, so you have a constant view of what’s going on in the real asset.”

- Lei Zhao

A GLIMPSE OF THE FUTURE

Because of virtual development, we are able to deliver the delicious, satisfying, crunchiness of Cheetos, anywhere around the world. And we're doing it faster, better and more efficiently than ever.

- **Smart Vision Systems** (cameras) automate a previously manual process, thereby reducing errors and inefficiencies.
- **Bulk Density Simulation** (sensors) in real-time predicts measurements.
- **Continuous Data Stream** for real-time process control.
- **Deep Reinforcement Learning Algorithm** for optimum Cheetos, all the time.



MEASUREMENT SCIENCES

FEATURING
JO HUNT
PRABHAKAR
KASTURI
JASON PARCON



EARLY ADOPTERS

The background of the entire page is a complex network of nodes and lines. The nodes are represented by small circles in various colors, including light blue, white, and purple. The lines connecting these nodes are thin and also in various colors, creating a web-like structure. On the right side of the image, a hand is visible, holding a white pen or stylus, pointing towards the network. The overall aesthetic is clean, modern, and tech-oriented.

Measurement Sciences has been on a digital journey since 2006. Their digital capabilities grants us the opportunities to look for ways to tie together virtual technologies.



DYNAMIC HEADSPACE

An interview with Prabhakar Kasturi

Ana Tech Director

Can you tell me what is dynamic headspace and what this technique does?

Dynamic headspace (DHS) is primarily used today for flavor analysis. It takes into account the smell and taste of a product that a consumer experiences. Using the DHS methodology we go beyond product label and look closely at the chemical signature of the flavors. The chemical signature tells us how we can get closer to the ideal consumer liking profile.

What can you do with all the data generated by this dynamic headspace method?

It really helps in speeding up innovation. We will use the Dynamic Headspace data to guide flavor formulation. It does this in two ways. First, this will give us a predicted win in the marketplace. Second, it improves our speed by doing fewer iterations.

Tell me how a tool like DELTA is going to help you with speed to innovation.

This is the exciting piece!

Right now, we have siloed data. The vision for DELTA is one enterprise laboratory information management system for cross functional lab data (sensory and consumer product insights data, dynamic headspace data, other analytical data, micro data, etc). These data will be standardized such that they can be joined through analytics and deliver new innovation insights. Today, finding and joining data sets is very manual and time consuming. DELTA will be a game changer and make this nearly automatic.

MEET THE GEEK

Q&A WITH ROBERT NOLAN

WHAT IS THE CLOUD?

Welcome to a day in the life of Robert Nolan, Ana Tech Sr. Director, as captured through a conversation with Jake del Campo, Sr. Manager & PMO for Virtual Development.

Jake del Campo

So we're going to start with some light questions to get to know you personally before we get a bit technical.

Coffee or tea?

Robert Nolan

Lots of coffee, too much, too much coffee.

Jake del Campo

Favorite PepsiCo snack and beverage?

Robert Nolan

Walker's cheese and onion 'crisps' as we call them, 'chips' as they are known in North America and a Pepsi Max.

Jake del Campo

Android or iOS?

Robert Nolan

iOS.

Jake del Campo

Google, AWS or Azure?

Robert Nolan

Microsoft Azure is PepsiCo's primary cloud provider of choice. However, all have their advantages, and all provide a similar level of capability.

Jake del Campo

What would you say is your most used mobile app?

Robert Nolan

YouTube. And, uh, a couple of crossword games that I have on my iPhone. Oh and a chess application that I found recently where I've realized I am terrible at chess.

Jake del Campo

What is the purpose of your data and engineering team?

Robert Nolan

To mature R&D's digital capability both technically and operationally by developing ever more sophisticated business impacting digital solutions.

Jake del Campo

What is the cloud?

Robert Nolan

The cloud is a key enabler of a modern digital transformation strategy.

NOLAN Q&A CONT.

It is worth mentioning before going into a description of the cloud and its capabilities, that the cloud or indeed any specific technology alone cannot get us to our desired state of digital maturity.

While our technology and cloud strategy supports and delivers new process possibilities and opportunities for people to optimize the roles they perform to focus on high value activities, the technology pillar needs to mature in line with our process, people and governance strategies.

With that said, simply put, cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet to offer faster innovation, flexible resources, and economies of scale. You typically pay only for cloud services you use.

[This is an interesting article](#) which provides a little history for fellow “geeks”.

Over the past 10 years the cloud providers either developed or integrated additional “services” to enable users to quickly develop, data solutions and cloud-native applications. The number and sophistication of the cloud services that organizations such as PepsiCo can leverage increases each year, e.g. the cloud platforms provide us with the capability to create, manage, ingest huge volumes of data, (in near real time when required) and to create applications which interact

with and/or enhance that data. The cloud platforms furthermore provide the environment for us to create and run complicated (processor heavy) analytical algorithms seamlessly all in the one “space”.

In summary the cloud is a key technology enabler in our pursuit of rapid data driven/informed decision making.

Jake del Campo

And how will the cloud be leveraged in our R&D digital strategy?

Robert Nolan

Organizations like PepsiCo are moving to the cloud in the pursuit of speed and agility of digital solutioning to maximize business impact. We will develop the cloud to provide the environment on which we can create what are called cloud native solutions. Cloud native solution design where outputs are interoperable is one of the hallmarks of digital maturity.

We will also use the cloud to test and build new applications. Reducing application development cost and time by using cloud infrastructures that can easily be scaled up or down.

We will also use the cloud to ingest, clean, join and analyze data, unifying our data across teams, categories, and locations. We will also use cloud services, such as machine learning and artificial intelligence, to uncover insights for more informed and faster decisions. The cloud will enable us to embed data driven intelligence into our day-to-day business processes.

Finally, the cloud is going to be the key enabler for our democratizing data and solution development.

Jake del Campo

What would be your recommendation for how we think about the cloud?

Robert Nolan

I hope what we have already talked about conveys the fact that the cloud offers a lot more than a place where we “put” data. The cloud provides an opportunity to get at data much more easily and readily, but more importantly it is where will convert data into business value.

DIGITAL SuperStars TOUR

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digital strategy



SEPTEMBER



AUGUST



JULY



JUNE



MAY



APRIL



MARCH



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We're always going to have the big systems such as SAP or Salesforce or LIMS that have been optimized to carry out certain specific processes. However, the cloud is also what will enable those systems to interoperate with each other and other cloud native applications that we design.

Jake del Campo

How can we manage data across systems more effectively than we are today?

Robert Nolan

We should focus on ensuring data and digital solutions are coherent and interoperable. Coherent means the data has common meaning across solutions and can be leveraged effectively to answer questions. The concept of master data is one that we're still maturing but it will be a key aspect of an improved coherency of data across multiple systems and applications.

If we follow some common design principles, then we maximize the chances of our digital solutions seamlessly interoperating with each other.

That said, we get to coherency and interoperability by having clear business problems and/or key questions we wish to answer. This will drive our data and technology strategy and get us to where we want to be much faster.



EDGE FEEDBACK



I really liked how EDGE was presented, it was easy to read and visually engaging - thank you!

For future editions, it would be great to hear about these examples from a diverse range of countries, rather than a US focus. It'd also be great to perhaps have a section explaining a digital term, because many people use words but I'm not sure they understand the meaning behind them.

Anna Lowndes
Director
Chatswood, NSW, AUS



I listened to all of the interviews, and it went beyond my expectations, because it made me realise that since I joined PepsiCo in 2003, the roadmap is coming together.

What reading the 2 issues flagged to me is that I need to continue allocating time to the trainings provided in terms of mindset change associated activities.

A point I could not feel in the 2 issues, is how we, as a business, are addressing the training of employees in terms of data analysis. I believe I have got good academic skills in terms of data analysis but I graduated in 1998!

If we are equipped with better quality of information but we do not understand them, the digital transformation would not be the right success to enable the even better, even stronger, even faster motto.

Linda Swallow
Principal Scientist
Leicester, England





FEEDBACK



Are you ready for more Virtual Development in R&D?
Click the icon to send us feedback and you maybe featured in a future edition of EDGE.

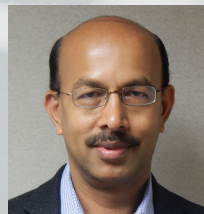
ACKNOWLEDGMENTS & ADDITIONAL RESOURCES



Our sincere thanks to the R&D team members who graciously participated in this issue. We are pleased to share the full interviews as well as additional resources below.



Abdullatif Tay
Interview



Prabhakar
Kasturi Interview



Jason Parcon
Interview



Jenna Wang
Interview



Frank Brenkus
Interview



Sean Eichenlaub
Interview



Jo Hunt
Interview



James Yuan
Interview



Lei Zhao
Interview



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Jake del Campo

Sr. Manager - Global
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Chris Kohatsu

Consultant &
Sr. Content Strategist