AUTOMATA   **CellVoyant**

Automata x CellVoyant: Autonomous workflows for cell culture

Turning Living Systems into Learning Systems

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Pulling Tomorrow's Lab Into Today's Reality

Automata is overhauling how lab automation is done by demolishing legacy barriers, obliterating complexity and supercharging discovery — driving a seismic shift that pulls tomorrow's labs into today's reality, for all. For labs shaping the future of science, Automata delivers the only fully integrated, AI-ready and easy-to-use platform that is dynamically modular, radically configurable and intelligently open.

CellVoyant exemplifies this transformation. By integrating their AI foundation models with Automata's LINQ™ platform, they've created the world's first truly adaptive, AI-driven cell culture system—turning the theoretical orchestrated iterative concept into operational reality.

Pioneers of Cell Culture

CellVoyant is pioneering the integration of AI foundation models with automated cell culture to transform how biologists monitor, predict, and optimize cell-based processes. By utilizing solely label-free white light images, this preserves biological integrity in ways legacy imaging assays cannot achieve. Their flagship product FateDrive™ leverages CellVoyant's Foundation Models, computer vision and *in silico* modelling to enable real-time, non-destructive cell analysis and process optimization. This is a vast improvement over the traditional fluorescently stained assays coupled with human interpretation of the results. This enables much faster and more consistent identification of markers within cell populations.

The Challenge: Complex, variable biology demands a streamlined, adaptive approach

Cell-based protocols are complex, lengthy processes that traditionally require:
- Manual intervention often every single day, including weekends
- Destructive sampling to gather quality metrics
- Extensive trial-and-error to optimize treatment combinations
- Significant time investment for routine tasks like cell counting and monitoring

Legacy automation systems compound these challenges. Most automated platforms available were monolithic for fixed workflows with no room for intervention or adaptation. As Rafael Carazo Salas, Founder and CEO of CellVoyant, explains: "Most automated cell culture platforms that have imaging in them when we were exploring the market were monolithic, so they didn't allow us to intervene. The reason for this is that traditional

automation for cell culture aims to reduce variability and cost by streamlining hardware operation to minimise deviations, not to accommodate to deviations."

However biological reality demands the opposite: "Cells' proliferation and behaviour can be very different depending on the specific cell sample material used on the day and depending on the specific reagents and experimental conditions used even if they correspond to the same treatments, and depending on the cell batch and cell line used. And so, working with cells and optimizing cell culture demands the opposite, that is to accommodate for and leverage optimally those deviations."

CellVoyant needed an automated platform that could not only handle routine cell culture tasks but also interface dynamically with their AI algorithms to enable adaptive, real-time protocol adjustments—something legacy systems simply could not deliver.

Photo credit: Science Creates
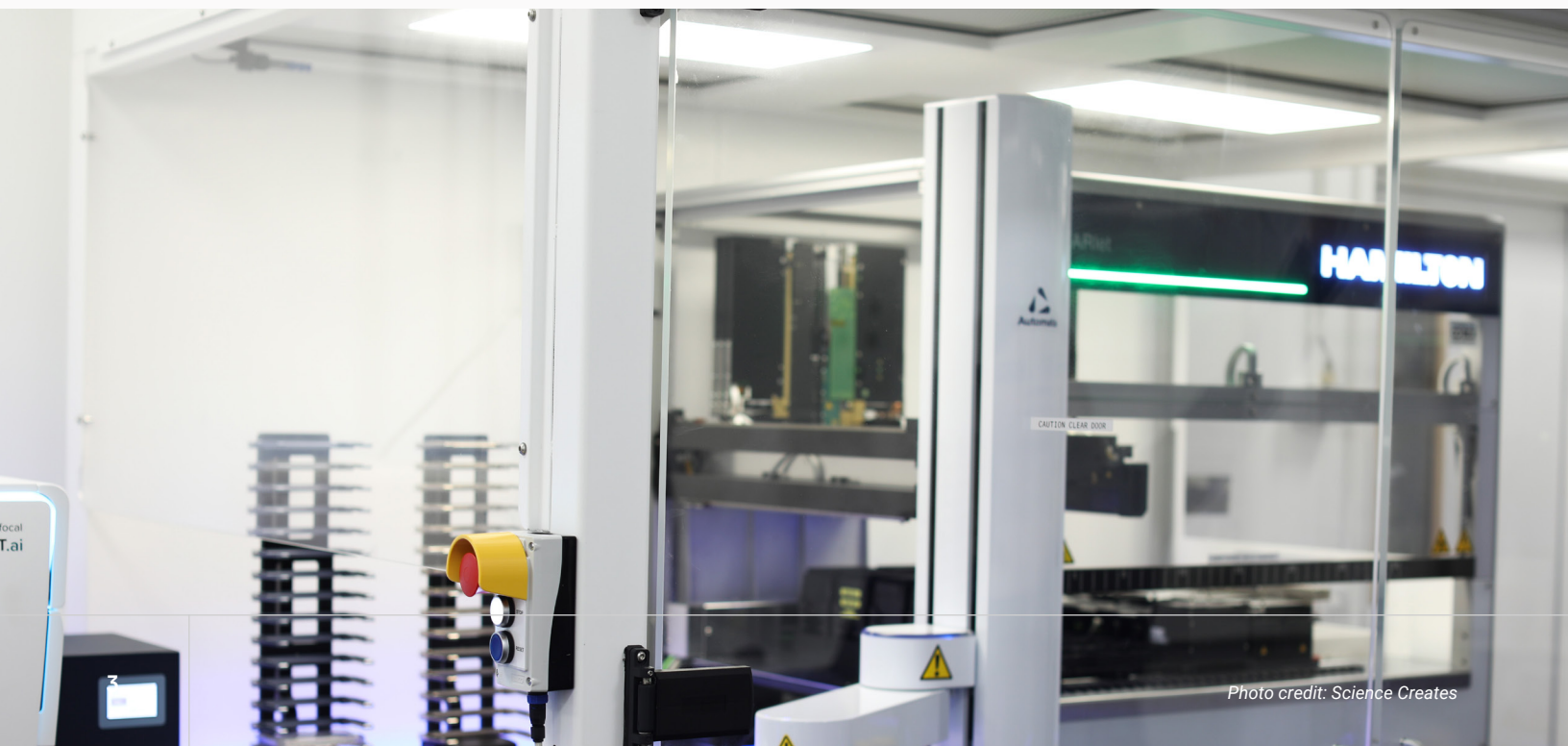
The Solution: Breaking legacy barriers with Automata's LINQ™ platform and CellVoyant's FateDrive™

While legacy alternatives fragment and stall labs, the combined Automata and CellVoyant solution modernizes and propels them.

After 4 years of platform development and nearly 2 years with the Automata LINQ™ system, CellVoyant has established a pioneering adaptive workflow that demonstrates what becomes possible when disruptive interoperability meets radical configurability:

- **Dynamically Modular Hardware:** The Automata LINQ™ automated work-cell for cell culture, treatment, and imaging.
- **Intelligently Open Architecture:** Direct interface between CellVoyant's FateDrive™ AI and Automata's orchestration software.
- **Adaptive Control:** Real-time protocol modifications based on AI predictions.

"The key differentiator of the Automata LINQ™ platform is that it was modular enough that it could liaise and interact with our AI models and capabilities", Rafael notes. "What really appealed to us when it comes to the Automata system was the capacity to be able to interface with it and our AI models and capabilities."

This integration exemplifies Automata's mission: making the lab of the future not just possible, but inevitable. Built on an open data architecture and engineered for rapid deployment, the LINQ™ platform eliminates the pre-defined static workflows that have plagued cellular imaging-based lab automation for decades.

How It Works

FateDrive™: *In Silico* **Process Evolution**

"A bit like Google Maps navigation in real time, where if you take the wrong road, or if there's suddenly a traffic jam, then you can reroute."

Leveraging CellVoyant's FateView™'s - a breakthrough technology that enables 'live' label-free cell detection and counting, cell type identification at population and single-cell levels, and future state predictions hours to weeks in advance - FateDrive™ simulates and predicts millions of process variations that optimize treatment protocols:

- Models combinatorial treatment effects across millions of possible combinations of experimental conditions
- Predicts quantitative outcomes for different interventions
- Recommends optimal treatment combinations based on the target output requirements
- Instructs the Automata LINQ™ platform to execute optimized protocols

"FateDrive™ adaptively explores what is humanly impossible, that is it thoroughly explores the universe of different combinatorial treatments by carrying out *in silico* millions of multiday or multiweek experimental processes within minutes, and based on that, it can make predictions and recommendations for what the best treatment combination would be for the intended output" says Rafael. "A bit like Google Maps navigation in real time, where if you take the wrong road, or if there's suddenly a traffic jam, then you can reroute to get optimally to your destination."

Seamless integration of CellVoyant's FateDrive™ via Automata LINQ™

CellVoyant's AI interfaces with Automata software to provide updated instructions dynamically. The Automata system then orchestrates all hardware components — liquid handling, imaging, incubation — to execute the optimized protocols.

Results and Impact

Operational Efficiency: Fast, continuous, adaptive non-destructive processing with insights at every step

- **24/7 Operation:** The system runs continuously, including weekends, eliminating the need for manual weekend cell maintenance
- **Automated Scheduling:** Media changes, passaging, and differentiation triggers occur automatically
- **Non-Destructive Analysis:** Samples remain intact for reuse and re-sampling
- **Faster Timelines:** Quantitative decisions made in minutes instead of days, significantly de-risking and reducing the cost of workflows

"The possibility to do that changes everything, from minimizing human error and burden to step changing reproducibility and productivity" Rafael confirms.

Enhanced Capabilities: Improved workflows regardless of labware, cell type or instrumentation available

- **Flexible Well Formats**: Works with 6-well to 96-well plates and beyond
- **Multiple Protocols:** Successfully optimized multiday to multiweek cell differentiation protocols
- **Cell Type Agnostic:** Applicable across adherent cells, suspension cells, and spheroids
- **Equipment Agnostic:** Compatible with various imaging systems and automated platforms

Real-Time, Closed-Loop AI Controlled Automation Delivers Step-Change Improvements in Cell Differentiation Data

As a proof point of this adaptive workflow, CellVoyant and Automata executed a closed-loop case study on the LINQ™ platform, demonstrating real-time, AI-driven control of a complex 1-2 week cell differentiation process, using cardiomyocyte differentiation from human Pluripotent Stem Cells as exemplar process. Label-free cell population images were automatically acquired at regular intervals and analysed by CellVoyant's FateView™ AI to quantify cell count on the fly as well as to predict 'live' the percentage of cells in the population expressing the transcription factor OCT4 (which usually can only be determined by sacrificing cells), as a measure of cell pluripotency. Those predictions were streamed directly into FateDrive™, which continuously refined the cell culture protocol by dynamically updating the growth factor concentrations to be delivered and the timing of delivery, and by instructing LINQ™'s liquid handling system to update the protocol accordingly through the cardiomyocyte differentiation process. This closed-loop optimisation delivered an eightfold improvement in differentiation efficiency over the baseline protocol, and outperformed a state-of-the-art DOE-based optimisation run in parallel by 60 percent.

Data Acquisition at Scale: Continuous Training of AI Models

"Automation allows us to remove the human factor and significantly scale up the acquisition of data. This is essential for continual AI model improvement in particular for multi-task foundation models, given the scale and variety of data they need.", Rafael said.

The platform enables continuous data collection with fine temporal resolution, allowing early termination of unsuccessful experiments and more informed decision-making throughout extended protocols lasting multiple days to multiple weeks.

Breaking New Ground: Revolutionizing How Science Is Done

CellVoyant and Automata are pioneering dynamic automation for adaptive cell culture processes — supercharging discovery in ways that were impossible with legacy systems. As Rafael emphasizes: "Closed-loop automation in this type of sense really has not been achieved until now. So, we are breaking ground, each of us and collectively, to bring cell culture to the AI era and make possible the future of cell culture today."

The partnership focuses on overcoming technical constraints and expanding flexibility in treatment delivery, timing, and protocol complexity. "Most of the challenges involved are purely technical and can be overcome through time, and this is what our work of the past 2 years has shown" Rafael notes.

This collaborative approach embodies Automata's philosophy: while legacy alternatives stall progress, Automata's radically configurable platform propels labs forward — enabling them to tackle challenges that would be impossible with traditional automation.

Future Vision: Accelerating Faster Clinical Impact

"Working with clinical-stage partners as much as possible this year to leverage FateDrive™'s capabilities to help step change and optimize cell-based therapeutic development with clinical-stage companies. That's our goal for this year."

CellVoyant plans to leverage the Automata LINQ™ platform to:

- Partner with clinical-stage pharma and biotech companies to optimize cell-based therapeutic development and production, for example at pre-IND stage
- Expand dynamic, adaptive capabilities with greater treatment
- Accelerate R&D and manufacturing optimization for partners/clients
- Ultimately help deliver faster clinical impact through process optimization

About the Technology

CellVoyant's FateView™ is available as a cloud-based platform with free trial access at fateview.cellvoyant.com. Users can register online and begin analyzing cell images within 30 seconds.

CellVoyant's FateDrive™ is the AI process development brain that helps biotechs and pharma improve and optimise their processes, significantly improving yields and reducing costs.

The Automata LINQ™ Platform delivers the only fully integrated, AI-ready and easy-to-use platform that is dynamically modular, radically configurable and intelligently open. Built on an open data architecture, it smashes legacy barriers with disruptive interoperability—making advanced automation accessible to all labs shaping the future of science.

Together, they represent a seismic shift in intelligent, autonomous cell culture—where AI-driven insights meet automated execution to transform biological manufacturing and research, forever.

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We are Automata — redefining what's possible in the future of lab automation.

Born from a world-leading research lab, we're demolishing legacy barriers and obliterating complexity to create a new, integrated era of intelligent, accessible automation.

Our platform, LINQ™, is the first fully integrated, AI-ready and easy-to-use automation platform that connects every component of your lab — digitally and robotically — to deliver end-to-end workflows without compromise. Its dynamically modular smart benches and powerful cloud-based software reimagine how you design, orchestrate and monitor experiments, wherever you are.

Built on an open and interoperable architecture, Automata enables labs to move faster, scale smarter and innovate continuously — turning tomorrow's lab into today's reality.

Get in touch with our team of automation experts, engineers and scientists to unlock new possibilities and supercharge your lab's discovery.