BIOVIA

3DEXPERIENCE

FROM TARGET TO CANDIDATE:

Smarter, Faster Biologics Discovery with *In Silico* Modeling

DASSAULT SYSTEMES

INTRODUCTION: FROM INTUITION TO AI-POWERED DISCOVERY TO FASTER DEVELOPMENT

The path to biologics discovery has traditionally been long and complex, riddled with trial-and-error experiments, high costs, and low success rates. For decades, pharmaceutical R&D mostly relied on intuition, serendipity, and time-intensive laboratory work to identify, test, and optimize therapeutic candidates. But as the industry shifts toward new modalities and personalized medicine new challenges emerge, including the need to accelerate timelines, reduce failure rates, and address the complexities of biologics manufacturing.

This E-Book explores how lab digitzation and AI-powered *in silico* modeling transform drug development, enabling biopharma companies to reduce time to market, enhance candidate quality, optimize bioprocess development, and meet regulatory standards. Through these advanced technologies, BIOVIA provides a comprehensive suite of applications for researchers to design and develop high-quality biotherapeutics, helping them gain a competitive edge in the race for life-saving treatments.

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THE COMPLEXITY OF BIOLOGICS DISCOVERY

Drug discovery is often compared to finding a needle in a haystack. Millions of potential therapeutic molecules are screened to identify a few with affinity for the target, yet most fail to achieve desired clinical outcomes. This inefficiency makes drug discovery costly, lengthy, and high risk.

Core Challenges

1. **Identifying and Validating the Right Targets**
   Identifying the correct biological targets is foundational to drug discovery but highly iterative. Precise experiments are required to confirm relevance, and missteps at this stage can derail the entire process.
2. **Screening and Optimizing Therapeutic Candidates**
   Biologics, such as antibodies or peptides, must be rigorously tested for efficacy, safety, and manufacturability. This often involves multiple cycles to meet stringent regulatory standards, further adding to the complexity and lengthy timelines associated with biologics discovery.
3. **Developing Scalable Processes**
   Even when a promising candidate is found, ensuring its stability and scalability in production is challenging. Biologics require sophisticated manufacturing processes to maintain quality and efficacy.

Fail Early to Succeed Faster

The "fail early" approach is a critical strategy in biologics discovery. Molecular modeling and AI/machine learning help researchers eliminate poor candidates early, long before costly lab and clinical testing. This approach allows R&D teams to focus resources on the most promising candidates, saving time, reducing costs, and increasing the likelihood of success.

The Promise of Molecular Modeling and AI/Machine Learning

BIOVIA's biothereapeutics design solutions tackle these challenges, reducing the need for extensive lab experimentation by helping researchers to:

- **Predict Outcomes Earlier:** Prioritize candidates with higher potential.
- **Streamline Workflows:** Minimize waste and speed up timelines.
- **Reduce Costs:** Focus resources on high-quality candidates.

The Drug Discovery Challenge by the Numbers

$2 Billion[1]
Average cost to bring a single drug to market.

10+ Years[1]
Typical timeline for drug discovery and development.

10% Approval Rate in Clinical Trials[2]
Fewer candidates have succeeded in clinical trials in recent years.

[1]DiMasi, 2014; DiMasi et al., 2016

[2]Clinical Development Success Rates and Contributing Factors 2011-2020

FROM TARGET TO CANDIDATE: A SMARTER APPROACH TO DISCOVERY

The discovery of novel biotherapeutic candidates demands precision, speed, and alignment with regulatory, business, and market expectations. BIOVIA revolutionizes this process by integrating best-in-class molecular modeling and simulation methods with novel AI and machine learning models.

Researchers can gain insight into molecular behavior, predict outcomes, identify and refine candidates faster *in silico*, reducing the need for costly, time-intensive experiments.

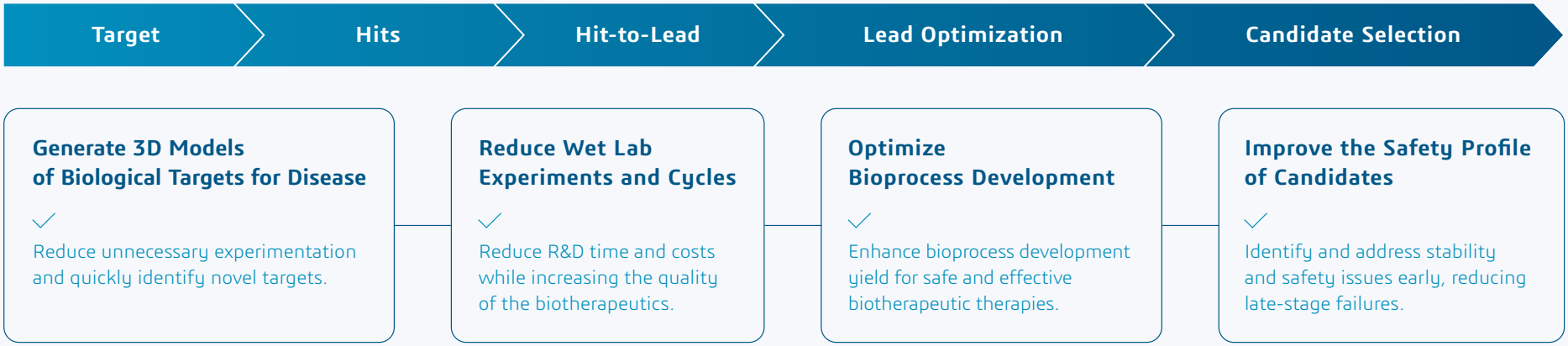
By embedding quality-by-design principles into every stage of the discovery process, BIOVIA accelerates workflows while ensuring candidates meet the highest standards for clinical and market success.

At the core of this approach is the ability to predict and optimize critical properties of biotherapeutics, including:

- **Affinity:** How well does the candidate bind to its target?
- **Efficacy:** Does the candidate deliver the desired therapeutic outcome?
- **Safety:** Are there risks of adverse effects or toxicity?
- **Scalability:** Can the bioprocess yield support large-scale production?

By addressing these factors early, researchers can focus resources on the most promising candidates, minimize late-stage failures, improve bioprocess development, and shorten the path to market.

THE BIOTHERAPEUTICS DISCOVERY JOURNEY



Together, these steps streamline the discovery of biotherapeutics, enabling researchers to deliver innovative treatments faster, more efficiently, and with greater confidence in their success.

STEP 1

GENERATE MODELS OF BIOLOGICAL TARGETS FOR DISEASE

The first step in biologics discovery is to generate models of disease-related biological targets. This critical step involves identifying novel targets for the treatment of disease, a process traditionally reliant on extensive experimentation.

In silico modeling and simulation with BIOVIA Biotherapeutics Design portfolio can help streamline this process, enabling researchers to reduce unnecessary wet lab cycles and focus on the right drug targets.

How BIOVIA's *In Silico* Modeling Supports Target Identification

- Create detailed 3D models of biological targets, helping identify druggable binding sites.
- Analyze gene and protein sequences, simulating molecular dynamics and post-translational mutations that impact target structure, behavior, and functionality.

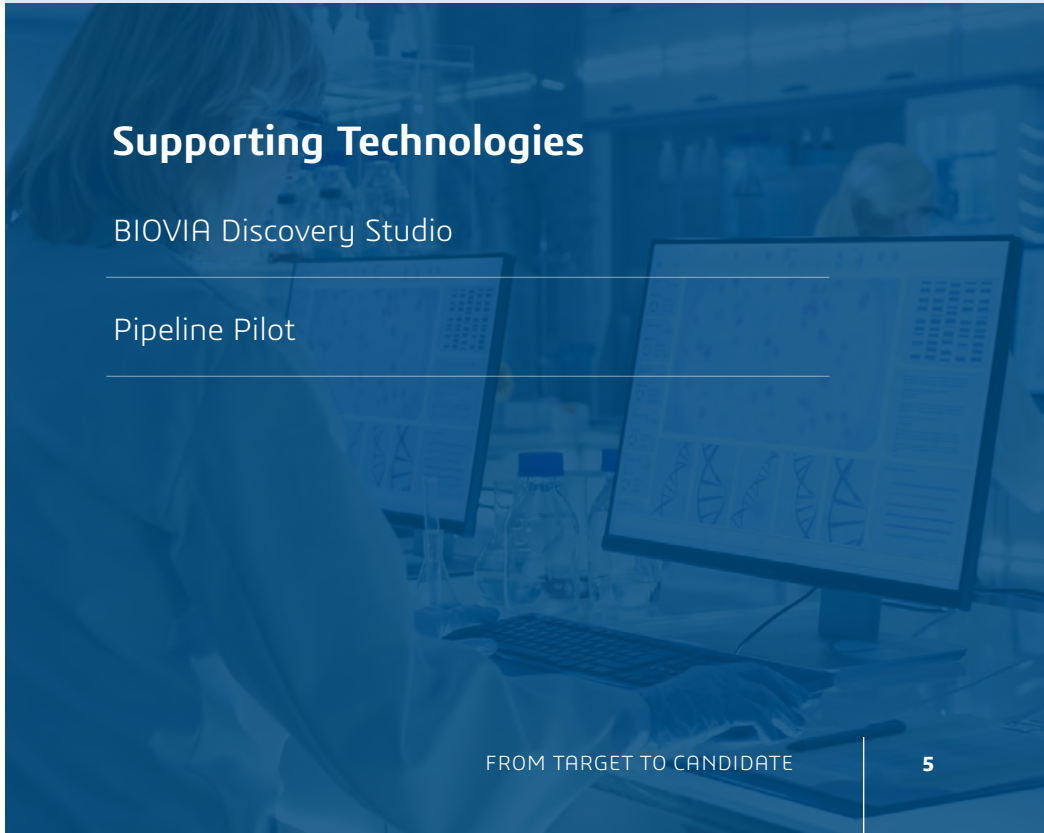
This approach helps identify drug targets faster, saving time and resources when discovering novel biologics.

Key Highlights of *In Silico* Target Modeling

Generate 3D protein models allowing for structural and functional insights.

Conduct virtual experiments to prioritize druggable targets.

Analyze protein and gene sequence to identify novel targets.



Supporting Technologies

BIOVIA Discovery Studio

Pipeline Pilot

STEP 2

REDUCE WET LAB EXPERIMENTS AND CYCLES

The second step in biologics discovery focuses on reducing the number of design-make-test cycles.

By leveraging BIOVIA Biotherapeutics Design portfolio, researchers can use *in silico* methods to evaluate potential biotherapeutic candidates virtually, minimizing reliance on physical testing and enabling more efficient exploration of therapeutic possibilities.

How BIOVIA's Laboratory Informatics Solution Optimizes Candidate Testing

- Generate 3D models of target proteins with homology modeling or AI to provide a robust starting point for protein-protein docking for screening novel candidates.
- Leverage AI and physics-based modeling to predict and optimize binding affinity, efficacy, and safety.
- Perform molecular dynamics simulations to explore molecular behavior and gain insight into mechanism of action.
- Explore advanced modalities, such as bispecifics, single-chain variable fragments, and antibody-drug conjugates, to identify the most promising candidates.

By reducing the number of lab cycles of unlikely candidates, researchers can focus resources on those with greater potential, streamlining development and improving overall outcomes.

Key Highlights of *In Silico* Target Modeling

Rapidly assess diverse therapeutic candidates virtually, minimizing trial-and-error in the lab.

Predict critical properties early for better candidate selection.

Enhance biotherapeutic quality using advanced molecular modeling and AI.

Supporting Technologies

BIOVIA Discovery Studio

BIOVIA Biological Registration

STEP 3

DEVELOP AND OPTIMIZE BIOPROCESSES FOR SAFE AND EFFECTIVE BIOTHERAPEUTIC THERAPIES

The third step in biologics discovery focuses on refining potential biotherapeutic candidates *in silico* to ensure they are scalable for production while maintaining their biological integrity.

With BIOVIA Biologics Process Development portfolio, researchers can digitize lab data to address the challenges of developing bioprocesses that produce safe and effective therapies efficiently, meeting both quality and yield requirements.

How BIOVIA's *In Silico* Modeling and Simulation Transforms Bioprocess Development

- Design, capture, and optimize cell lines, cell media, and process parameters in upstream and downstream bioprocess development.
- Reuse knowledge from previous work, such as data from similar cell lines and process conditions, to avoid starting from scratch.
- Employ tools like design-of-experiments and predictive modeling to identify and mitigate potential pitfalls early in development.
- Combine predictions for affinity, efficacy, and safety with bioprocess development yield to refine production strategies.

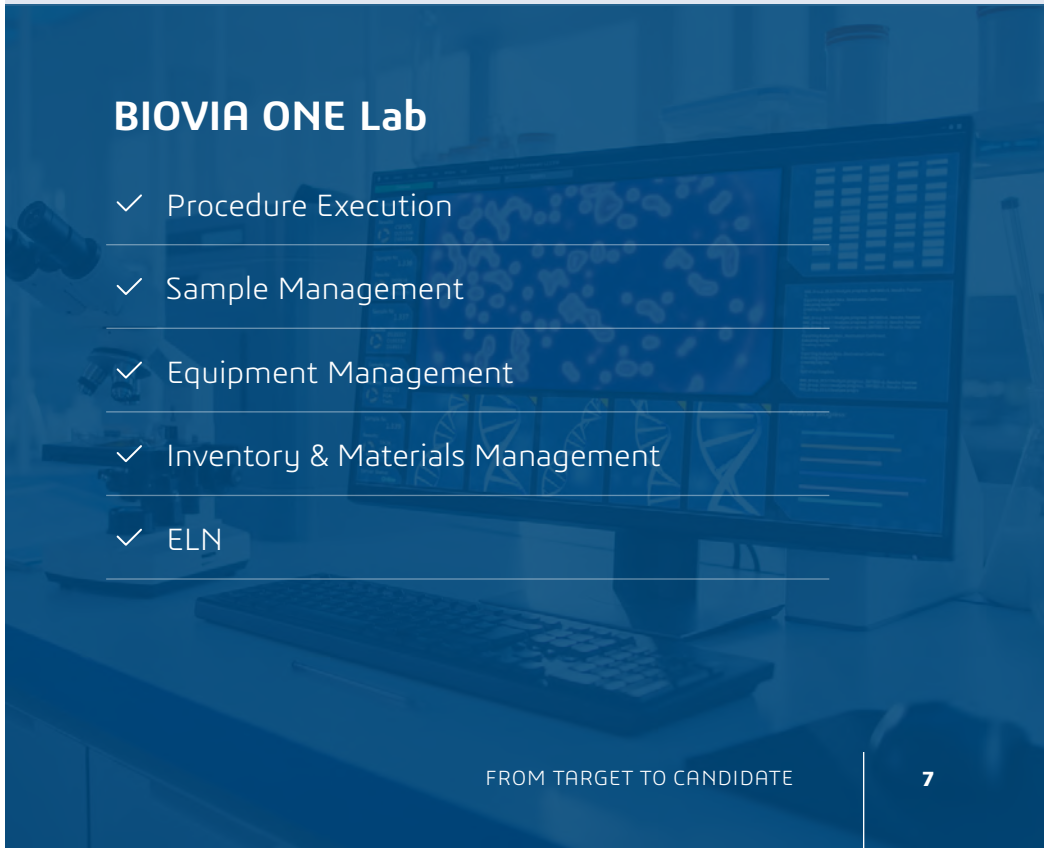
This approach streamlines bioprocess development by leveraging both past expertise and computational modeling, reducing the time and resources required to establish scalable and stable production processes.

Key Highlights of Bioprocess Optimization

Optimize bioprocess parameters virtually, minimizing trial-and-error approaches.

Reuse validated knowledge to improve production efficiency and reduce risk.

Align bioprocess development with business goals, focusing on scalability and sustainability.



BIOVIA ONE Lab

- ✓ Procedure Execution
- ✓ Sample Management
- ✓ Equipment Management
- ✓ Inventory & Materials Management
- ✓ ELN

STEP 4

IMPROVE THE SAFETY PROFILE OF DRUG CANDIDATES

The final step in biologics discovery focuses on improving the formulation properties and safety profiles of drug candidates. Once molecules with high likelihood of success and scalability are identified, *in silico* modeling can help optimize these candidates.

With BIOVIA Biotherapeutics Design portfolio, researchers can improve the safety of the candidates, as well as their formulation properties.

How BIOVIA's *In Silico* Modeling and Simulation Ensures Safety and Stability

- Predict potential immunogenicity issues and humanize antibodies for developing safe treatments, helping avoid costly failed Phase I trials.
- Evaluate biophysical properties such as solubility, viscosity, and aggregation propensity to minimize stability challenges early.
- Refine candidates through virtual testing, enabling modifications or unique formulation approaches to enhance safety and stability.

This approach minimizes late-stage surprises and reduces costly adjustments, ensuring biologics are optimized for clinical success and patient safety.

Key Highlights of Lead Optimization

Reduce immunogenicity with published humanization protocols.

Identify stability challenges, including solubility and aggregation, improving success rates in clinical development.

Optimize formulation properties for flexible manufacturing, additional drug delivery options, and extended storage and shelf life.

Supporting Technologies

BIOVIA Discovery Studio

BIOVIA Biological Registration

THE IMPACT OF *IN SILICO* MODELING AND SIMULATION

BIOVIA's comprehensive suite of modeling and simulation solutions are integrated with AI and machine learning models for faster discovery. Together with BIOVIA's process development capabilities, they enable biopharmaceutical companies to accelerate biologics discovery and development while ensuring quality and scalability.

BIOVIA supports and improves every aspect of the drug discovery and development process, from target identification to candidate development, giving researchers a significant competitive edge in the race to deliver novel biotherapeutics.

Key Benefits

- **Accelerated Target Identification:** Rapidly pinpoint biologically relevant targets to focus discovery efforts on the most promising candidates.
- **Enhanced Affinity for the Desired Drug Target:** Identify candidates with high affinity, improving therapeutic outcomes.
- **High Biological Efficacy:** Develop biotherapeutics with greater potential to achieve clinical success.
- **Optimal Safety Profile:** Address safety concerns such as immunogenicity early to reduce in later stages.
- **Improved Bioprocess Yield:** Optimize scalability and stability to meet manufacturing demands efficiently.

What This Means for Biologics Discovery

Broaden Scope of Discovery
Virtual screening of thousands of molecules in a matter of hours

Increased Success
75-80% success rates with antibody candidates designed virtually

Improved Accuracy
Up to 90% of candidates with improved target interaction

Time Savings
Up to 60% reduction in early discovery phase

Cost Savings
40-60% reduction in early R&D costs

Source of metrics: BIOVIA internal analysis

FROM TARGET TO CANDIDATE

The pharmaceutical industry has experienced a boom of innovationover the past two decades. The leaders in the Life Sciences industry are partnering with BIOVIA, a Dassault Systèmes brand, to accelerate their drug discovery and development. BIOVIA's comprehensive molecular modeling and simulation suite Discovery Studio supports researchers from target identification to lead optimization.

It offers a wide range of powerful tools that enable computational chemists and computational structural biologists to engineer stable and optimized novel biotherapeutics.

Data traceability is critical as treatments move from discovery through development to clinical manufacturing and commercial operations. BIOVIA ONE Lab solution supports all the scientific workflows and processes biopharma companies have to develop new and novel biotherapeutics.

For more information, visit **www.3ds.com/products/biovia/biotherapeutics-design-and-optimization.**

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