WuXi Biologics
Global Solution Provider

Seamless Technology Transfer for Reliable Outcomes

Accelerating project execution from years to months with unmatched quality

The field of biologics has experienced remarkable growth in research, development, and manufacturing over the past decade, with no signs of slowing down. Keeping pace requires nimble transitions between product stages and teams—a crucial process achieved with technology transfer (TT). TT transfers documented knowledge and experience gained during development and commercialization from one organization to another. Done properly, TT ensures consistency, quality, and regulatory compliance for a biologic product.

Typical TT involves internal transfer within an organization or external transfer between organizations. In either case, TT reliably plays a key role throughout biologic product development, facilitating the success of activities such as:

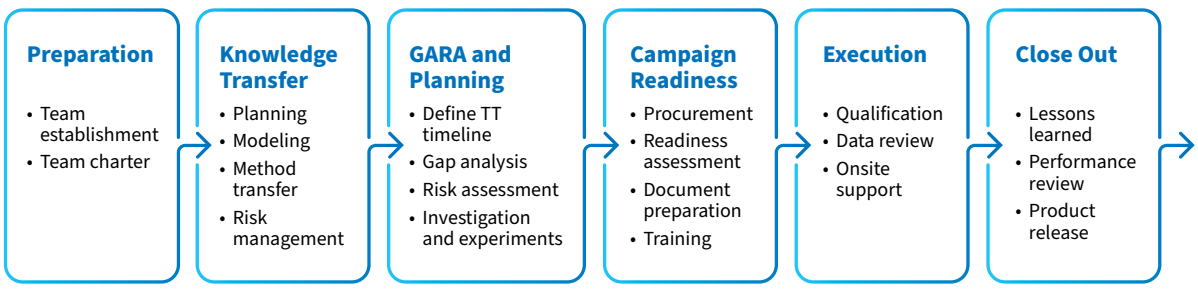
- Preparing the first Good Manufacturing Practice (GMP) batch production after initial process development for an Investigational New Drug (IND) application.
- Producing GMP batches after process characterization (PC) and during performance qualification, as part of preparation for the Biological License Application (BLA).
- Transferring production from a clinical to commercial manufacturing site to support the ongoing production of the commercialized product.

For all its benefits, TT is not without risks. A poorly planned, poorly executed TT can introduce inconsistencies and errors that compromise quality and compliance. A single discrepancy might delay or even fail a program, in turn costing the biopharmaceutical company a leading position that is hard to regain in today's competitive marketplace. Untangling TT's complexities to mitigate risks requires careful planning, detailed documentation, effective communication, and collaboration between the sending and receiving units. Equally significant is thorough knowledge of bioprocesses, equipment, quality attributes, supply chain, and more. Understandably, entrusting the project to an established contract research, development, and manufacturing organization (CRDMO) is becoming more popular.

Technology Transfer Essentials

As a leading CRDMO, WuXi Biologics delivers rapid, comprehensive biologics services that are tailored to meet diverse client needs. Drawing on a strong record of biologic commercialization, WuXi Biologics recognizes that TT is fraught with risks and has developed a well-structured process to prevent these challenges (Figure 1). In this white paper, we highlight four key factors for optimizing TT: meticulous project preparation, proactive risk management, efficient communication, and a CDRMO model.

Figure 1: Overview of the technology transfer process



Meticulous Project Preparation

Investing in project preparation at the outset facilitates execution, minimizes risks, and sets the foundation for successful TT by aligning resources, timelines, and objectives from the beginning. Importantly, project preparation also establishes a subject matter expert (SME) team that has an in-depth knowledge of transferred materials and processes. To ensure the receiving unit understands the transferred materials and processes, the sending unit must provide as much detail as possible and recognize impending gaps.

After the team is established, facility fit is prioritized. Different facilities have different expertise, preferences, and setups, so an experienced SME team is well-positioned to assess how the transferred plans will align with the facility's operations, such as:

- Whether stocked materials in the receiving unit cover the list of transferred materials
- Whether stocked materials in the receiving unit meet the production needs
- Whether stocked equipment in the receiving unit covers the transferred plan

If materials or equipment are unavailable, lead time becomes an important consideration. Quickly identifying alternative options that meet requirements for functionality, operating parameters, quality grade, regulatory compliance, and biosafety is essential. An unyielding supply chain can challenge final material and equipment selection, potentially extending lead times and jeopardizing the overall timeline. After finalizing material and equipment lists, building a detailed action plan with information such as schedule, responsibilities, and deliverables improves project efficiency.

Proactive Risk Management

Limited experience with process development (PD) and GMP production often frustrates projects in the pre-clinical or clinical phase. Gap analysis and risk assessment (GARA) allows organizations to proactively identify areas for improvement and prioritize and mitigate risks before they become problems. GARA promotes systematic analysis of knowledge, equipment, materials, analytics, and processes to foster a comprehensive understanding of alternative plans. Although gap analysis and risk assessment are distinct processes, joining them enhances the accuracy and success rate of the entire transfer process.

Successful TT is apparent when the receiving unit can reproduce the transferred product using a predefined recipe.[1] Any deviations, discrepancies, or challenges identified during GARA can undermine process performance and product quality. And, if acceptance criteria are not met, investigating and addressing the variant's cause is paramount. Having mitigation strategies in place, such as further modifying a technology or process, provides additional assurance and increases the likelihood of a successful TT.

Performing a post-production review in the project closure stage is beneficial. It provides another opportunity to scrutinize and discuss the learnings discovered during TT. These lessons learned, including observations, workarounds, and corrective actions, will likely find utility for managing or avoiding departures in future projects.

Efficient Communication

Too often, miscommunication or incomplete communication leads to misunderstandings or errors during the transfer. Even subtle gaps in understanding can affect outcomes. This challenge is often exacerbated by language barriers. A TT that leverages the many advantages of globalization frequently does so the expense of communication. Language barriers between sending and receiving units might, for example, erode a sending unit's confidence. Efficient communication is vital.

Having an experienced and international SME team comprised of project management, PD, manufacturing, supply chain, quality, and regulatory professionals benefits the receiving unit by directing a continuous flow of relevant information and questions from the sending unit to the right point of contact. Additionally, this model empowers the receiving unit to share expertise and technology, helping identify potential improvements. For example, the receiving unit might upgrade existing product processes or improve the overall yield.

At the start of a transfer, face-to-face communication between the sending unit and the SME team responsible for TT is ideal. This approach exposes any miscommunications upfront and prompts discussion. Direct conversations also accelerate feedback, support individuals, and unite teams by granting space to build rapport. Personal connections not only contribute to team chemistry—they facilitate the auditing process, bringing significant economic benefits to both sides.

CRDMO Model

A CRDMO company brings significant advantages to a TT in the biopharmaceutical industry. In contrast to companies that specialize in specific areas, a CRDMO has both depth and breadth of experience spanning the discovery, development, and manufacturing. WuXi Biologics is a pioneer in this area, possessing expertise of biologic products and the many modalities they stem from, including monoclonal antibodies (mAbs), bispecific antibodies (bsAbs), Fc-fusion proteins, recombinant proteins, enzymes, and antibody drug conjugates (ADCs).

Leveraging this experience grants better insight into the various aspects of internal TT:

- Well-trained engineers and scientists foster effective internal communication and a profound understanding of the fundamental mechanisms driving cell culture and performance.
- Strategic partnership agreements with many global material and equipment suppliers enhance supply chain resilience.
- Platform scale-up and process fit tools backed by documentation and quality systems improve manufacturing support.

Material, method, equipment, environment, and process expertise also benefits external TT:

- Platform strategies apply to the adaptation of most industrial cell lines, such as CHO-K1, CHO-S, CHO-M, CHO-DG44, NS0, and SP20.
- Scale-up and process fit tools can quickly identify variations caused by changes in manufacturing location, process, or material and offer a list of potential alternatives within a short timeframe.

Due to the transfer of non-linear parameters, bioreactor scale-up is a common obstacle to commercialization that a CRDMO is well-equipped to overcome. The goal is to create a similar microenvironment between large and small scales. Risk assessment tools such as a failure mode and effects analysis (FMEA), are employed for a thorough investigation of the identified gaps and their associated risks. WuXi Biologics will, for example, subsequently provide a mitigation plan—that is, planning and initiating change control—depending on the classified risk severity to make sure product quality and safety still meet regulatory standards and client requirements.

Table 1 lists several representative scenarios that demonstrate our experience managing most available CHO cell lines. This experience imparts the advantage of being able to effectively manage these types of risks.

Flexibility and scalability are other key advantages of partnering with a CDMO. Maintaining diverse manufacturing facilities in the United States, Ireland, Germany, Singapore, and China allows WuXi Biologics to offer a versatile, robust, and global supply chain network capable of meeting any client or partner needs. Our procurement strategy includes several benefits:

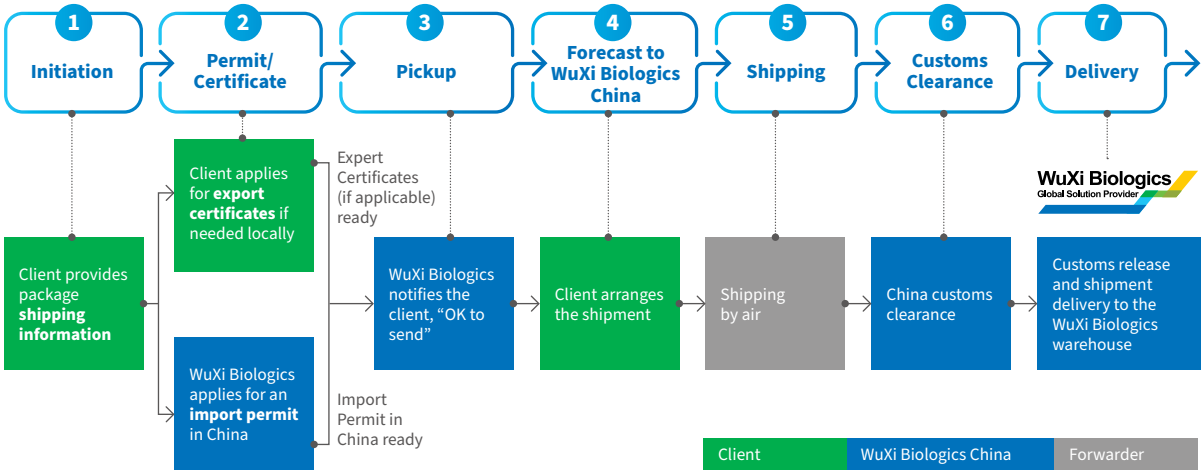
- Expertise and capability in professional category sourcing promotes quick project initiation.
- Sustainability initiatives such as a dual-source, dual-site approach and supplier diversification secure both daily and long-term deliveries.
- Strong price negotiation capability due to group volume bundling encourages a competitive material price.
- Robust supplier management mechanisms are in place.

For sending unit-supplied materials, WuXi Biologics integrates services to eliminate mistakes from the shipping and release process. First, the sending unit receives a questionnaire to

Table 1: Representative scenarios during technology transfer

Cell Type	Potential Risk	Scenario
CHO-A	Sensitive to shear force	Rapid cell viability reduction and high gas-flow rate
	Not applicable	Cell agglutination
CHO-B	Inoculation failure	Worse recovery ability, low viability, and cell agglutination
	Long recovery time and large cell culture variations	
	Exceed the manufacturing equipment capability of K_LA and mass flow controller (MFC)	High oxygen consumption
CHO-C	Filter clogging caused by growth factor components in the media	Abnormal production performance caused by poor cell growth in the seed train
	Abnormal lactate metabolism	No lactate consumption
CHO-D	Abnormal lactate metabolism	Lactate accumulation (i.e., during glucose supplement)
CHO-E	Sensitivity to a WAVE bioreactor system in the seed train	Cell agglutination

Figure 2: Shipping from overseas clients to WuXi Biologics in China



- For animal cell lines, if the expert certificate is ready or not required, the duration is 5–6 weeks (steps 2–7). If the expert certificate is required and not ready, the total time is 7–11 weeks (steps 2–7).
- For medical device/medium/chemicals/buffer with no import permit requirement in China: the total time will be 2 weeks (steps 2–7), if Q certification is needed by China customs, the total time will be 8 weeks.

input information. The completed questionnaire is then used to evaluate whether the information or documentation like a Certificate of Analysis (CoA) is sufficient for introducing the material to WuXi Biologics. Following our clear shipping guidelines, the sending unit ships us the approved material (Figure 2).

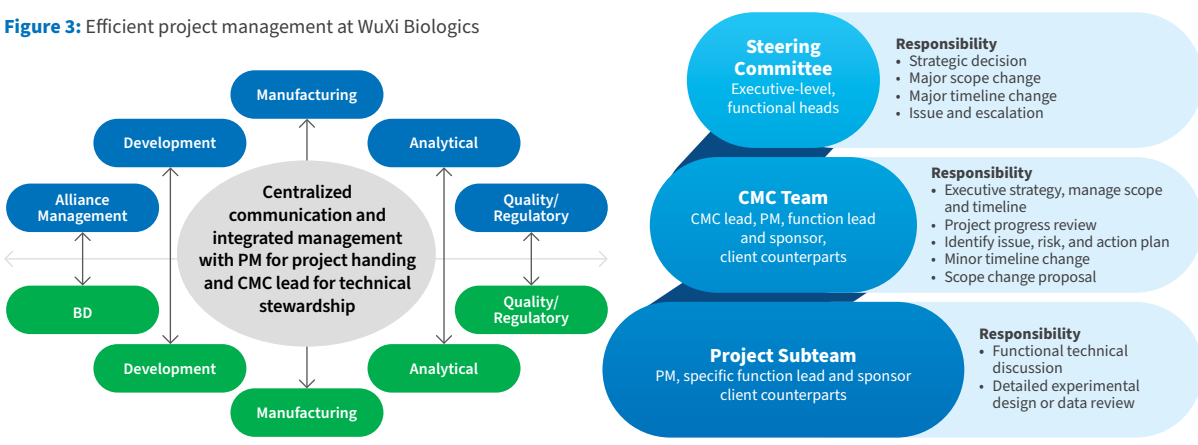
When the material arrives, additional testing and checking of reception-related documents gate the final release. These established material introduction and shipping processes ensure the successful preparation and execution of the TT project's production.

Efficient project management with open communication and cooperation are CRDMO hallmarks. As shown in Figure 3, upon project initiation, a dedicated project manager (PM) and highly experienced CMC ensure efficient and effective communications that support the sending unit. The PM and CMC lead assemble the CMC team, including point-to-point function leads, within two weeks and collaborate closely with all functional teams to advance the project. A TT project timeline depends on process and material readiness, facility fit, and the complexity of the process. The standard industry timeline is 1–2 years. However, our advantages reduce the average transfer process to about 5 months with the potential to expedite to 3 months. During project execution, WuXi Biologics references a three-level governance structure as an essential factor of project success (Figure 3).

Showcasing a 3.5-Month Transfer

A recent and remarkable achievement underscores the importance of TT. In this case, WuXi Biologics helped a client fulfill an urgent clinical supply need. The project processes

Figure 3: Efficient project management at WuXi Biologics



were pre-developed and transferred from the sending unit. The transferred recipes, especially for the in-house medium, were extremely complex, containing over 30 non-platform materials. At least 10 of those materials required replacement due to global regulatory standards. In addition, urgent clinical needs from the sending unit severely restricted the TT timeline.

Multiple accomplishments during the transfer contributed to overall program success. One example is the adaptation of a single-use bioreactor (SUB) from one vendor to work with a bioreactor from another vendor. A series of lab-scale evaluations focused on optimizing specific processes, like the sparging strategies, enabled the adaptation, which ultimately maintained performance in the new setup.

To prevent any GMP production issues, WuXi Biologics conducted growth promotion studies for lab- and engineering-scale batches at the manufacturing facility. The studies investigated and became familiar with the specific medium recipes from the sending unit. The goal, which we achieved, was to ensure that the biological materials grew properly and consistently, minimizing the risks of scaled-up manufacturing. In only 3.5 months, we completed the entire transfer process (Figure 4).

Support Considerations and Transparency

Customer support is another important consideration for TT. To meet any need, WuXi Biologics provides several customer support options. One option is an in-plant visit. At any point, clients are welcome to come onsite. This transparency builds trust and accountability while improving collaboration.

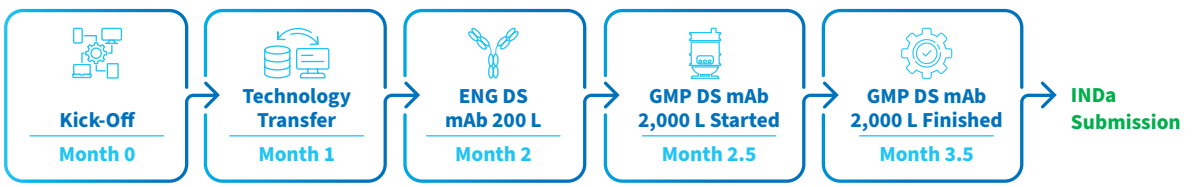
Because travel for an in-plant visit is not always convenient or possible, we also offer remote person-in-plant (PIP) systems, including video conferences and live tours, to address technical issues that might arise during TT. For specific requests or actions, such as auditing, a PIP system also allows the review of related documentation.

Our Experience, Your Advantage

Through the first half of 2024, WuXi Biologics has successfully transferred more than 350 projects, showcasing our unparalleled ability to support clients throughout the entire biologic lifecycle, from early-stage research and development to full-scale commercial manufacturing. This end-to-end CRDMO service model overcomes virtually any challenge that arises during TT.

Our unwavering commitment to rigorous quality control and assurance standards ensures the delivery of high-quality products that fully comply with the latest industry and regulatory requirements. By offering a seamless, fully integrated solution, WuXi Biologics not only mitigates risk but also optimizes efficiency to reduce project costs and accelerate timelines. In today's competitive and unpredictable market, our TT approach gives clients a critical advantage.

Figure 4: An example TT project with a tight timeline



Reference:

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About WuXi Biologics

WuXi Biologics is a leading contract research, development, and manufacturing organization (CRDMO) that provides end-to-end capabilities to healthcare organizations worldwide. With operations in China, the United States, Ireland, Germany, and Singapore, we enable our partners to effectively and efficiently bring biologics and vaccines to patients worldwide through our comprehensive and high-quality drug development model.