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WHITEPAPER

Technology transfers: Best practices for optimizing success and mitigating risk

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Executive summary

Taking a pharmaceutical product from development to commercial launch requires a highly orchestrated technology transfer process involving multiple stakeholders, a deep understanding of the specific determinants of complexity that make each project unique, and a robust framework for the continuous assessment of business, regulatory, product quality, and technical risks.

In many ways, the successful transition of drug products between developers and manufacturers is equal parts science and art, defined by enabling processes, a culture of collaboration to support them, and, perhaps most important, a foundation of trust. Specifically, drug sponsors are sharing the product, process, and analytical information needed to bring their drug to market. To do this with confidence, they must be able to trust that their manufacturing partners will bring the following to the table:

- The physical capabilities, management systems, and control strategies required to ensure quality and manage risks
- Extensive process and product understanding of a broad portfolio of drug types and manufacturing options
- Closed-loop quality management
- Full data transparency and accessibility
- Sufficient human capital and facility space, with the capacity to take on new projects
- Extensive experience to support a variety of process and technical requirements, and confidence in the ability to deliver “right first time” and on time

In return, manufacturers must trust that sponsors will support open, bidirectional communication to ensure that all stakeholders have access to essential information when they need it. This two-way flow of process and product information ensures the alignment of upstream development with downstream scale-up.

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When built on this foundation of trust, the transfer of production between sites can improve productivity and efficiency, reduce program costs, optimize regulatory readiness, and accelerate time to market.

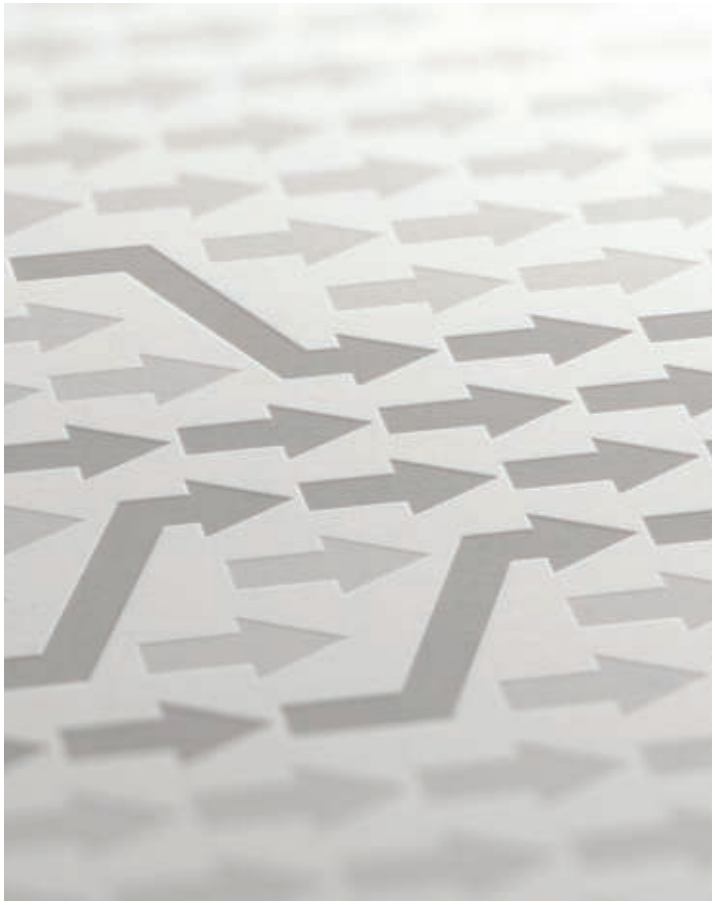
This whitepaper provides direction for ensuring successful technology transfer by identifying common challenges and offering case-based solutions and best practices for overcoming them.

Introduction

Technology transfer involves transferring product and process knowledge between stages of drug development and commercial manufacturing, or between manufacturing sites, so that the product and process can be properly produced by a facility other than the original developer or manufacturer. This involves communicating all the accumulated knowledge not just about the product itself, but also about its control strategies, validation approaches, processes, and manufacturing parameters.

When done correctly and as early as possible in project initiation, technology transfer can allow seamless transitions between stages or suppliers to help pharmaceutical companies safeguard their supply, shorten production timelines or time to market, reduce program costs, meet regulatory requirements, diversify geographical production and distribution options, and increase production flexibility. However, the technology transfer process involves complexity at each stage of the project, from securing raw materials to training new personnel to ensuring that production lines are available at the right time. To add to this challenge, each product carries unique considerations that must be managed in a customized, thoughtful way. Risks to the timeline, process, and budget should be identified proactively and addressed early, and robust communication between the partnered companies is essential.

Companies looking to mitigate risk, pass production work to experts in manufacturing and distribution, enhance their supply flexibility, or optimize their distribution network for key markets may find that technology transfer to a trusted partner with demonstrated expertise and experience will suit their needs as well as provide the added perk of potential financial or timeline benefits. To ensure a successful transfer—completed right the first time, on time—companies must select a manufacturing partner with robust project management, technology transfer, and drug manufacturing approaches and experience. In so doing, they can work with their partner to skillfully optimize a transfer plan with high confidence in a successful launch by founding the underlying processes on tried-and-true transfer techniques based on successful experiences.



Key elements in successful technology transfers

All technology transfers involve an ecosystem of teams, facilities, processes, and requirements that demand an experienced and proactive approach to organization and operation in order to succeed. Understanding the connections within and between teams throughout the project execution timeline is crucial to effective implementation of a project plan.

The key elements of technology transfer project management include:

- Building an effective project team and leveraging a full-scale network to support the effort
- Proactive planning based on robust experience to remove barriers before they arise
- High-performance team communication
- Managing for successful outcomes

These elements are linked; a misstep or delay in one category can snowball into problems with other aspects of the project. Likewise, the more elements of a project with inadequate execution or planning, the greater the potential risk to the end goals. Without this understanding and a detailed project plan, partnerships risk major inefficiencies that can sacrifice time and money—and even regulatory approval.

This whitepaper shares best-practice approaches for each of these key elements, common challenges, suggested solutions, and tips extracted from the Thermo Fisher Scientific Technology Transfer Project Management Toolkit.

Building an effective project team

The team selected to lead the technology transfer project makes or breaks the success of the project. No two transfers are identical, but teams with technology transfer experience can use lessons learned from past transfers to form their strategy for any new project. When companies internalize lessons learned from each transfer and can leverage the expertise and scale from their network, they can customize new project plans proactively, de-risk the project based on prior learnings, avoid repeat mistakes, and arm team members with the right tools to work toward a flawless execution.

When project teams are inexperienced, all elements of the technology transfer have the potential to suffer as a result of insufficient planning and alignment. It is critically important that each member of the team reliably complete their assigned tasks to meet the project timeline and proactively communicate any obstacles that arise and need support. At project kickoff, both companies should discuss preferred ways of working, including communication preferences, how to escalate issues, how to share information, how to perform the knowledge transfer, and how to best keep everyone up-to-date each step of the way.

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Partnering with an experienced team that utilizes the following best practices improves an organization's chances of success:

- Begin the project with a session focused on both companies' preferred ways of working.
- Establish core teams with dedicated functional representatives for each subsection of the project's phases or tasks, and clarify stakeholder roles and responsibilities.
- Commit to a regular meeting cadence to review project progress, escalate needs, and ensure alignment. The cadence should be optimized to the project's timeline and status in order to address needs proactively.
- Ensure adequate resource assignment where possible for required expertise, technology, and processes.
- Conduct lessons-learned sessions to gain insights from prior similar technology transfer projects.
- Leverage the power of a larger network to tap into expertise that can play a more prominent role on the team until in-house expertise is developed.
- Leverage additional vendor support, including on-site visits and trainings, throughout the project to develop expertise in areas such as new equipment.
- Ensure that the project manager is tracking closely any potential risks and keeping leadership informed should new issues arise so that the team can address them proactively.

Once the team structure and skill sets are optimized for the project, effective, proactive group coordination and regular communication must form the backbone of the team's interactions throughout the project.

Approaching a technology transfer in this way provides the following benefits:

- Streamlined alignment on requirements and project strategy
- Accurate timelines for critical processes
- Early risk identification and mitigation opportunities
- The ability to function as a single, coordinated team
- The opportunity to leverage deep cross-functional expertise
- Consistent leadership engagement to accelerate processes and decision-making
- Regulatory understanding to ensure that critical requirements are met
- Coordinated transitions and efficient operational management to keep projects on time and on budget

Toolkit tip

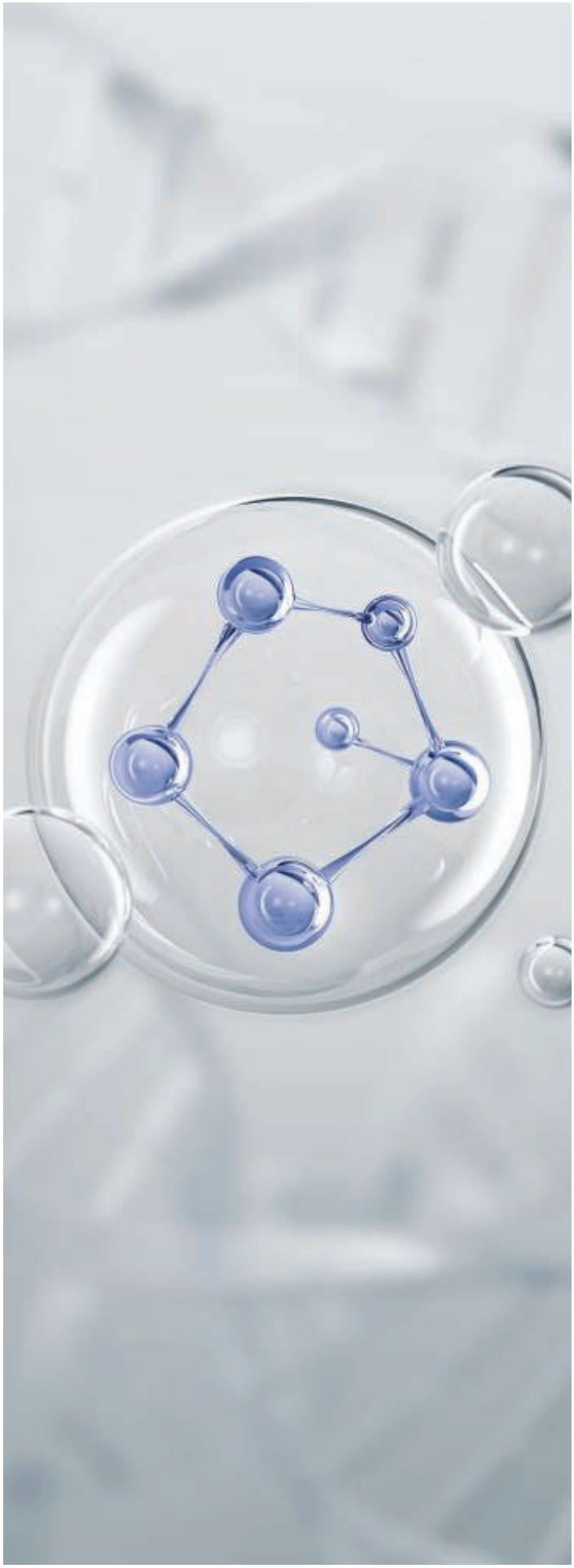
As the project gets underway, a best practice is to employ ongoing practical process improvement (PPI) to identify and fix problems such as business processes or technical issues proactively or as they arise. Training and engaging all team members in PPI improves project planning, simplifies project logistics, reduces risks, facilitates improved transfers in the future, and enhances customer relationships.

Case study

Overcoming obstacles to recover timelines and launch on schedule

Situation	Solution	Outcome

• Multiple risks required mitigation to avoid delay in launch date.
  • Client needed more time for procurement
  • Equipment vendor lead time increased by several months
  • Team had challenges with technical installation and qualification of new equipment
	• Hired additional full-time and consultant support for multiple shifts to complete parallel equipment installation, qualification activities, and training
	• Created strategy with daily activities mapped out to meet new timeline
	• Held daily meetings for teams and stakeholders to monitor progress
		• Back end of timeline was expedited through enhanced productivity
		• Project launched on time



Leveraging expertise and advanced planning

Planning for each team and process involved in the technology transfer is paramount. This helps quantify and document each task, including who owns each task, and provides a detailed road map for personnel to follow. The project manager should ensure the availability of a detailed plan that has the necessary links between activities and that sets target dates which allow work streams to be completed ahead of time, with a clear understanding of the critical path. Planning should reflect key business processes, regulatory components, and key timing to be ready for successful commercialization if that is within the scope of the project. Step-by-step planning ensures a realistic timeline and drives understanding on both sides of the partnership regarding the components and necessary processes involved in a complex project.

Planning must also go beyond the initial needs of the people and equipment involved to ensure readiness for long-term production needs and process management. Shortsighted planning can lead to decisions that optimize only the most immediate project needs, which can lead to downstream problems such as insufficient materials, equipment, or resources to execute the work. This can threaten regulatory approval, jeopardize productivity or supply, and put a strain on resources. Challenges with proper planning have clear implications for downstream efficiency, handoffs, productivity, and timelines.

Common challenges arising from ineffective planning include:

- Underestimating the effort, time, and cost involved in technology transfer projects
- Poor understanding of task associations and interconnectivity
- Late realization of missing or new requirements
- Timing misalignment and unrealistic deadlines that result in hurried processes and potentially failed activities.
- Scope changes resulting in unplanned timeline and budget increases
- Insufficient knowledge transfer between handoffs

Thankfully, many planning-related challenges can be mitigated or avoided altogether through proper efforts early in the project. It is essential to precisely delineate tasks, along with task ownership and time frames for start and completion. Thorough upfront planning can help identify which processes can be performed in tandem and which are dependent on the completion of earlier tasks.

If problems do emerge, a pause for precise planning can help drive problem-solving by making it clear which tasks can be shifted on the timeline and which are immoveable. Due to the complexity of technology transfer projects, effective documentation and visualization of these details should include flowcharts and process-specific checklists associated with all key steps, and all of these should be supported by adequate training. These aids can prevent missed requirements, streamline data and documentation collection early in the project, help deliver appropriate information at handoffs, and ensure that the requirements for task execution are lined up ahead of their needs.

Good documentation and information-sharing tools and processes can help the team when they are faced with common challenges, such as turnover or equipment scheduling conflicts for a production run.

It is essential to precisely delineate tasks, along with task ownership and time frames for start and completion.

Checklists that precisely define the technology transfer function and are maintained in a manner that continuously pulls in new requirements and learnings from completed projects across the network as well as any new industry and/or company requirements can help ensure that all team members have full visibility into project status at all times. In addition, process mapping using flowcharts supported by a PPI effort can help identify and implement significant process improvement.

Finally, all planning resources must be available across the team and brought into alignment with the overall project strategy. Departures in one element in the transfer process can have far-reaching impacts for other teams, timelines, and processes. Communicate all plans in advance—or, if necessary, at the time of problem recognition—to avoid rapid degeneration of the quality, timeliness, and/or cost of project finalization. Project requirements must be continuously prioritized within the scheduling systems and functions at the site. It is especially important to plan short-term as well as long-term requirements for the entire project based on known and estimated details to avoid surprises down the road.

Toolkit tip

Use the 7M approach to proactively evaluate each technology transfer process with an eye on customer needs, commercial readiness, market factors, and related tasks. The framework, described in Figure 1, leverages learnings from successful technology transfers to provide a robust, centralized repository of all requirements and critical considerations for an entire project. It provides teams with a broad view of what a project will involve, including related risks and internal strategies that should be incorporated into the planning process to avoid problems down the line. The 7M approach is focused on looking ahead to ensure that prerequisites are in place for each task in a plan, potential risks are mitigated before they arise, and all previous learnings are incorporated early in the project to avoid repeat issues.

Machines

- New equipment performance, lead times, and requirements
- Existing equipment capabilities; capacity analysis including current and forecasted projections
- Facility modifications

Materials

- Supply lead time; availability
- Quality concerns
- Supplier issues

Manpower

- Staffing considerations
- Capacity and ability to meet fluctuating demands
- Project, lab, and commercial teams

Manufacturability

- Product issues in development
- Process finalization and robustness
- Commercial readiness

Market

- Market intelligence review
- Probable market share, volumes, competition, market acceptance, etc.
- Regulatory strategy

Measurement

- Testing/modeling boundary limits identified in other M
- Ability to respond to and meet launch and supply needs
- Potential scenarios and risk identification

Mitigation

- Launch readiness evaluation
- Risk evaluation and severity rating
- Development of mitigation plans

Figure 1: The 7M approach to proactive technology transfer project planning

Adopting communication strategies to sustain high-performing teams

Technology transfer projects are complex; there are typically thousands of tasks across different layers of work covering dozens of critical work streams. To keep both the team and stakeholders aligned, a plan for effective project communication must be in place. Communication within and across teams propels a project forward and facilitates smooth transitions from one stage to the next. It also enables proper risk identification and mitigation, thorough and effective training, rapid problem-solving, and responsive relationships between vendors and customers. Without processes in place to prompt both regular updates and special communication for key concerns—such as risk identification and changes in requirements—the entire project can falter unnecessarily.

Strong communication adds value to the project in multiple ways, including the following.

- Alignment of client–contractor strategies and efforts
- Optimal knowledge sharing and the ability to incorporate prior learnings
- Efficient project execution and error avoidance
- Complete documentation of clear actions, decisions, and expectations
- Closing of communication gaps related to on-time task completion or resolution of open actions/decisions
- Timely decision-making to avoid project pauses or holds
- Adherence to manufacturing timelines and alignment with cost projections

These considerations enable process efficiency and downstream success; therefore, risks must be identified and mitigation strategies must be adequately discussed, documented, and properly executed.

Avoiding communication gaps is best managed by establishing clear expectations, processes, and preferences early in the project. The following activities can help teams avoid common problems that arise from a lack of clarity around expectations:

- **Identify the optimal cadence to bring the right people together to share progress, next steps, and issues requiring discussion or escalation.** In practice, this can range from daily huddles to weekly or monthly check-ins, depending on the complexity of the work streams involved, the stage of the transfer, and any current or anticipated operational challenges. Communication with customers and external parties can be customized according to preferences or project needs as well. Having cross-functional representation is key to ensure that all critical functions are available for an effective discussion.
- **Promote principles of high-performing teams.** Each team member should feel empowered to speak up about concerns and project needs, collectively weigh in on technical and strategy discussions related to the project, and take ownership of their function as it supports the team. Team members should also leverage and share their technical expertise with the rest of the team, be accountable to deadlines, promptly communicate issues and updates as they arise, and be transparent in their needs or concerns throughout the project.
- **Establish effective governance to support the project.** Implement monthly or quarterly meetings with site leadership and governance or steering committees. At each session, share key performance indicators (KPIs), execution progress, open risks, successes, and decisions that require support. Not only do such meetings solidify organizational alignment on strategy, progress, and division of responsibilities, they can also streamline decision-making and align priorities.
- **Use the most efficient and effective tools.** In particular, digital project management platforms that integrate visual tools and analytics offer a powerful way to communicate and monitor project needs efficiently and effectively. The use of the right tools can contribute to team engagement, streamline communication, improve productivity, reduce meetings, improve visibility of the program's urgent needs across the site, and reach audiences more effectively.

Toolkit tip

Establish a stage gate process for the project, including a review within the project team, cross-functional management, and project stakeholders. In a stage gate process, the team reviews the project's progress, data, and identified risks at predefined stages prior to making a collective decision on whether to advance the project to the next stage. Only when the required deliverables have been completed satisfactorily, risks have been addressed, and all other project requirements have been executed to expectations can the project advance to the next stage. An effective stage gate process is critical for ensuring alignment and improving a project's chances of first-time-right execution.

Maintaining a focus on the path to success

High-performing teams keep a sharp focus on their vision for a successful outcome. This requires continuously evaluating progress and reprioritizing as needed to achieve the desired end. Even with the most thorough planning, unexpected issues can arise, from supply interruptions to changes in requirements to staff turnover. Teams must be aware of the possible curve balls and be ready to address them to keep the project on track. In addition to change-related challenges, business-related threats can emerge, such as pressure to meet key dates that could impede optimization efforts.

When the need for a change arises, the tendency is often to rush to a solution. While this may help preserve the timeline or budget, it can create a snowball effect on project quality and viability in the long run.

In addition to change-related challenges, business-related threats can emerge, such as pressure to meet key dates that could impede optimization efforts.

Common challenges that emerge from rushed project changes include:

- Ineffective risk consideration or missed mitigation options
- Last-minute process or variable adjustments without sufficient verification or validation
- Unconsidered long-term impacts on timeline budget, process repeatability, reliability, and product quality
- Insufficient adjustments in training, knowledge transfer, or handoff contexts
- Moving too quickly into subsequent stages without success, and then having to take a step back to fully diagnose the change and repeat development

Some disruptions may be novel or uncontrollable events—such as a global pandemic—that throw a wrench in even the most experienced transfer operations. However, most project hurdles can be quickly managed by teams and companies with advanced contingency plans. Staff turnover, changes in suppliers or material availability, shipping disruptions, scheduling conflicts for equipment, last-minute updates to a development or validation test strategy, shifts in launch dates, a process change due to a new requirement, and other common changes can often be planned for in advance. With predefined strategies for managing these types of changes, effective teams can accommodate unexpected adjustments with the least possible damage to the project's success, budget, and timeline. Some of the tools and solutions that support developing these strategies include:

- Predefined instructions and best practices that may be defined in a playbook or checklist, supported by the 7M approach
- Conducting lessons-learned sessions with support from a global network of teams and individuals who may have faced similar change risks previously
- Engaging the global network for support in adopting alternative solutions, including the provision of additional material, resource support, expertise, and equipment capacity
- Using team huddles and steering committees to prioritize and allocate resources
- Conducting scenario planning to familiarize teams with activities that maximize success, including PPI strategies
- Leveraging a stage gate forum and an executive-level steering team to review proposed changes, solutions, change implementation plans, and the potential impact on project goals and objectives

Less common threats can also often be mitigated through creative problem-solving and team flexibility. Experienced project teams with the support of their global network may be able to prevent change-related project delays by proposing alternative options, such as accessing alternative suppliers or alternative inventory for critical materials, additional manufacturing capacity to support parallel studies, additional staff with relevant expertise/training who can shift responsibilities to support the team, or a reprioritization of activities to best meet both companies' objectives.

In a perfect world, timelines would be generous, progress would be smooth, all significant risks would be mitigated with thoughtful attention, and each decision along the technology transfer pathway would be made with the long-term success of the product in mind. In reality, managing time and budgets effectively while also optimizing the quality of the process and product for an on-time delivery requires careful and creative choreography, planning, and replanning.

In all situations, teams must carefully weigh the risks and benefits of prioritizing one objective, such as an aggressive launch timeline, over another, such as process optimization, to ensure that a short-term win, such as meeting a planned launch window or achieving current budget boundaries, doesn't have a negative effect down the line.

Optimizing outcomes in real time

Before project initiation and throughout the course of every technology transfer project, teams should take the time to develop each element of the process, prioritizing decision-making around the product's ultimate success. This involves conducting adequate studies for validation and verification, feasibility testing, process parameters, quality control, and regulatory requirements. This helps avoid eventual project setbacks to earlier phases and saves time and money in the long run. To this end, both companies should prioritize the following activities:

- Align at the outset on a preferred process to manage change, evaluate scenarios, and make decisions. This may be supported by a project management team, stage gate framework, and executive steering team to weigh in on and review any changes and monitor progress.
- Be transparent as early as possible on business requirements, success factors, key dates, and must-haves.
- Understand the short-term and long-term implications of making changes as well as the implications associated with an inability to make changes or optimizations. These scenarios should be explored in detail with estimated costs, returns, and impacts.
- Prioritize product quality over all else. This includes

Case study

Global steering team guides complex project to on-time launch

Situation	Solution	Outcome
• Very complex project involving numerous sites and a tight timeline • Several technical difficulties and challenging new equipment	• A cross-divisional, cross-functional global steering team was established to provide oversight to ensure that multisite teams and leaders aligned on process timeline, risk management, and technical approach • Site teams hosted weekly internal meetings that included the global support leader • Root cause analysis was performed and site visits and development studies were conducted to identify and address problems • Additional vendor funding was secured to provide additional on-site support and develop expertise	• Sites shared lessons learned and remained aligned on strategy, timeline, and needs • Timely resolution of technical difficulties at each site • On-time launch

being mindful of the ability to meet all quality requirements reliably and repeatedly at all stages of production.

- Regularly review risks and process improvement opportunities.
- Consider creative options to address optimization recommendations.

While much of this can and should be addressed in early planning stages, changes in course, unexpected risks, and even market disruptions can result in the need to reconsider product optimization in real time. The key is not to delay any optimization that can possibly be managed in the moment. Consider adapting other resources—such as the number of staff dedicated to the project, the number of shifts involved in advancing tasks, or the number of suppliers used—rather than skipping robust analytics and control testing. It is easier to temporarily boost staff input to conduct the appropriate optimization legwork when the need first arises than it is to go back after launch (or after regulatory denial) and implement changes that will affect all downstream processes.

An experienced project team, thorough planning, and effective communication provide the foundation for technology transfer success. While many problems can be resolved as they arise, contingency plans and careful risk mitigation strategies can prevent or minimize many potential project concerns before they have the chance to negatively impact time and budget.

Companies seeking technology transfer support should search for a manufacturer with the resources, tools, experience, and network to effectively manage even the most complex transfer projects. A partner with the right framework for navigating everything from simple commercial production transfers to the most complicated global manufacturing and distribution plans can offer a level of professionalism, preparedness, and support that less experienced manufacturers cannot provide. Carefully planned and appropriately managed technology transfer enables companies to reduce program costs, mitigate risks, and better meet the needs of regulators and critical markets.

Conclusion

Case study

Leveraging global network capabilities

Situation	Solution	Outcome
• Client bumped up launch by three months • Vendor had a more than four-month delay in vial supply • Technical equipment problems	• Parallel development studies conducted at multiple sites to enhance process troubleshooting • Additional staffing obtained • Guideline/template creation • Streamlined data collection, analysis, and review	• All appropriate, robust validations and verifications conducted • Process performance qualification (PPQ) completed within nine months of project award, on time • Highly satisfied client

About us

Thermo Fisher Scientific provides industry-leading pharma services solutions for drug development, clinical trial logistics, and commercial manufacturing to customers through our Patheon brand. With more than 65 locations around the world, we provide integrated, end-to-end capabilities across all phases of development, including API, biologics, viral vectors, cGMP plasmids, formulation, clinical trials solutions, logistics services, and commercial manufacturing and packaging. Built on a reputation for scientific and technical excellence, we provide pharma and biotech companies of all sizes instant access to a global network of facilities and experts across the Americas, Europe, Asia, and Australia. We offer integrated drug development and clinical services tailored to fit your drug development journey through our Quick to Care™ program. Our Quick to Clinic™ programs for large and small molecules help you balance speed and risk during early development so that you can file your IND quickly and successfully. Digital innovations such as our mysupply Platform and Pharma 4.0 enablement offer real-time data and a streamlined experience. Together with our customers, we're rapidly turning pharmaceutical possibilities into realities.

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Derek Gallo is the director of global technology transfer and strategic projects at Thermo Fisher Scientific. He is responsible for the technology transfer and project management function across nine drug product facilities in North America and Europe, including over 90 tech transfer project management leaders. He leads internal initiatives focused on how to manage global projects for the new Pharma Strategic Projects team.

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