KDDF
Korea Drug Development Fund

www.kddf.org

KOREA DRUG DEVELOPMENT FUND

The innovative medicines initiative 10 years of public-private collaboration. We will stand by your side and become a reliable partner for successful global licensing-out deals.

A consortium of three health-related Korean Ministries
— the Ministry of Science and ICT; the Ministry of Trade, Industry and Energy; and the Ministry of ***Health and Welfare*** *—*
is a government-initiated drug development program, which aims to transform Korea into a global leader for new drug development and to enhance national competitiveness in the global arena

KDDF

KOREA DRUG DEVELOPMENT FUND

Contents

06 I. INTRODUCTION

1. Evolution of the KDDF
2. Building Trust with Research and Development Communities

10 II. ORGANIZATION

1. Proposal review and selection processes
2. Request for proposals
3. Project presentation
4. Due diligence
5. Investment decisions
6. Milestone and budget adjustment
7. Project management
8. End of milestones

16 III. STATISTICS

1. Licensing deals
2. Patents
3. Publications

20 IV. KDDF'S BUSINESS SUPPORT PROJECTS

1. BRIDGE Project
2. CIDD Project
3. ACT project
4. Global C&D Project
5. LPG (Licensing Partners for Globalization) Project
6. Drug Development Information Database Project
7. Training Programs for Young Scientists and Business Developers
8. Promotion of KDDF

29 V. LESSONS LEARNED

1. Globalization
2. Analysis of evaluation results of KDDF's portfolio
    1) Overview of the final evaluation results of 162 programs
    2) Factors influencing success/failure of a drug development program
    3) Why clinical-stage programs fail
3. Next-level collaboration models in the healthcare space

I
INTRODUCTION

The biopharma industry has been one of the fastest growing businesses in the 20th century, and it is expected to stay highly lucrative with a global market forecast to reach $1.18 billion in 2024, at a CAGR of 6.9%. While the major players of the biopharma industry are still the traditional big pharma companies, threats exist that may hold them back such as if they fail to innovate in the competitive drug development arena or fail to protect their blockbuster products from patent loss. For this, many giant corporates are now open to expand their business models partnered with smaller biotechs, to maintain scientific integrity and to explore new technologies that may be the next-generation lifesaver.

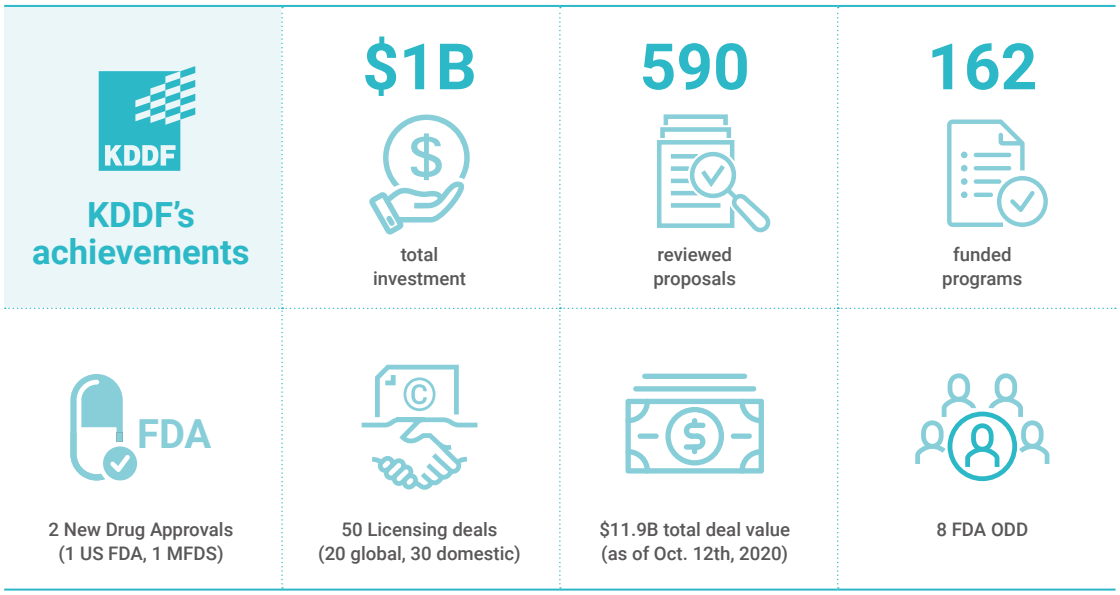
Meanwhile, the pharmaceutical industry in Korea was largely dependent upon generic drug sales until 2010 due to lack of experience and proficiency in the drug development field. Traditional Korean pharma companies were threatened by multinational corporates for their existence, and it is then that they realized their conventional business model had to change. They needed to find new means to survive in view of the massive flow of drug products that were to be imported as part of the FTA agreements, and most importantly, they needed innovation to survive in the new era. With the hope that the Korean pharmaceutical industry would continue to thrive and become globally recognized, the Korean government began to acknowledge the need for a complete transformation of the R&D system.

Prior to launching of KDDF, government-led funding for R&D was functionally diversified and lacked a systematic support system that could help researchers make a smooth transition from bench work to the business world. Each ministry (e.g. the Ministry of the Science, Health and Welfare, Trade and Energy etc.) was only focused on supporting a specific sector(e.g. basic science, commercialization, clinical development), and there was minimal communication between the ministries to bring

> We reflect on some of the challenges faced and discuss how this business model could be extended to encompass current challenges and deliver the changes necessary to help the healthcare businesses become more affordable and sustainable for all.

each part together. To deal with this issue, the three ministries formed a consortium and launched the "Korea Drug Development Fund" that would transcend all R&D support models that had ever been tried. This new business was initiated in 2011 and continued through 2020, with a one billion USD budget to support the drug development industry from all angles and to upgrade drug development capabilities and proficiencies. The initial goal for the KDDF was to have at least 10 programs successfully sign global licensing deals by 2020.

In this article, we reflect on how the KDDF worked to revolutionize the R&D system in Korea, and what can be delivered by using this business model as the basis for future sponsorship. We reflect on some of the challenges faced and discuss how this business model could be extended to encompass current challenges and deliver the changes necessary to help the healthcare businesses become more affordable and sustainable for all.



1. Evolution of the KDDF

The KDDF is a public organization initiated by the Korean government to provide comprehensive support for drug developers during the entire drug-development cycle. We aimed to develop at least 10 new drug programs partnered with global companies and to introduce an entirely transformed R&D investment platform. Instead of implementing a simple funding and managing scheme in our business model, KDDF has been fully engaged in initiatives to strengthen our R&BD (Research & Business Development) function – i.e. the business-centered assistance program – beginning from idea creation and continuing to research strategy, planning, and investment.

There are two main business models by which KDDF selects and manages portfolios in alignment with global big pharmaceutical companies' interests that are capable of commercializing the asset globally; the first is R&D support programs including BRIDGE Track, Innovative Track, Joint R&D Track, and ACT Program; the second is business supporting programs including the LPG program and the Global C&D program.

The KDDF sought opportunities in developing a new platform for business development support by recognizing the needs of different organizations and providing tailored consultation and related services for globalization of the developing product. So far, we have mediated two Joint R&D Programs covering the areas of investment structure, operation method, procedures, and items of agreement. The partner for joint programs were Johnson & Johnson Innovation for the development of a novel drug for type 2 diabetes, and MSD for an anticancer drug.

2. Building Trust with Research and Development Communities

During the first stage of the KDDF (2011–2014), we focused on establishing a transparent and unbiased evaluation system that highlights superior technology and developmental potential. We tried to implement the management system of major pharmaceutical companies; that is to allow CEOs to develop, plan, and invest in new drug development programs all year round.

During the second stage of the KDDF (2014–2016), we tried to identify possible setbacks from the previous stage and implement practical solutions. One of which was installing our own database system to efficiently manage the portfolio and operation systems that we created. To build trust among drug development communities, we openly shared our progress and performance with our partners and external members of the drug development society. By regularly investigating our own progress, the objectives of each stage of development were specified and optimized. We also tried to expand our roles to differentiate ourselves from conventional funding agencies; that is, actively engage in business development opportunities with international corporates and big pharmas and grow global networks to eventually open the path for globalization of our partners in Korea.

The third and the final stage of the KDDF (2017–2020), was mainly directed towards incorporating a sustainable system by upgrading and optimizing the pre-established one for project selection & evaluation, R&D support, and BD support. For newly submitted proposals, the evaluation process of the IP right was intensified. We also provided strategic support for patent filing scenarios for successful commercialization and building external partnerships. As the completion of the first round of the KDDF approaches, our major focus was to find an effective method for preparing a delivery package of our know-how, platforms, and networks to the next generation of funding agencies and the industry. Besides the Innovative Track and Joint R&D Track, the portfolio operation scheme during the final stage additionally incorporated the BRIDGE Track to focus on Breakthrough Therapy Candidates that have a greater chance of reaching early-stage licensing deals.

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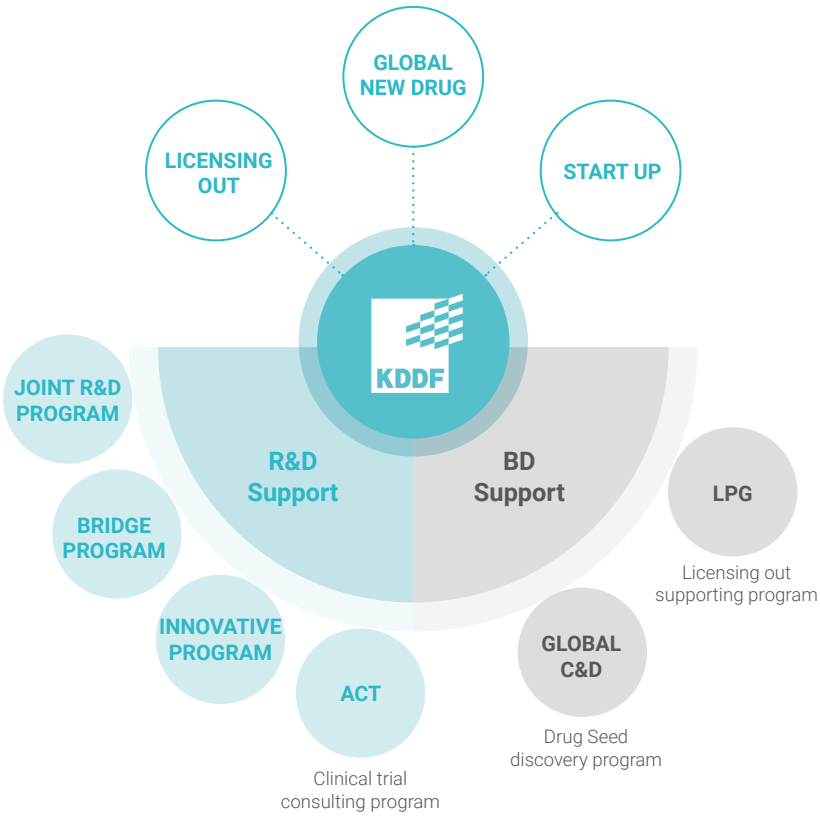
II
ORGANIZATION



The KDDF's main function can be categorized into two main divisions: The R&D division and the business division.

Most science and investment-related tasks such as reviewing proposals, making investment decisions, appointing a scientific advisory board, providing in-house consultancy, evaluating R&D accomplishments, and operating various partnered programs (e.g. BRIDGE program, ACT consulting program) are systematically carried out by the Project Evaluation & Management team, which is a central part of the R&D division. The Chief Scientific Officer and the team have high expertise and long experience in the drug development industry.

The business division is functionally divided into the business development (BD) team and the strategy management team. The BD teams are specialized in

aiding portfolio institutes to find potential business partners that fit their needs. All other business-related activities such as building networks, managing alliance, out/in licensing consultation, hosting various networking events, aiding in joint R&D projects for multinational pharma companies and managing public relations are also part of the BD team's responsibilities.

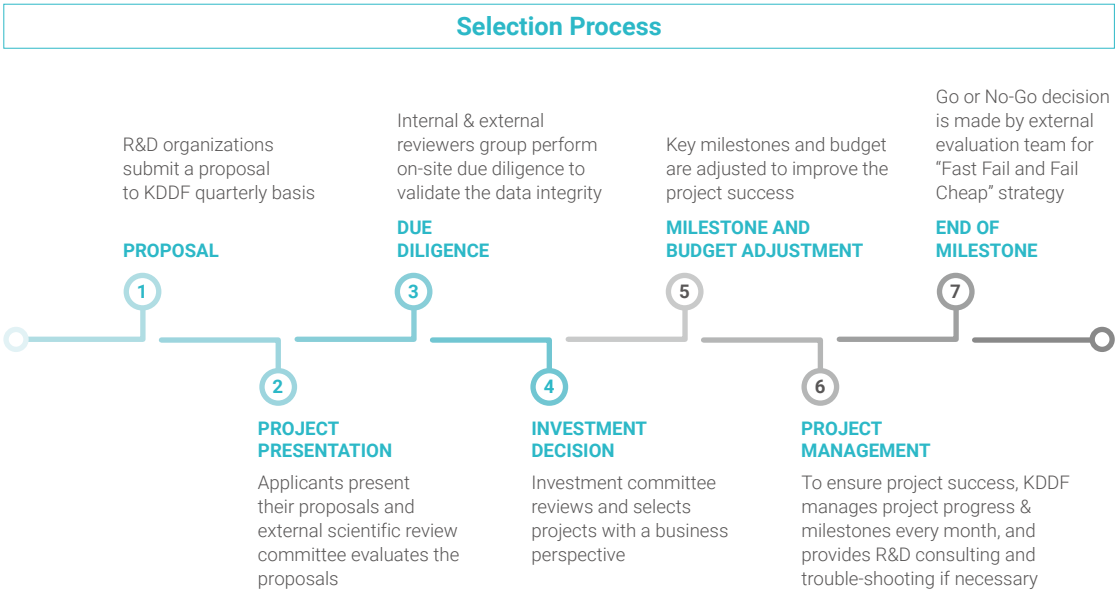
The strategy management team communicates with various government-affiliated agencies for R&D sponsorships and the government itself, supervises pivotal internal functions including financial operation, human resources, accounting audit, and recording tracks of outstanding accomplishments.

> **"The KDDF's main function can be categorized into two main divisions: The R&D division and the business division."**

1. Proposal review and selection processes

The KDDF takes a systematic approach to review, evaluate, and select research proposals to be funded and included in our portfolio. The Project Management & Evaluation team works in close collaboration with external experts to gain efficiencies in the process. The evaluation committee collectively reviews and determines investment value of the proposals by assessing scientific evidence, affirmative data, and intellectual property. The KDDF's selection criteria is distinct from conventional R&D funding agencies (e.g. Korea Evaluation Institute of Industrial Technology, Korea Health Industry Development Institute, and the National Research Foundation, etc.) in that we have implemented a practical perspective from the investor's angle to meet their interest in weighing the possibility of global market entry.

To encourage participation from all drug development stakeholders including industry, academia, research institutes, and hospitals, the KDDF provides a pre-consultation service to guide the process of proposal submission, evaluation, and required information/data. Post-consultation service was optional for rejected/pending applicants to be revised and reapply for the next round of selection.



2. Request for proposals

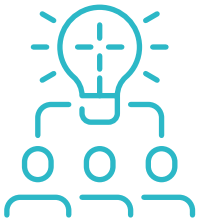
The KDDF regularly notified an official RFP (Request for proposals) for application via affiliated websites. Submission of applications for innovative new drug projects are opened 4-6 times a year, and joint R&D projects were to be submitted on a rolling basis throughout the year when the RFP from the partner company was publicized. The KDDF has agreed on MOUs with multiple global pharma companies to regularly share detailed RFP to find propitious projects that fit their co-research or co-development needs. For each application, the KDDF thoroughly reviews whether the project meets the RFP requirement and whether it falls into any disqualifying categories such as having an incomplete previous project, restriction history due to deceitful behaviors and lack of compliance with R&D protocols and ethics.

The evaluation committee usually consists of 10-12 drug development experts across the field (industry, academia & hospitals) and were individually identified and recruited for each evaluation procedure depending on the project's nature. Each member of the committee was invited to evaluate the efficacy, effectiveness, development strategy, business feasibility, and the overall potential for successful drug launch. The members of the committee were selected from a vast pool of experts that encompass the full drug development cycle, from discovery to clinical stage. The experts pool was exclusively managed by the KDDF and updated as needed, for the purpose of ensuring credibility and transparency of the review processes.

The KDDF's experts pool currently consists of 990 evaluators from various affiliated organizations (59% academia, 30% industry, 7% government-related institutions and research institutes, 4% others). The CEO supervises the result of the evaluation/selection processes and related information.

3. Project presentation

The evaluation criteria for selected proposals for presentation was assembled to reflect the needs of the current market, and suitability for further development processes. The KDDF's ultimate objective was to support our partners' promising technologies to successfully enter the global market; hence the evaluation questions were thoughtfully selected to take the specific market situation into consideration, and emphasized the importance of distinctly defining the product label such as the patient group to be targeted.



4. Due diligence

The on-site due diligence processes were conducted for selected projects to evaluate R&D capabilities, development strategies and issues identified during the presentation stage. The due diligence committees were made up of at least one external and four internal experts.

5. Investment decisions

For an impartial, objective, and professional investment decision to be made, the KDDF convened the pre-organized investment committee as the last stage of the selection processes. The decision-making process was commenced when more than two-thirds of the invited committee members were present. The deliberation agenda was resolved when more than two-thirds of the present members voted affirmative. When the final investment decisions are made, the detailed funding schedule and terms of conditions (e.g. milestone accomplishments, size of the grant) were readjusted upon discussion with the partner institute. If agreed on the details, the responsible party (i.e. the partner company/ institute) was committed to sign the standard contract within one month after notification of the investment decision (two months if existing joint R&D partner is based overseas).

6. Milestone and budget adjustment

The top priority of the KDDF in managing our portfolio was to fully communicate with the partners to understand their goals, and to provide necessary aid until the goal was achieved. The partner company/institute mandatorily shared monthly progress and plans and if any further discussion was needed, it was fully discussed with the project officers.

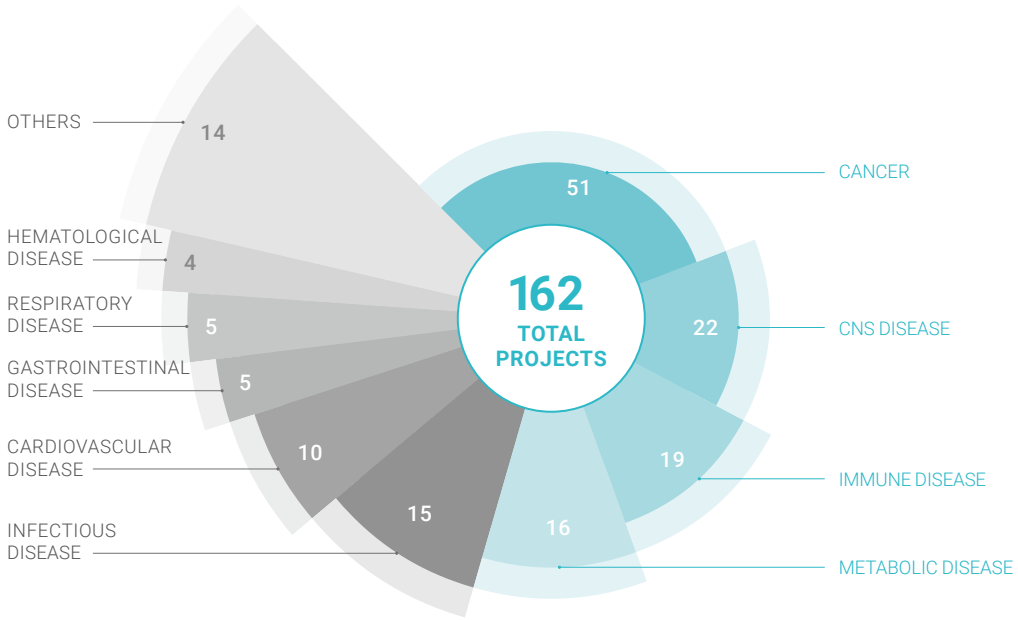
7. Project management

The KDDF's project officers instructed grantees (i.e. scientists) to report monthly progress and reviewed the status of execution of the research fund, as well as having in-person meetings on an as-needed basis. Upon request from the institutes, the terms of the conditions were amended if deemed appropriate. An interim evaluation procedure was also recommended for a project that needed its milestones to be reassessed for authorizing installment payment of the remaining grant.

8. End of milestones

The final process of the KDDF's R&D grant involves evaluation of the R&D progress and achievement of the milestones as agreed on the initial contract. Based on the evaluation result, the project would receive a final evaluation result that would fall into one of the following categories : Milestone achieved, Milestone not achieved due to unexpected outcomes, Milestone not achieved due to mismanagement/ misconduct. The KDDF's evaluation processes heavily emphasize qualitative factors (i.e. technical advancement or business potential) as a practical means to interpret R&D progress. Quantitative measures (i.e. number of publications, patent filing) are not decisive factors during the evaluation process. Technical indicators are designed to evaluate how strongly the project's R&D fundamental is set up, how well established is the target product profile, and how reasonable is the next developmental plan.

III
STATISTICS



During the past nine years, 590 proposals were submitted for review and 162 of them were selected for funding. In all phases of development, industry has contributed to more than 50% of all proposals. Most of the proposed drug candidates were synthetic chemicals, and the least were natural products. 60% of all proposals were in the phase of early development before the lead candidate selection phase. Any projects that were beyond clinical phases were less than 10%. Disease indications were diverse across all therapeutic areas, yet oncology accounted for the major portion (34.7%).

※ 2011-2019 proposal submission status by organization: Industry: 58.5%, Academia: 31.9%, Research Institute: 9.7%

※ 2011-2019 proposal submission status by material source: Small molecule: 51.5%, Biologics: 44.1%, Natural Product: 4.4%

※ 2011-2019 proposal submission status by developmental stage: Lead to Candidate: 60.0%, Pre-clinical: 21.0%, Phase I: 9.8%, Phase II: 8.0%, Phase III: 1.2%

※ 2011-2019 proposal submission status by therapeutic areas: Infectious Disease: 8.8%, Metabolic Disorders: 11.4%, Gastrointestinal Disease: 3.4%, CNS Disease: 10.0%, Cardiovascular Disease: 3.9%, Oncology: 34.7%, Immunology: 12.5%, Hematological Disease: 1.0%, Respiratory Disease: 2.0%, Others: 12.2%

The main keyword for the majority of finally selected 162 programs from 2011 to 2019 were “lead candidate”, “industry”, “synthetic chemicals”, “oncology”.

※ 2011–2019 funded programs by organization: Industry: 72.2%, Academia: 21.0%, Research Institute: 6.8%

※ 2011–2019 funded programs by organization: Small molecules: 50.6%, Biologics: 46.9%, Natural Products: 2.5%

※ 2011–2019 funded programs by developmental stage: Lead to Candidate: 52.5%, Pre-clinical: 19.8%, Phase I: 16.7%, Phase II: 11.1%, Phase III: 0%

※ 2011–2019 funded programs by therapeutic areas: Infectious Disease: 9.3%, Metabolic Disorders: 9.9%, Gastrointestinal Disease: 3.1%, CNS Disease: 13.6%, Cardiovascular Disease: 6.2%, Oncology: 31.5%, Immunology: 11.7%, Hematological Disease: 2.5%, Respiratory Disease: 4.3%, Others: 8%

> The increasing numbers of noteworthy achievements suggest that the business model of KDDF plays a significant role in the global drug development industry.

Through funding from the KDDF, two new drugs were successfully launched in the market: Xcopri® (SK Life Sciences) approved by the US FDA for partial-onset seizure in adults, and K-Cap (HK Inno.N) approved by the Korean MFDS for gastroesophageal reflux disease. Additionally, 8 drug candidates were granted orphan drug designation by the FDA. The increasing numbers of noteworthy achievements suggest that the business model of KDDF plays a significant role in the global drug development industry.

In November 2019, Xcopri® developed by SK Life Sciences won FDA approval for partial-onset seizure in adults. KDDF has supported the Xcopri project from discovery to its global Phase 2 trial.
SK Life Sciences was also successful in closing a deal with a Europe-based company for a total licensing value of $500M. It is expected to reach over $1B in sales in the upcoming year, which would be the first global blockbuster product developed by a Korean biotech.

A new form of anti-ulcer drug, namely K-Cab®, was launched in Korea as of July 2018. It is the 30th new drug approved by MFDS, the Korean authorization agency. The developer, HK innoN (formerly known as CJ healthcare), also signed multiple licensing deals with overseas companies, including Medi Pharma in Vietnam, and Laboratorios Carnot in Mexico. Through this deal with Carnot, which sums up to a total $100M, HK is now able to export K-CAB in 17 Latin American countries. K-CAB is now one of the most widely sold anti-ulcer drugs in Korea, reaching $26M in sales in 2019. HK is now conducting additional clinical trials for expanded indications, and there are many hopes that K-CAB will score deals on more continents. The KDDF has supported the K-CAB project during its pre-clinical stage.

1. Licensing deals

50 programs, out of the total 162, have entered into licensing agreements either with domestic or international companies. The total licensing fees agreed to be paid if all the milestones are successfully achieved, adds up to $11.9B in total. The licensing activities of the funded programs became more and more active as the years of extensive support accumulated. The initial goal that was set by the KDDF during the first year of business was to have at least 10 programs successfully partnered with global companies; now that goal is over-achieved.

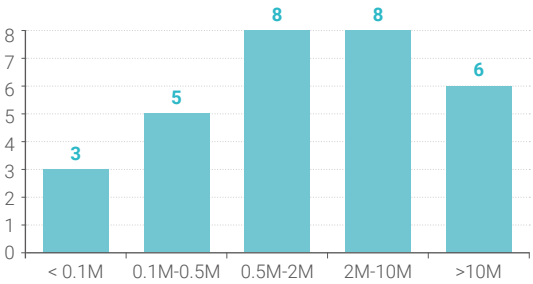
Most domestic deals (8 out of 30) fall into the range of small size ($0.5M-$2M), while the remaining 8 deals were in the range of $2M -$10M. Global deals were mostly in the range of $10M-$200M, while 4 deals were over $1B in total value.

We analyzed the licensing activities of the funded programs in different development stages. Most deals were signed during the lead candidate stage, while the cumulative deal value was at its maximum during Phase 2 trial ($766M on average).

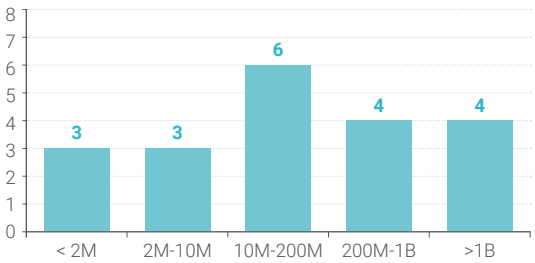
The proportion of the programs that reach their pre-established milestone was 68.7%, which corresponds to the average phase transition success rate published in many professional articles. To note, the success rate of clinical-staged programs was over 70%, which exceeds the average value.

Distribution of the Licensing Fees of the Deals

• Regional deals



• Global deals



Development Stage	No. of signed deals (%)	Cumulative deal value (US$)	Average deal size (US$)
Lead Optimization	9 (18%)	8.7M	0.9M
Candidate Selection	18 (36%)	632M	34M
Pre-clinical	9 (18%)	5.87B	625M
Phase 1	8 (16%)	1.44B	170M
Phase 2	6 (12%)	3.99B	766M
Total	50 (100%)	11.9B	229M

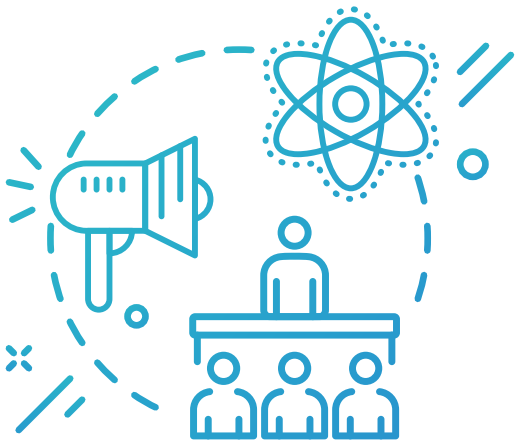
2. Patents

817 patents related to the KDDF's funded programs were either filed or published by 2019. 450 are still pending for registration, and 367 are registered. On a yearly basis, more than 100 patents were filed since 2014. 75% of all filed patents were international, mainly distributed in Japan, US, EU, and China. The total status of patent application and registration appeared in 47 countries, with the most cases distributed in Korea (203), US (82), EU (52), and Japan (52) in that order.

3. Publications

From 2012 to 2019, a total of 80 research papers were published in SCI(E) journals with the KDDF's support. Impact factors of the publications ranged from 5.787 to 7.573, which is in a reasonable range to assume quality research. The top-tiered journals that published the KDDF's funded research was CIRCULATION (IF: 17.047, 2 cases), Nature Chemical Biology (IF: 12.709), and the Journal of the American Chemical Society (IF: 12.113). Although the number of publications and patents are not considered to be decisive factors for evaluating the overall performance of a funded program, the numbers suggest increased quality in fundamental R&D capabilities.

IV
KDDF'S BUSINESS SUPPORT PROJECTS



1. BRIDGE Project

The BRIDGE (Bio-pharmaceutical Renovation Inter-organization Development and Global Extension) project seeks to solve the initial research program's bottlenecks by supporting promising early technologies and actively utilizing the knowledge, know-how, and networks of the KDDF. The BRIDGE was designed to consult and train early stage programs to build an initial business connection to promote intermediary research for the target indication and commercialization plans. Accordingly, the BRIDGE project consisted of discovering innovative technologies in Korea, supporting researchers, and establishing the necessary networks.

In 2017, an advisory group was formed to conduct discovery, evaluation, and consultation of innovative candidates that are being developed at universities and research institutes across the country and a strategic partnership was founded between the KDDF and the Commercialization Promotion Agency for R&D Outcomes. Through the website that was exclusively created for this project, we received 8 proposals for review and signed 7 MOUs with venture capitals to support start-up companies. We identified 35 early programs that we considered to have advantages in the top 10 indications with the highest unmet medical needs and provided consultation for 6 programs to be involved in the BRIDGE project. In 2018 and 2019, a partnering event named "the Investment Showcase" aimed at nourishing investor-researcher relationships was organized by the KDDF. During these events, 6 of our partner institution/start-ups advertised their technologies which led to 24 cases of investment meetings and 1 final investment.

The BRIDGE Program

2. CIDD Project

The CIDD (Consulting for Innovative Drug Development) Project was designed to address various issues that might arise during the complex R&D process and to provide practical solutions to the developer to educate and foster the biopharmaceutical industry in Korea. A comprehensive consultation session was held for selected proposals to provide active feedback between the developers and professional consultants that the KDDF recruited for a specific session. Many researchers from academia, research institutes, and start-up companies applied to receive tailored fit solutions to various issues arising from discovery to pre-clinical and clinical development. This project was initiated by the Ministry of Health and Welfare and conducted by the KDDF to enhance the efficiency and success rate of drug development programs.

The pilot project was initiated in 2017 with 12 applications and 8 selected programs. In 2018, 27 applications were submitted, and consultation sessions were held for 20 programs (3 lead optimization stage, 8 lead candidate stage, 7 preclinical stage, 2 clinical stage). In 2019, 16 applications were submitted and 11 of them were consulted (3 lead optimization stage, 5 lead candidate stage, 3 pre-clinical stage).

3. ACT project

The ACT (Advancing Clinical Trial) project is another platform for consultation, which was specifically arranged for clinical-stage programs. The scope of consultation involved clinical development planning and protocol review for a successful path to drug development in the given indication. The KDDF collaborated with KoNECT (Korea National Enterprise for Clinical Tools) for this project, a specialized public agency focused on enhancing clinical trial efficiency and globalization. The KDDF and KoNECT worked together to recruit professionals in the clinical fields in the specific disease area to write and review the protocols that could differentiate the

candidate from the competitive landscape (e.g. target patient groups, biomarkers, investigators, etc). For a selected program, a comprehensive reassessment from multiple angles were sought to identify unmet needs, provide strategies specific for the candidate's type and MOA, advise on CRO selection process, and risk management plans.

4. Global C&D Project

The Global C&D project was one of the major portions of the business development support packages. Although most pharmaceutical companies in Korea are now vigorously seeking in-licensing opportunities for promising programs from wherever possible resources they can find, there are still shortages of information and networks between globally recognized research institutions or funding organizations that have a broad and robust pipeline. Moreover, there were fundamental absences of both experience and knowledge when it came to structuring a deal through negotiations. To come up with

The 3rd and the 4th global C&D Techfair (2019-2020)

We believe that such an in-licensing experience would enhance R&D quality and reduce developing costs and that similar attempts should be continued to encourage C&D efficiencies for many companies hoping to expand their pipeline.

an effective solution for numerous asset-seekers in Korea, the KDDF initiated the global C&D project in three different directions. 1) Making direct connections with the developing company. 2) Searching for "failed" early-stage assets initially developed by global pharmaceutical companies. 3) Building a robust collaborative network with global funding agencies/ research institutes to find available assets for in-licensing or co-development. The diverse set of assets collected for the global C&D project was secured in the KDDF's database to provide the necessary information to potential investors and co-developers. This was an unprecedented approach that the KDDF tried for the first time to be able to introduce various research projects with great potential from all around the world to drug developers in Korea. We believe that such an in-licensing experience would enhance R&D quality and reduce developing costs and that similar attempts should be continued to encourage C&D efficiencies for many companies hoping to expand their pipeline.

5. LPG (Licensing Partners for Globalization) Project

We began a consultancy program for companies looking to out-license their developing assets in 2017. Even if the developing company is not necessarily looking for an urgent licensing deal, planning for future out-licensing strategies and assessing the current value of the developing program is hugely important during the entire drug development process. There were two major tracks in how we carried out the LPG (Licensing Partner for Globalization) project: 1) Asset valuation of the developing pipeline using the risk-adjusted method. 2) Consulting services for out-licensing and managing potential partners. The two tracks were essentially combined to provide a comprehensive strategy-building service from the complex valuation process to constructing a stepwise strategy for differentiating the asset from the current competitive landscape. We have recruited expert members to form an advisory board and hired a professional consulting firm to carry out the project to maximize the chance of licensing activities of the KDDF's asset and to create a sustainable platform that can continue our efforts. We regularly made and distributed various forms of advertising materials that contained information of our portfolio and partner companies. We have also introduced a number of our funded programs to Nature's Biopharma Dealmakers in an article for three different issues (Mar 2019, Nov 2019, Mar 2020), and actively participated in major partnering events to promote ourselves and our partners.

6. Drug Development Information Database Project

We built our own database system to effectively organize and manage the massive data accumulated in the KDDF. Through this effort we were able to promote a Value-Added Service for our partner companies and institutions by providing them with an easily accessible source to new drug development information worldwide.

The drug development information database project was composed of three parts. First, the DB was initially created by integrating information on a certain program's origin, management history, milestone achievements, competitive landscape, regulatory status, drug approval status, related market, technology transaction history, IP rights, etc. This database was especially useful for public institutes, small laboratories, and start-up companies that usually have limited access to expensive private database systems.

We built our own database system to effectively organize and manage the massive data accumulated in the KDDF. Through this effort we were able to promote a Value-Added Service for our partners.

7. Training Programs for Young Scientists and Business Developers

The largest hurdles that many scientists face is making a smooth and efficient transition of the researcher's works into the business world. Well-schemed development strategies for clinical trials and commercialization is an essential part of the biopharma business, yet the majority of young scientists from Korean biotech have very limited exposure to such opportunities. The KDDF desired to introduce training workshops for young talents where they can have hands-on experience and learn know-how from experts in the field. Since 2019, the KDDF organized two main workshops, namely "LAB2IND" and "Young BD Person Workshop."

"LAB2IND" was exclusively designed for young scientists working in the drug development fields. 50 scientists with different research backgrounds participated by invitation-only. The participants were divided into 10 teams and worked on a project for the two-day course. Each team worked together to come up with a detailed R&D development plan from lead-opt stage to IND submission and structure a target product profile during this course. The KDDF's project officers reviewed and shared useful feedback with the participants.

Such efforts to educate young drug developers in Korea to improve R&D efficiency and the overall

LAB2IND & LAB3IND

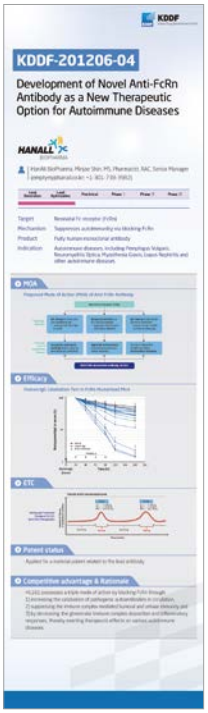
Young BD Person Workshop

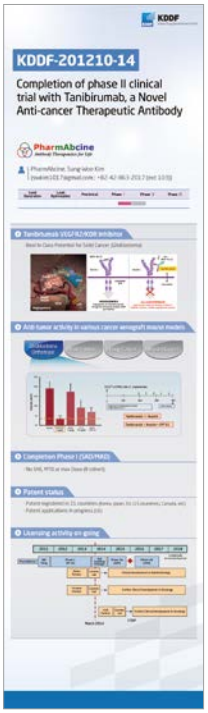
success rate of drug development were highly appreciated in the community, and we continued to organize succeeding events to meet the communities' needs (LAB3IND).

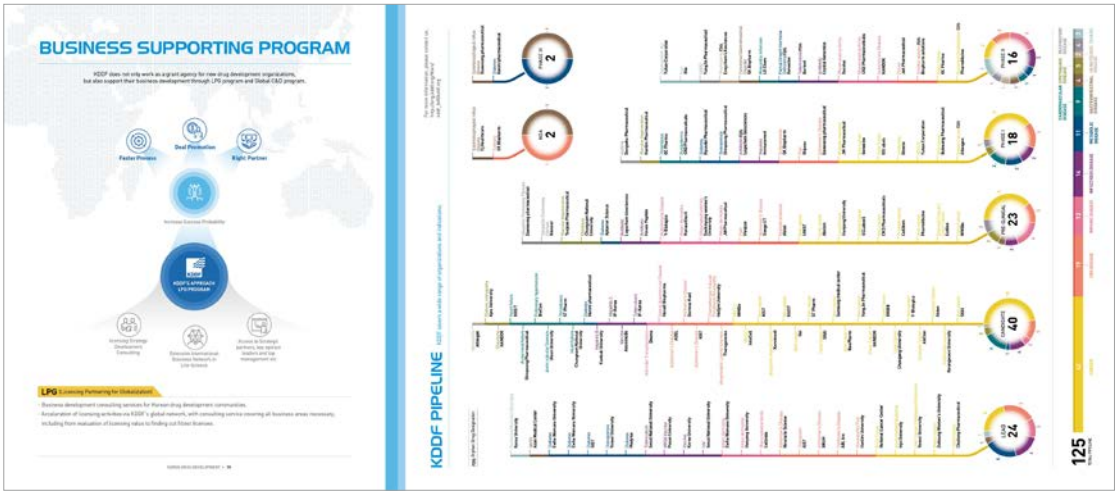
Aside from the training program for scientists, another idea came up to organize a similar training course for young business developers as well. The Young BD Person Workshop was designed for them to experience and learn real-life business development skills and know-how from actual BD experts recruited from all around the world. In this workshop, participants were able to create their own marketing materials to effectively advertise their technologies, to meet with potential partners in a 30-minute partnering setting, to learn basic knowledge and tips on various topics including IP rights, deal structuring, and valuation. The mentors and speakers were recruited from globally renowned institutions and firms to help and guide young business developers in Korea.

8. Promotion of KDDF

The KDDF actively distributed press releases on major events and performance to the drug development and business communities. The continuous effort and achievements of the KDDF was widely recognized through major media in various forms (news, interviews, articles, etc.).







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LESSONS LEARNED

We analyzed the data accumulated over nine years during the KDDF's existence to provide more insight into future applicants and affiliated agencies. In this session, we share our experiences and thoughts that we had working with many different institutions on various topics.

1. Globalization

The ultimate goal of the KDDF and the Korean government is to successfully bring home-grown new drugs out to the global market. It is tremendously burdensome for drug developers to fund their own late-stage clinical development and to launch a product in the major market. Once a drug candidate enters this phase, it is all about the company's financial abundancy and well-structured development strategies that is based on experience and skills. This is certainly an unexplored area for most domestic drug developers. Rather than taking a high-risk, they are comfortable choosing an indirect path to globalization; that is to find a partner for out-licensing their product for overseas development and commercialization. We are now seeing a few domestic corporates employing their own phase 3 trial and winning an FDA or EMA approval by themselves. In other cases, some companies choose to get their drug product approved locally or on a regional basis prior to reaching major markets. This type of approach is helpful for domestic companies to increase their experience and accumulate related skills before they find the right partner for globalization or enter the market themselves. The example of such cases are the developers of a

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new type of GERD (gastroesophageal reflux disease) treatment that is based on a completely different mechanism of action from conventional treatments. Although their approach was fresh and innovative, most big pharmas that already possess one or two major GERD treatments in their pipeline are hesitant to acquire or co-develop new technologies for the same indication. The developing company had to choose an alternative strategy for international commercialization. They chose to directly carry out overseas development by first seeking regional approval and gradually expanding the product's sales in the existing market. The investment committee considered this approach to be forward-looking and decided to fund the company. It has become one of the most widely sold new drugs in the domestic market and has been launched in a number of individual countries.

2. Analysis of evaluation results of KDDF's portfolio

1) Overview of the final evaluation results of 162 programs

Among the 162 programs in KDDF's portfolio, 81 programs received "Milestone achieved" grade and 39 programs received "Milestone not achieved due to unexpected outcomes" grade after the final evaluation process. We provided more in-depth analysis of the various factors evaluated and how those factors influenced the overall success and failure of the development program.

2) Factors influencing success/failure of a drug development program

The most common issue with the programs that received the failure grade was not being able to discover a valid candidate molecule for further development. We suggest to our partners that discovery research should focus on two important aspects: the novelty, either in the molecule itself or in the MoA, and the feasibility of the molecule for drug development. We consider that the novelty of the molecule must be secured and backed by strong scientific data that proves its activities, and that the feasibility of the molecule's drug-like properties with data supporting its stability and safety.

The factors that influence the fate of a drug development program become more complex when it comes to biologics, given the fact that controlling the homeostatic state of a biologic molecule is extremely difficult during its CMC (Chemistry, Manufacturing, and Control) process. A drug candidate must maintain its physico-chemical properties at a pre-determined range and yield reproducible data at each step of pre-clinical or clinical development phases, which becomes especially difficult to control for biologic molecules. Biologic developers must be able to provide robust CMC data that was generated in line with regulatory guidelines. We emphasized the importance of this process as early as the time of the agreement and supported scientists when they needed consultation or to be connected with professional agencies with ample experience in the related fields.

3) Why clinical-stage programs fail

For most clinical-stage programs, the major cases of "milestone not achieved" grade were due to their candidate molecule's inadequacy in providing convincing data to suggest that the molecule has reached the milestone. The issue was not particularly the molecule itself, although it is common to see a trial withdrawn due to a molecule's unexpected toxicity or lack of efficacy. Rather, the most common issue for our funded program was not being able to complete the trial in the pre-determined time frame and to provide reasonable data to persuade the regulators to approve the next stage. The underlying cause of the delay in the trial mainly arose from ambiguous and unsophisticated protocol design, spawning inefficiencies in patient recruitment during the initial phase. A well-planned clinical trial must not only demonstrate a concise and effective method to determine statistical significance of the endpoints, but other components such as the target disease, inclusion/exclusion criteria, trial site, and the primary investigators must also be thoughtfully considered. The overall development cost and time is hugely dependent upon this process, and a failure can result in a point of no return for a small sized company. At the KDDF we helped our partner institutes to get a full-service consultation through the ACT program.

3. Next-level collaboration models in the healthcare space

To prepare for the completion of the KDDF's business, we focused on organizing our accumulated data on know-how, evaluation policies, management skills, and networks to pass on to the next generation of funding agencies and the industry. For this, we established SOPs to manualize the operation system of R&D funding, and published documents that contain brief yet essential information for successful and failed R&D programs to be widely distributed in the industry. The standardized guidelines for selecting and managing funded programs are now adopted by many R&D affiliated agencies outside the drug development area.

Besides funding, the KDDF offered various support projects and held numerous education sessions, seminars, and networking events to enhance the overall drug development quality in Korea. We have established sustainable platforms to effectively evaluate and select early development programs for global C&D programs. We also invented a discovery process that can be utilized for searching promising seed research programs in Korea. Finally, we expect to further aid individual or corporate researchers to upgrade their resources by publicizing the KDDF's database and know-how.

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