Jun. 13, 2023
Lion Corporation

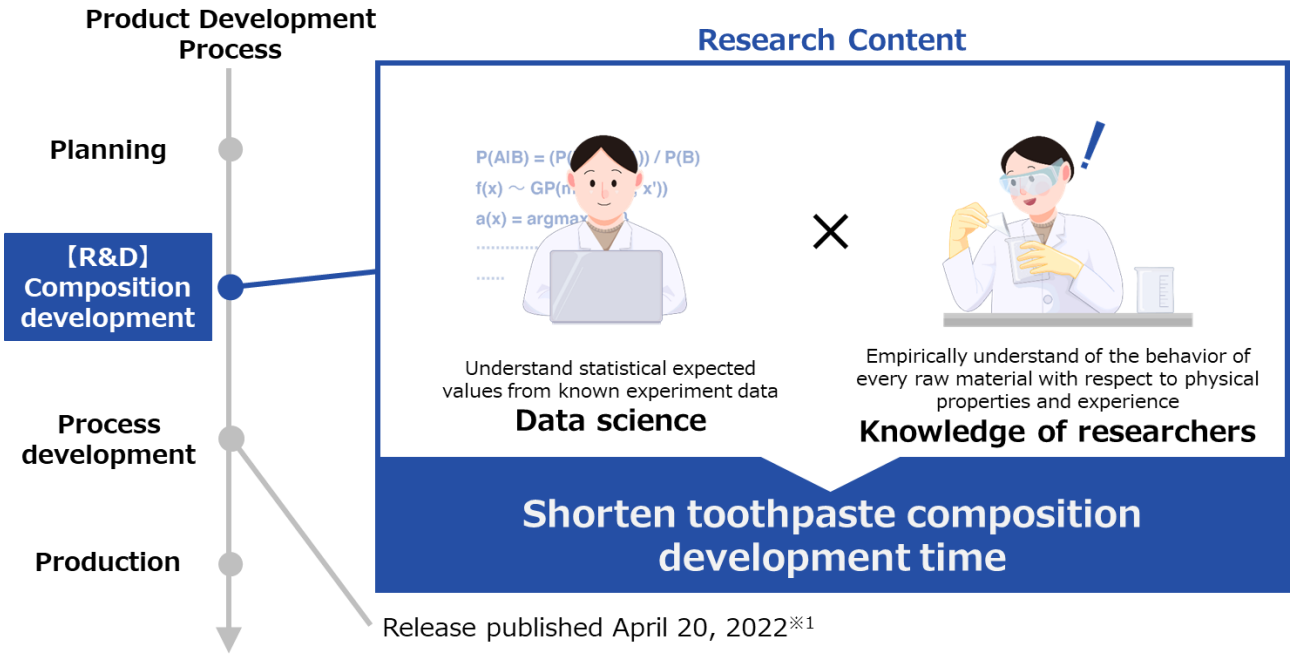
Shorten Toothpaste Composition Development Time by About Half
New Experiment Design Method Combining Researcher Knowledge and Data Science Established

Lion Corporation (President: Masayuki Takemori) is striving to improve its research and development productivity through the utilization of digital technology.*1 Specifically, we began applying a data science approach to product development, establishing and using materials informatics (MI)*2 and innovatively implementing researcher knowledge-driven experimentation.*3 When we applied this technique to toothpaste composition development, we were able to substantially decrease the number of iterations of experiments needed for development, reaching completion in about half the time anticipated, leading us to expect accelerated research and development in the future. This research approach was presented at the 37th Annual Conference of the Japanese Society for Artificial Intelligence (Tuesday, June 6 to Friday, June 9, 2023).

*1 Release published April 20, 2022: "Lion and Hitachi Shorten Product Development through DX and Develop a System That Predicts Toothpaste Manufacturing Issues and Automatically Proposes Optimal Compositions" (in Japanese)

*2 A research approach that uses machine learning and other information sciences to improve the efficiency of composition and materials development.

*3 Determining the flow of research based on data and informed decision making.



■Research Background

In recent years, the product qualities consumers have been seeking out have increased in diversity and sophistication, and in order to develop high-quality products that meet this demand, we must improve the productivity of composition and process development.*4 At Lion, we are developing an MI system*1 to shorten the period of study needed during process development.

In conventional composition development, potential compositions are devised based on existing research data and researcher knowledge, following which iterative experimentation is conducted to

identify satisfactory candidates. Under this system, each change in the development process, such as the introduction of a new ingredient formulation or property, necessitates an additional study period due to a lack of research data from earlier stages.

To address this, Lion has worked to improve the productivity of its research and development through the cultivation of human resources with specialized MI knowledge and by establishing a proprietary experiment design method that can be used for toothpaste composition development, Lion's core business.

*4 Developing compositions in small quantities in the laboratory, as well as optimal processing conditions for large-volume mixing using industrial-scale factory equipment.

■Research Content

When developing a toothpaste composition, multiple targets must be met simultaneously, such as optimal user experience regarding flavor, foaming, and paste texture in terms of softness or firmness as well as cavity and gum disease preventive functions.

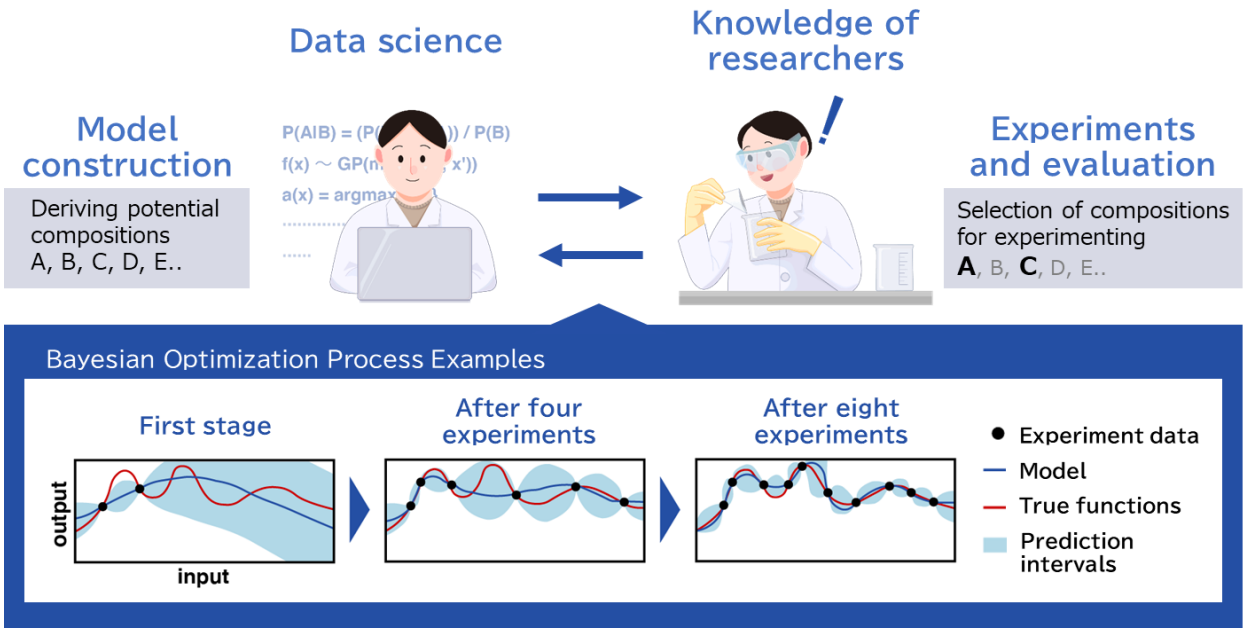


Figure 1. Process of Toothpaste Development Using Bayesian Optimization

In the course of conducting such research, we established an experiment design method that allows researchers to simultaneously consider multiple targets with fewer rounds of experimentation. The method effectively incorporates researcher knowledge using Bayesian optimization, a machine learning method that allows a composition search that starts with limited, known data (Figure 1).

■Research Results

Using the above experiment design method, we searched for the optimal modulus of viscosity and elasticity, which indicate physical properties such as the softness or firmness of toothpaste. As a result, it is not unusual for us to repeat an experiment more than one hundred times, we were able to derive a composition that met all of our targets after just sixteen attempts, completing composition development in about half the anticipated time, including the time required for the additional processes involved (Figure 2).

Going forward, we plan to expand this method to the composition development to more products, including toothpaste.

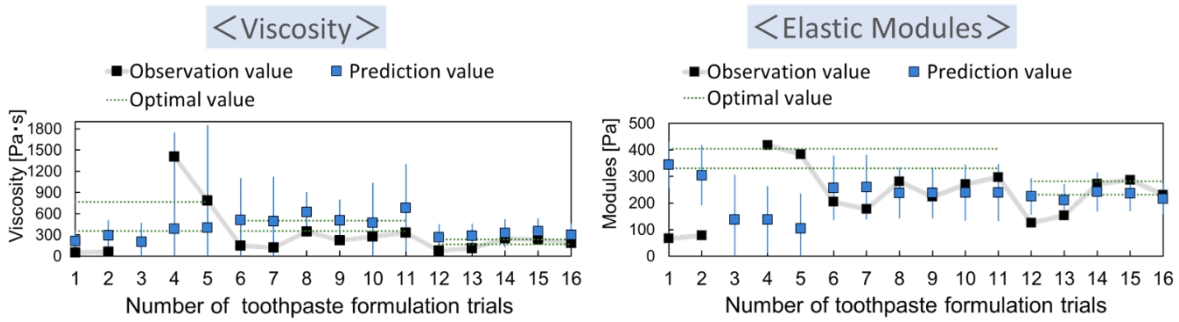


Figure 2. Toothpaste Composition Search with this Method

The results of this research were presented at the following event.

【The 37th Annual Conference of the Japanese Society for Artificial Intelligence, 2023
June 6 (Tuesday) to 9 (Friday), 2023】
"Acceleration of Toothpaste Development using Bayesian Optimization"

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Lion will continue to create new value by utilizing digital technology, including using the experiment design method established over the course of this research, to improve the productivity of its product development and employing the time gained to research consumer needs and develop technologies and products to fulfill them.