

PERSPECTIVE AND ROADMAP

Artificial Intelligence in Formulation

Connecting formulation, production, and quality into one feedback loop.

For years, formulation and production have worked on opposite sides of a gap. The formula is written on one side. The production line runs it on the other. Quality results come back late, often after the batch is finished. To cover that delay, formulators build in safety margins and repeat trials.

BESTMIX exists to close that gap. BESTMIX connects formulation, production, and quality into one feedback loop. What the line does and what the lab measures flow back to the formula, and the next formula starts from better information.

This document is a perspective on where formulation is going and a record of what BESTMIX has built and is building. Each capability below is a piece of that loop. Artificial intelligence has a role in the loop, and it is the clearest evidence that the loop works, which is why it appears throughout. The loop is the point, not any single feature.

Operating Principles

01 Accuracy precedes novelty

A formulation system must be correct. BESTMIX does not deploy AI that lacks production-grade accuracy. The cost of a wrong formula recommendation is a failed batch, a missed specification, or a customer complaint. A capability must meet a measured accuracy threshold before it enters the product.

02 Capabilities are labeled by their technical category

Statistical analysis is not artificial intelligence. Pattern matching is not artificial intelligence. Trend reporting is not artificial intelligence. Each BESTMIX capability is described by its real technical category: AI, predictive analytics, or data analysis. The difference matters, because each category needs different infrastructure, different validation, and a different level of trust.

03 Validation on production data

Many AI claims in food and feed are validated on small lab datasets or simulated runs. BESTMIX predictive models are validated on years of production data, across many production lines and equipment types. Validation on real production data is the condition for any capability that informs a live production decision.

Capability Categories

Three technical categories run through this document. Each needs different infrastructure, a different way to validate, and a different level of trust. Every capability is labeled by the category it belongs to.

Artificial Intelligence (AI)

Systems that learn from data and produce new outputs

A system that learns from data and creates new outputs. A model that suggests a starting formulation from patterns in past formulations is an AI capability. It needs a large body of training data, ongoing validation, and clear constraints. At production accuracy, it is hard to reach in formulation.

Predictive Analytics

Models that predict an outcome from inputs

A model that uses input values to predict an outcome. Predicting finished moisture from production line settings, ingredient composition, and ambient conditions is predictive analytics. It is less complex to validate and run at production scale than AI.

Data Analysis

Computation applied to existing data

Computation run on structured data that already exists. Comparing a formulation portfolio to find similar formulas or merge candidates is data analysis. BESTMIX calls this analysis, not AI, whatever a comparable tool is called elsewhere.

Capabilities Deployed Today

Capabilities in production with customers today.

AI Chat Assistant

ARTIFICIAL INTELLIGENCE · LIVE

A retrieval-augmented generation (RAG) assistant that runs inside the BESTMIX documentation portal and answers software and setup questions in plain language. It is delivered through the BESTMIX documentation platform, which finds the most relevant passages in BESTMIX documentation and writes a short, cited answer. It is trained only on BESTMIX product documentation. It is a closed system. It does not access customer formulations, formulas, or production data. It shortens ramp time for new users and takes load off senior staff.

Predictive Analytics for the Production Line

PREDICTIVE ANALYTICS · BESTMIX INSIGHTS · LIVE

Start with a question a formulator has never been able to answer with confidence: how much safety margin am I carrying because finished moisture varies, and how much of it can come out?

Finished moisture moves from batch to batch. A wet batch dilutes the nutrient concentration, so the formula is padded with a safety margin to make sure every batch, including the worst one, still meets its label. That margin is paid for in raw material on every ton.

BESTMIX Insights predicts finished moisture from the production line's own history, so the formula can be set to the true target instead of padded for the worst batch. It reads the plant's process data and formulation specifications together. Because BESTMIX holds the formula and the finished specification, it can relate what the line did back to what the formula requires. That link is the loop.

To hold moisture on target, BESTMIX Insights recommends settings to the line from the same history. Steady moisture is the mechanism that lets the safety margin come down.

In technical terms, BESTMIX Insights is a supervised machine learning model. It is a regression model, which means it learns the relationship between the line's settings, the formula, and the conditions from the plant's own history, and predicts a number: finished moisture on the next run. It is not a chatbot and not a language model. This is the predictive statistical model that a nutritionist, quality manager, or process engineer can rely on.

Validated performance in aquafeed extrusion: R squared of 0.92, a mean absolute error of 0.51 percent, 50 percent more accurate than experienced operator predictions, and 87 percent of predictions within a 1 percent tolerance. Each prediction is explainable through SHAP values, so a formulator or engineer can see why a setting was recommended and audit it.

This was validated in aquafeed extrusion. Pet food proof-of-concept work is underway with validation partners. The same predictive approach extends to pelleting. On a pelleting line, the predicted outcomes are pellet durability, energy use, and throughput rather than moisture.

CASE STUDY

Where the Savings Come From

In a validated aquafeed extrusion operation, across two production lines, tighter moisture control produced savings in three places. The largest came from formulation.

~\$393K

TIGHTER FORMULATIONS

Smaller safety margins, lower costs.

Formulators pulled back safety margins once the moisture swing dropped.

~\$157K

REDUCED REWORK

Less product outside tolerance.

Less product outside tolerance that has to be recycled.

~\$16K

FASTER STARTUPS

Less time dialing in each run.

Less time spent dialing in settings at the start of each run.

Not included: energy savings and yield recovery from running closer to target. These are additional upside.

How the formulation saving works: when finished moisture varies, wet batches dilute the nutrient concentration. To protect label minimums on every batch, formulators add a safety margin. When moisture control tightens, that margin can come down toward the true target while the product still meets its label. Less margin means lower ingredient cost on every ton.

These figures were validated across two lines in an aquafeed extrusion operation. They are directional for pet food and feed, not a guaranteed outcome. The figures are shown in US dollars, converted from the validated euro result, and are approximate.

Capabilities in Development

Capabilities in development or in validation with partners.

Recipe Analyzer

DATA ANALYSIS

Compares formulation portfolios to find merge candidates, ingredient overlap, and consolidation opportunities. Parameters include nutrient priority, declaration weight, and similarity threshold. Output is a ranked report with side-by-side composition. This capability is data analysis. The computation is similarity scoring across structured data, not machine learning.

Scan PDF to Recipe

AI-ASSISTED DOCUMENT PARSING

Reads a customer specification PDF and creates a starting formulation with ingredients and constraints filled in. Handles common formats, including supplier product sheets and outside nutrition panels. The formulator reviews, adjusts, and approves. It removes much of the manual data entry when a formula starts from an outside document.

Recipe Starter

ARTIFICIAL INTELLIGENCE · GENERATIVE

Generates starting formulation compositions from past formulations and defined inputs. It flags possible stability risks, regulatory concerns, and ingredient conflicts before lab testing. Each suggestion shows its reasoning: the past formulations and ingredient relationships that shaped it.

DESIGN DIRECTION

BESTMIX is building this so that historical production feedback surfaces inside Recipe Management while a new formula is being created. Relevant production constraints and suggestions would reach the formulator during formulation, rather than being found later through repeated trials. This is design direction, not a shipped capability.

In-App AI Knowledge Agent

ARTIFICIAL INTELLIGENCE · CONTEXT-AWARE

An evolution of the documentation chat assistant. It sits inside the application and is aware of the user's current workflow. It includes a guided task mode for complex processes. It draws on BESTMIX documentation, training content, and best practices through a structured knowledge base. It shortens ramp time for new users and moves experienced users toward advanced features.

Custom Functions and Customer Models

Platform capability. This is an integration, not a BESTMIX AI model.

BESTMIX can bring a customer's own model, or an external partner's model, into formulation through custom functions. A result such as a palatability score, a sustainability or carbon impact, or a process capability target can be calculated against a formula and used during optimization. The composition and nutritional values are sent to the model, the model returns a result, and that result appears against the formula for the formulator to use.

The model belongs to the customer or their chosen partner. BESTMIX gives it a place to run inside formulation. This is a platform and integration capability, not a BESTMIX AI model.

Formulating to a process capability target

Process capability, or CpK, is a measure of how consistently a process stays within its specification. Formulating to a CpK target means formulating to a confidence level that meets specification, rather than to a single average value. That requires knowing the variability of each ingredient, not just its average.

BESTMIX supports this in two ways. It can account for ingredient variability directly in formulation, so a formula can be optimized to hold a CpK target. And BESTMIX Precision handles variability continuously, re-optimizing against the actual incoming ingredient values rather than averages.

Frequently Asked Questions

Common questions about these capabilities and the data behind them.

What kind of AI is each capability?

Each capability uses a different kind of AI, and some are not AI at all. Every capability in this document is labeled by its category for this reason. The table below sets out each one.

Capability	What kind of AI it is
AI Chat Assistant	Retrieval-augmented generation (RAG). A language model that answers only from BESTMIX documentation.
BESTMIX Insights	Supervised machine learning. A regression model that predicts a production outcome, such as finished moisture or pellet durability. Not a language model.
Recipe Analyzer	Data analysis. Similarity scoring across structured data, not machine learning.
Recipe Starter	Generative AI. Proposes a starting formulation from past formulations.
Custom Functions and Customer Models	Not AI. A platform integration that runs the customer's own model.

Is our data secure, and do you use it to train other models?

Your data is yours. BESTMIX systems are closed. The documentation assistant is trained only on BESTMIX documentation and never sees your formulations or production data. A predictive model built for you is trained on your data, for your use. BESTMIX does not pool your data to train models it then sells to others, and your data does not become a BESTMIX product. If a project ends, your data stays with you. We suggest asking any AI partner the same questions: who owns the data, who owns the models trained on it, and whether your data is ever used to build something for another company.

How can BESTMIX understand our production data better than our line supplier or our process systems?

BESTMIX does not replace the equipment supplier or the process systems, and it does not claim to know the machine better than the people who build and run it. Your process systems, whether an MES, SCADA, a batching system, historian, or operator logs, record what the line did. What they do not hold is the formulation and the finished quality specification, so they cannot relate what the line did back to what the formula requires. BESTMIX holds the formulation and quality data, so BESTMIX connects the two. The process data is an input to BESTMIX, not a competitor. The better those systems are, the better BESTMIX performs, because the data is already there.

What data is needed for the predictive capability to work?

Three things, recorded against the batches that were run: the formulation, the process settings the line used, and the finished quality result the plant cares about, such as finished moisture. BESTMIX relates these to each other. More history improves accuracy, and a plant does not need new instrumentation to begin. It needs the records it likely already keeps.

Do we need to replace our formulation system to work with BESTMIX?

No, not to run the predictive work. The predictive models need formulation, process, and quality data in a structured, readable form, and for a proof of concept BESTMIX can work from your own exported formulation data. BESTMIX Recipe Management is a formulation system, so moving to it is a separate decision you can make on its own terms. The feedback loop is strongest when formulation and quality sit in BESTMIX Recipe Management and Quality Control, because the data layer is already structured and connected, but that is a later choice, not a condition for starting.

How is model accuracy maintained over time?

A model is validated before it informs any live decision, and it is checked against new production results as they accumulate. Ingredients drift, seasons change, and lines are adjusted, so a model is not set once and left alone. Accuracy improves as more production data comes in, and SHAP explainability lets a formulator or engineer see whether the reasons behind a prediction still hold.

Can we see these capabilities in a demo?

The AI Chat Assistant is live and can be shown. The predictive work is proven on production data and is best seen through a proof of concept on your own line, because its value comes from your data rather than from a fixed feature. The capabilities in development are shared as roadmap. The best starting point is a conversation about the roadmap and whether your line is a fit for a proof of concept.

When will these capabilities be available?

BESTMIX labels each capability by whether it is deployed today or in development, rather than by date. Specifics on availability are shared through your BESTMIX representative, and current customers can follow new capabilities as they ship through the in-application release notes.

Data Foundation

AI accuracy depends on the data architecture underneath it.

BESTMIX predictive models operate on the structured data layer held in BESTMIX Recipe Management and Quality Control: formulation specifications, ingredient variability, process outputs, and finished quality results. This is the feedback loop. Formulation informs production. Production outcomes feed quality data. Quality data improves the next formulation. Model accuracy improves as production data accumulates.

QUALITY IN THE LOOP

The same production and quality data that sharpens formulation also lets quality work move from reactive to predictive, flagging drift toward a specification limit before a batch falls out of spec.

Where generic AI struggles

A general AI consultancy can build a dashboard on a plant's data. What it cannot do is connect those production insights back to the formulation, because it has no formulation engine. BESTMIX does. That connection, production learning feeding back into formulation over time, is where the lasting value sits. Without a closed loop between R&D, production, and quality, a model cannot learn from what happened on the line.

The data architecture is the prerequisite. AI is built on top of it.

NEXT STEP

Exploring a Proof of Concept

For teams that want to test the predictive approach on their own production data.

A proof of concept builds and validates a predictive model on one production line, using the plant's own historical formulation, process, and finished quality data. It delivers a clear, measured read on how much variability is costing that line and how much of it a model can recover, together with a joint ROI built from the plant's own numbers and a written feasibility report. Nothing touches live production.

BESTMIX takes on a small number of validation partners at a time, across extrusion and pelleting operations. A partner helps shape the capability as it develops, working from its own production data.

Confirming your data is ready

No formal preparation is needed. It helps to know the answer to three questions for one line:

- ♦ Can you export the process settings the line recorded?
- ♦ Do you record a finished quality result, such as moisture, and can you tie it to the batch that ran?
- ♦ Are your formulations held in a system you can export from?

The predictive work needs data that is digitized and exportable, from a historian, MES, SCADA, batching system, or structured logs. The data can sit in more than one place. What matters is that process settings, formulations, and finished results are recorded and can be tied to the batches that ran.

On how much, a useful guide is about a year of production history on the line, and six months is often enough to begin. The more a line varies in products and conditions, the more history helps, so treat this as a guide, not a fixed rule.

If the answers are yes, or mostly yes, there is enough to begin, and the next step is a conversation with your BESTMIX representative.

If the data is not there yet

Some producers record little of this today, or it sits only in an operator's notes or a machine that does not export. The path is the same, it just begins a step earlier. The first move is to get one line's process settings and finished results into a digital, exportable form, and to bring the formulation and quality data that sits in different places into one place. That centralized data is what lets the closed loop run, and holding it is what BESTMIX Recipe Management and Quality Control are built for.

If your production data looks like a fit, contact your BESTMIX representative to discuss whether a proof of concept makes sense for your line.