RIVERLOGIC

Product Comparison

River Logic vs. IBM Optimization Platforms

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Introduction

The topic of Prescriptive Analytics or "Optimization" has received increased attention recently, including analysts such as Gartner, The Advisory Board and Butler Analytics as well as other industry thought leaders. On May 28, 2015, Gartner published its first ever Market Guide for Optimization Solutions. In the guide, Gartner predicts that "by 2018, optimization will no longer be a niche discipline; it will become a best practice for leading organizations to address a wide range of complex business decisions." This is due to the transformational value that optimization can bring to an organization.

However, optimization has been around for 30+ years, and despite ROIs typically ranging from 5x-20x, market penetration lingers below 5%. Why is this? In a breakthrough report (Prescriptive Analytics - A Business Guide, May 2014), Butler Analytics describes some of the key technical roadblocks to mainstream adoption:

1. One of the most significant overheads is the creation and maintenance of business rules (i.e. constraints). Even modest optimization projects might involve hundreds or thousands of rules, and recreating them for every optimization problem is expensive and error-prone

2. Prescriptive analytics needs an integrated analytics environment capable of integrating business rules, predictive models and prescriptive analytics.

3. The compute intensive processing required for optimization has traditionally been associated with very long solve times - typically days and weeks

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Nevertheless, obstacles remain as traditional programming languages have made it challenging to drive wide adoption of more complex integrated models of the business that generate the highest value. Therefore any technology that seeks to expand the penetration of Prescriptive Analytics must therefore directly address the technical obstacles of agility, ease of use and value.

To illustrate, we contrast two of the seven optimization platform software vendors highlighted in the Gartner report, River Logic and IBM. Specifically, we compare River Logic's Enterprise Optimizer® (EO) platform to the IBM® ILOG® CPLEX® Optimization Studio platform, which consists of the Optimization Programming Language (OPL), an integrated development environment (IDE) used to build OPL-based models, and the CPLEX solver.

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This comparison is intended to facilitate adoption decisions and to generate maximum value for current and potential users. To do this, a team of business analysts and operations research practitioners developed the same model using both systems.

At face value, this is a reasonable comparison to make. Both systems incorporate use of a modeling language and development environment in order to solve optimization-based problems. In practice, however, there are significant and highly visible differences that limit the overlap of target audience, users and use cases and which mean the comparison loses some relevance. For example, River Logic's EO is typically deployed in enterprise wide integrated business planning models that support tactical and strategic planning processes. These models are used by business analysts and are frequently updated to reflect changes in the business.

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A language like OPL is used almost exclusively by Operations Research professionals and software engineers as it presents a steep learning curve for business analysts and company executives. Furthermore, developing and maintaining such complex models in a programming language requires years and months, which limits agility and therefore defeats the business purpose.

The following pages describe the major features associated with each platform:

IBM® ILOG® CPLEX® Optimization Studio

IBM's latest entry into the optimization solution market occurred in January 2009 when it purchased ILOG, a leading business rule management system based in France.

As part of that acquisition, IBM also acquired CPLEX, the market leading commercial optimization solver, and additional products that are the focus of this report: Optimization Programming Language, or OPL, is a specialized algebraic mathematical language that contains features designed specifically for modeling optimization and constraint programming problems. OPL is considered a 4th-generation language. An OPL program consists of declarations, a definition of the objective function and an enumeration of constraints, all of which together constitute a unique model. Constructing a model in OPL requires coding acumen and experience; specific knowledge of language structure and sytax; and, equally important, expertise with optimization terminology and concepts.

While an OPL model can be run from the Windows command line or using a script, it is normally edited and debugged within the Optimization Studio's integrated development environment (IDE). This component allows the user to create an OPL project, which includes at least one OPL model file, one or more run configurations, and optional connects to external data sources. In addition to authoring model code, the IDE is used to solve the model, display and debug error messages and infeasibilities, and display solution results.Learning to code in OPL inside its IDE takes considerable time and effort and is normally done by Operations Research professionals or software engineers.

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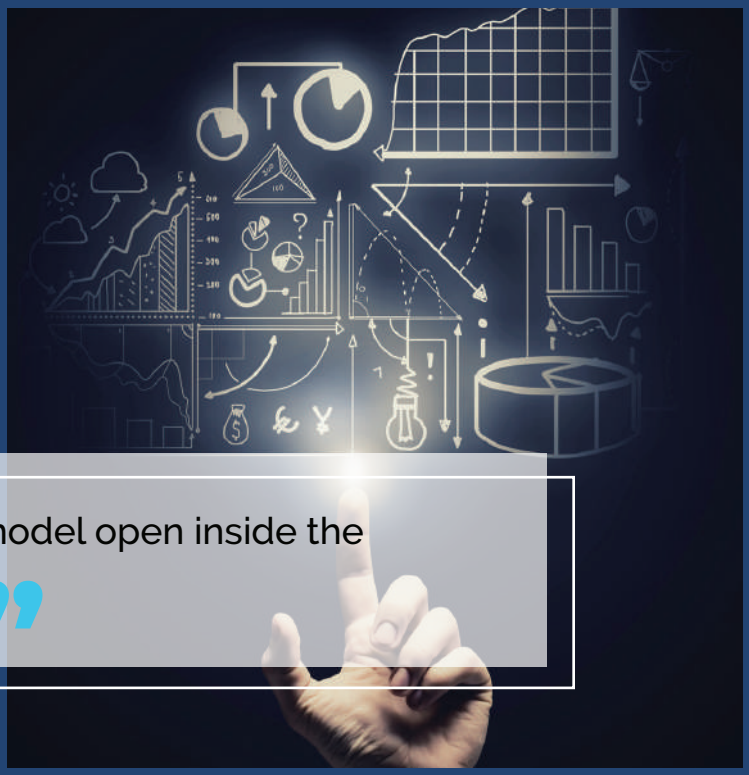
As a comparison, developing full expertise in the OPL language and IDE typically favors users experienced with computer programs like Pascal, Visual Basic, C++, or other low-level programming languages. And, although prior OPL projects can be copied, renamed and reused for a new project, to the untrained eye, every OPL model open inside the IDE looks like every other model, and thus is highly dependent on the trained user's skill level.

Along with the IDE, an application programming interface (API) exists allowing users to extract data from and export the solve results to spreadsheets or databases.



> ...to the untrained eye, every OPL model open inside the IDE looks like every other model.

River Logic® Enterprise Optimizer® Platform

River Logic was incorporated in early 2000 primarily to commercialize the Enterprise Optimizer (EO) platform, which currently consists of:

- Enterprise Optimizer Developer, Runtime, Research editions, which includes a 5th generation, visual modeling language inside an integrated development environment
- EO Server (EOS), a job automation program used to deploy EO models in multi-server, cloud-based environments
- EO Script Generator Wizard (EOSGW), a scripting program used to create SQL database schema scripts for easy integration with EO models

Since all components are tightly coupled, for the remainder of this paper they will be referred to just as the Enterprise Optimizer modeling platform. It requires no out-of-the box code writing to successfully build, test and deploy models and is based on these four differentiated capabilities:

> "It requires no out-of-the box code writing to successfully build, test and deploy models..."

1. **Holistic** – allows for physical, financial and strategic modeling
2. **Visual** – based on drag-and-drop modeling (no coding)
3. **Dynamic** – automatically generates equations
4. **Collaborative** – everyone works off the same model (versus customizing the model for each scenario)

EO includes a graphical user interface (GUI) for building models and a browser for managing global data, building queries, dashboards and reports. The GUI enables a modeler to drag-and-drop icons from a pallet to a window in order to visually represent the business problem (in the form of a process flow). Each model object contains a set of database tables that represent an intuitive basic function:

Purchase – materials enter at a given cost

Sales – materials exit in exchange for revenue

Inventory – allow for beginning and ending inventories, and hold materials for one or more time periods while accruing costs

Conversion – combinations of materials are transmuted from one form to another, while accruing production, resource hours and labor costs

In addition to process-based objects, the pallet also includes Financial Report objects that map the process flows to audit-quality profit-and-loss, balance sheet and cash flow statements.

Links between these objects provide for yields/distributions, limit material flows, costs and time delays. Additional constraints can be placed on a model through sets of attributes, constraint sets sand ratios.

At solve time, EO generates solver input by interpreting model semantics and translates this into decision variables and constraint equations in memory. EO is scriptable and has built-in data support for importing/exporting to external databases. Visualization and result analysis can be done through charts, graphs, dashboards and pivot tables. EO also has a job management application, which allows multiple users to run optimization jobs on one or more servers, and provides scenario management capabilities.

Comparison Summary

The following summary table and pages contain a detailed comparison and are separated into three main categories: **Key Differences, Modeling** and **Analytics**. The Key Differences section primarily focuses on how quickly someone with modeling aptitude can learn to build a deployable model and deliver tangible value in each platform. The Modeling section focuses on specific features and capabilities of each platform, and includes cursory information on how to build and debug a model. The Analytics section discusses how each platform can be used to analyze a working model in order to gain insights into organizational performance improvement and risk management opportunities.

Although both platforms can be used to solve industrial-scale optimization models, comparing them is not particularly easy. IBM's Optimization Studio, for all intents and purposes, looks and feels more like a traditional software development program. Due to its graphical nature, Enterprise Optimizer looks and feels more like Microsoft Visio or a simulation modeling package. As you read through the following pages note that in the Appendix we describe in detail one such effort to compare the two systems by building in OPL and its IDE what is considered a simple model in EO.

The following table is intended as a summary reference to highlight the major differences. For the full infographic that this table was based on, please visit: **www.riverlogic.com/optimization-software-infographic**

Category	Topic	Enterprise Optimizer	IBM Optimization Studio
Key Differences	Time to Value	4 to 12 weeks	6 to 24 months
	What do you need?	Business problem Company/industry knowledge 3—5 days of training	Same as EO, plus months of academic studies in Operations Research (OR), mathematical languages and software development.
	Who can use it?	Everyone	1+ dedicated OR professional per model
Modeling	Environment	Visual drag and drop Customizable icons, labeling and language One model, many use cases	Equations defined by code One model per use case Difficult to re-use
	Advanced Representations	Batch processing Sequencing Open/close, Buy/sell decisions Complex contracts And more…	Advanced techniques require experienced programmers Skills and time available define what is possible
	Financial Modeling	Configurable chart of accounts Constraint any financial variable or ratio Volume/conditional discounts Transfer pricing And more…	Requires expert financial accounting knowledge to represent these capabilities via equations from scratch.
	Quality Assurance	Infeasibility resolution Data and material balance checks Audits And more…	Programmer's skill plus basic debugging tools determine model quality and matrix generation performance.
Analytics	Financial Reporting	Customizable P&L, Balance Sheet, Cash Flow and Financial Ratios Generated Automatically	Not an out-of-box feature.
	Profitability Analysis	Activity-based unit costing Comprehensive margin analysis In-Context Opportunity Values Net Present Value And more…	Coding required each time to define these capabilities, shadow prices difficult to interpret in complex models.
	Visualization	The picture is the model Material flows and constraint visualization Drag and drop charts and visualizations	No process flow diagram possible, only matrix representations. Some include basic dashboard features.
	What-if Analysis	Limited by data, not equations Optimize for any goal on the fly Easy stochastic analysis And more…	Redesign or pre-programming needed for versatility.

Conclusion

As the Gartner report described, the range of use cases for Enterprise Optimizer and the IBM Optimization Studio are roughly comparable. The fundamental difference is that being an expert system EO represents a complete, visual-based environment, tailored specifically toward rapidly solving business problems, whereas the OPL language and its IDE solve a somewhat wider variety of optimization problems. Thus EO is more suitable for tactical and operational applications where financial modeling is critical, time to value is short which requires constant adaptation to support what-if analyses as the business evolves.

The IBM optimization portfolio provides the tools for generating an application, but lacks EO's built-in knowledge capture of business practices and analyses. An OPLbased application will typically take significantly longer to develop than EO, and will require the input of additional trained personnel besides the domain expert and knowledge engineer, such as IT professionals and programmers familiar with Java.

About River Logic

River Logic has been a global innovator in prescriptive analytics (optimization) since 2000. Its platform — designed for business users — enables enterprise-wide optimization, collaborative planning, and performance management, all delivered through a revolutionary user experience. By understanding how to best utilize cross functional resources and manage trade-offs, companies make more impactful decisions.

River Logic goes to market primarily through partner organizations like PwC, Deloitte, Accenture, and Microsoft, helping them develop high-value applications that monetize their IP. Recent clients include Unilever, Boral, Philip Morris International, Boise Cascade, McKee Foods, and the Russian Post. Typical client value-add ranges from 10% in cost reduction to profit improvements equal to 2-5% of annual sales. River Logic strives to help every customer achieve at least 10X return on investment, but it is common for customers to see even higher returns.

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