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TECHNOLOGY AUDIT

FICO™ Xpress Optimization Suite

FICO

BUTLER GROUP VIEW

ABSTRACT

FICO Xpress is a suite of mathematical modelling and optimisation products that allow organisations to model and solve large, complex optimisation problems. The offering is based on an optimisation engine and a modelling language – Mosel – which enables model definition and offers various solution techniques with the help of specific solver engines. This functionality is provided through a visual development environment – Xpress-IVE. Developers and business analysts can create and deploy models in Mosel with a few days of training, and can invoke the solver of choice, or even multiple solver engines if required, for a given problem. Xpress can handle large amounts of data, in the form of model variables and constraints, with relative ease. The solution also includes a GUI developer module (Xpress-XAD), and a performance tuner (Xpress Tuner) that helps determine various controlling parameters for enhancing Xpress-Optimizer's runtime performance. FICO Xpress helps analysts determine the optimal solution quickly. During execution, users can direct the toolset towards optimisation, feasibility, or computation time. The platform is extensible, and advanced users can create custom modules or other reusable components, and use solver engines via the IVE. Although the output generated by FICO Xpress can undoubtedly help organisations optimise their businesses, Butler Group feels that the offering would reach a broader audience were it to offer a richer set of visualisation facilities.

KEY FINDINGS

✓ Provides a flexible, extensible modelling and programming environment.

✓ Model definition and solution techniques can be combined in a single file.

✗ Would benefit from an out-of-the-box business analyst interface with enhanced visualisation and reporting functionality.

✓ Two decades of experience in developing and implementing optimisation solutions.

✓ Multiple modes of execution are supported, including invocation from Java, C++/C, and .NET applications.

ⓘ Features shared-memory, high-performance, multi-threaded algorithms and support for sub-problem/decomposition techniques to facilitate scale-out operation.

Key: ✓ Product Strength ✗ Product Weakness ⓘ Point of Information

LOOK AHEAD

FICO's roadmap for Xpress includes new technologies for improved computation times and a business analyst interface to empower the business user to control and interact with the optimisation model, manage multiple what-if scenarios, examine KPIs, modify goals, and relax business constraints, etc.

FUNCTIONALITY

Mathematical optimisation techniques enable organisations to solve complex real-world problems and to determine suitable values for parameters of significance to the business, such as revenue, profit, operating cost, time to market, etc. In any such problem-solving situation, some parameters need to be maximised and some minimised while staying within the constraints set by the business environment or market.

The simplest of spreadsheet tools can enable the business user to compare what-if scenarios. Indeed, many managers today still model their businesses by using spreadsheets or more sophisticated tools. In the Financial Services and Banking sectors, a range of more sophisticated tools that sits somewhere between the spreadsheet and the Business Intelligence (BI) stack is common. Other sectors, such as Retail, Healthcare, Manufacturing, and Logistics, also make use of solutions that are capable of optimising scenarios with very large numbers of variables.

Optimisation software, such as the FICO Xpress Optimization Suite, can clearly prove useful for organisations seeking to improve their decision making processes. The business value of FICO Xpress is in its ability to drastically reduce the computation time that is typically associated with mathematical modelling and optimisation software. Moreover, because Xpress enables users to prioritise solutions for optimality, feasibility, and computation time, it offers more flexibility to the business analyst. Furthermore, Xpress also helps determine 'n best' or 'n most optimal' solutions for a problem. This is especially useful when the solution set is quite large and complex, and it is difficult to manually compare solutions.

Product Analysis

FICO provides the FICO Xpress Optimization Suite, a collection of modelling and optimisation tools for solving optimisation problems and aiding enterprise decision making. Xpress-Optimizer is a multi-threaded engine which can be invoked from an application or accessed through the command line. The product incorporates various algorithms for solving different types of problems. The mixed integer programming solver is based on a branch and bound algorithm and incorporates pre-processing capabilities, cutting planes and heuristics to quickly arrive at good solutions. The solution suite supports a number of operating systems, enabling model portability. Users can also take advantage of multi-core CPU architectures through the product's parallel processing capabilities.

The Xpress offering became a part of FICO's portfolio through its acquisition of the UK-based Dash Optimisation. The acquisition was a logical step up for FICO, as it led to a well-rounded decision management portfolio and was a natural conclusion to the long standing partnership between the two organisations. Dash's Xpress optimisation technology was embedded in FICO's Decision Optimizer.

Dash Optimisation, a privately held, best-of–breed, point-solution provider has benefited from this acquisition in terms of a larger addressable market, access to a wider and deeper direct sales force, and greater resources for carrying out research and development. The move will also help FICO to serve a fast-growing market for advanced optimisation engines, especially in the Financial Services and Insurance sectors. Furthermore, the acquisition has opened up options for FICO: the vendor can now exploit the synergies between its Blaze Advisor business rules engine, Xpress Optimization software, and other analytics solutions, to offer a software solution that automates large-scale enterprise decision making. In fact, FICO has started marketing the business rules management system with Xpress Optimization Suite and cross-selling it to Xpress customers and prospects.

FICO Xpress makes use of an optional high-level proprietary programming language – Mosel – which acts as the framework, connecting models with solver engines, and allows the user to embed business logic, combining model-definition statements with solving logic in a single application.

Mosel is a flexible yet powerful language which also provides extensibility options to users. Advanced users can create custom heuristics and decomposition methods which can be reused in other models. Organisations can also build or purchase custom modules or plug-ins. End users can create their own solver modules using the published API. Xpress-Mosel also allows users to nest multiple sub models within a master model, leverage different solvers for different parts of the model, and decompose the model into parts for faster solve times.

FICO Xpress components (see Figure 1) include:

- Xpress-Optimizer, Xpress-SLP, Xpress-Kalis – a set of robust, high performance multi-threaded solvers covering all of the major optimisation problem types.

- Xpress-Mosel – an easy-to-learn rapid development modelling language.

- Xpress-IVE – a Mosel-based visual modelling and execution environment.

- Xpress-Application Developer (XAD) – a GUI designer for Mosel applications.

- Xpress-BCL – an object-oriented library for constructing optimisation models programmatically within application code.

- The Xpress Tuner – a GUI application for automatically configuring Xpress runtime parameters for best performance.
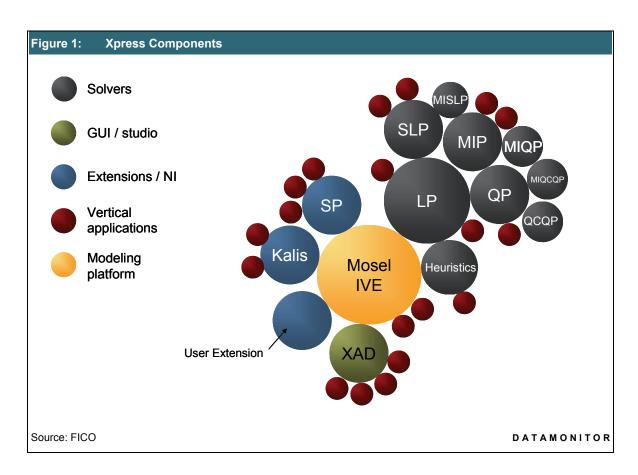
With the help of the tuner application, users can determine runtime parameter values which work better for their model than the solver default values, resulting in significantly enhanced performance. For instance, the product can be tuned for optimality, solution feasibility, or computation time. FICO Xpress also provides interfaces to programming languages such as Java, C++/C, and .NET so that developers can invoke Mosel models in their applications. The product can be used along with FICO Blaze Advisor (Business Rules Management System) for improving business decision making. FICO Xpress and Blaze Advisor toolsets interoperate at various levels to make this possible.

From a capabilities perspective, Xpress technology can be used to solve Linear (Simplex and Barrier) Programming (LP), Mixed Integer Programming (MIP), Quadratic Programming (QP), Quadratic Constrained Quadratic Programming (QCQP), Successive Linear Programming or non-linear programming (SLP), Mixed Integer QC and QCQP, Mixed Integer SLP, and Constraint Programming (CP) problems. Additionally the solution also provides a solver for Stochastic Programming. The solution enables users to adopt problem-specific optimisation techniques, and to invoke multiple solver engines for a given problem.

Xpress has expanded the reach and range of optimisation software, with the solution capable of being used by people with limited Operations Research (OR) background. FICO classifies Xpress users based on their skill level in three categories: None, Low, and Knowledgeable. End users with no knowledge of modelling and optimisation techniques can deploy models built and maintained by FICO; organisations with a limited skill base can modify and deploy models sourced from FICO; clients with sufficient end user skills, however, can use the software to build and deploy models themselves.

FICO Xpress helps improve the decision quality and reduce decision time. The optimisation suite finds applicability in a wide variety of organisations across verticals such as Manufacturing, Processing, Distribution, Retail, Transportation, Financial Services, and Insurance among others, for solving large-scale optimisation problems in areas such as Supply Chain Management (SCM), insurance pricing, retail shelf-space optimisation, production scheduling, marketing optimisation, operations, logistics, and asset management. The solution has proved itself in the market place for more than 25 years, and is among the market leaders in its segment. In Butler Group's opinion, the product should be considered by all organisations looking to optimise their business processes.

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Figure 1:   Xpress Components

Source: FICO

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Product Operation

The present (2009) version has improved parallel MIP functionality and boasts of better cutting planes, improved branching, and better pre-solving capabilities. It also has support for indicator constraints that enable users to specify logical constraints and simplify model generation. The components of the Xpress Optimization Suite are briefly described below:
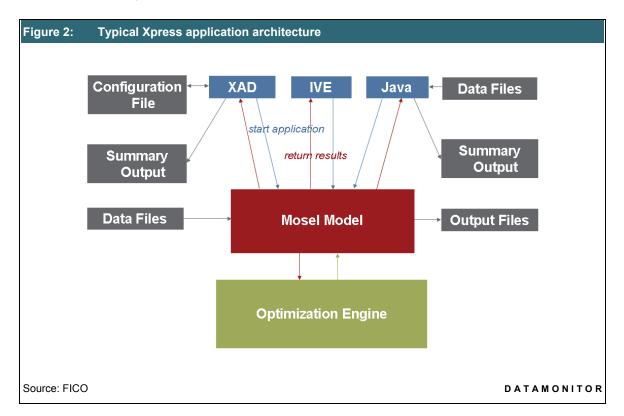
Xpress-IVE is an integrated visual development environment for creating, solving, and analysing Xpress-Mosel models. The IVE offers a text editor for writing Mosel code, a compiler, a debugger (which works like any other source code debugging tool), a profiler that helps reduce runtimes by identifying bottleneck steps, runtime progress graphs, a solution visualisation pane, wizards for template-based model creation and code generation, a drag-and-drop editor for creating XAD GUI components, and an automated deployment wizard for packaging and deploying Xpress applications.

Xpress-XAD is a GUI development tool. It can be used within the Xpress-IVE to create graphic interfaces for Mosel models. Users can leverage the easy-to-use drag-and-drop GUI editor for creating model simulations, for scenario evaluation, etc. The GUI code can be written and compiled with the model itself, so that the GUI is invoked every time the model is executed.

Xpress-Tuner is a GUI module that helps users determine control parameters and their values with the aim of reducing computation time for a given problem or a group of problems. The present version of the tuner allows warm starting a problem with a known solution to search for better solutions, parallelises the tuning process, and also optimises disk I/O. The cumulative effect of using the application is a significant reduction in solve times (usually by a factor between 2x and 10x).

Components of a Mosel application (see Figure 2) typically include the following: a model file; multiple execution interfaces, such as Xpress-IVE or command line for stand-alone execution, and GUI, or an external application such as Java, C++/C, .NET, VB for batch execution; a model configuration file; and summary output files depending on the mode of execution.

Figure 2:   Typical Xpress application architecture

Source: FICO   **D A T A M O N I T O R**

The model requires certain runtime parameters, such as input/output file names, and initial configuration parameters for execution. Model invocation is followed by data set initialisation, problem formulation, and solution. In case a solution is unfeasible, Xpress alerts the user and then attempts to solve it again with relaxed constraints. Results in the form of summary output, detailed output, and/or solution comparisons are made available to the user. Mosel models that contain internal GUIs (defined through XAD) can be run from Windows-based PCs, users can configure parameters and select constraints using the interface, and also choose the solution mode, and compare results.

The solution offers comprehensive scalability in terms of data input: input parameters can be varied by a factor of a million or more. The solution can handle large batches of small tasks and can also scale-up to solve large and complex problems that can be supported on current hardware platforms. Xpress is capable of handling millions of variables and constraints per model. Fault-tolerance efforts required are minimal as Xpress models are stored as text files; client organisations may use any third-party backup or version-control tool for this task.

Product Emphasis

FICO Xpress offers a strong modelling and execution environment in the form of Mosel. Mosel is a full-featured and powerful programming language and a differentiator for FICO. Notably, the Xpress platform is extensible; client organisations can create custom plug-ins and add-on modules if required. Other interesting features include support for multiple programming languages, wizard-based model creation, and integrated application GUI development.

The solution provides an intuitive and easy-to-use development environment, with all the capabilities of a conventional Integrated Development Environment (IDE), as well as features for visualising the solution process and the solution itself. Butler Group believes that enhanced information visualisation facilities would help the product gain broader adoption in the organisation. Overall, in Butler Group's view, the flexibility and depth of the Xpress feature set makes it a compelling solution with a wide variety of application areas for industry and academia alike.

DEPLOYMENT

The product is typically accessed as a desktop application; it may also be accessed over the network in a client server model. Product installation can be completed within a few hours by in-house IT personnel; however, complete implementation and solution roll-out may take a few weeks to a year or more in highly complex modelling environments. Average implementation time is close to six months. FICO claims that OR professionals can learn and implement solutions using Xpress with ease. Programmers and business analysts can also achieve good results with Xpress in a short time.

FICO Xpress offers modularity both in terms of scope of deployment and solution components. Typically, a proof-of-concept solution is implemented first, wherein a few optimisation tasks are modelled and solved, which takes a couple of months to implement and a few weeks for tuning and improving. This is followed by a final implementation where the solution is implemented for all optimisation problems that the client organisation wants to solve. This phase takes around six to 12 months to complete. In terms of solution components, the standard offering includes the Xpress-IVE, Xpress-Mosel, and solvers for LP and MIP. All other components mentioned in this document are available as add-ons, including the Xpress-BCL library, database connectivity components, programming platform interfaces, and solver engines.

Post-deployment resource requirements are minimal if the product is used as a local desktop application. In the case of network deployments, a primary task is to ensure that the model is supplied with the right data sets, in terms of flat files, or spreadsheets, or external data sources such as a Database Management System (DBMS). Solution administrators would need to set up a data-flow mechanism and monitor it periodically. This overhead resource requirement would be customer specific, as the nature and scope of implementation would be unique to each organisation.

The vendor offers classroom-based, as well as Web-based, training sessions. Classroom sessions can be held at customer premises or elsewhere. Training courses are usually two to three days long and classified as introductory and advanced. In certain cases FICO also offers custom training courses if requested by the client organisation. According to the vendor, the introductory training course is sufficient for modelling and solving small-scale problems, and for developing GUI-based applications using XAD.

The solution is available on 32 and 64 bit Windows operating systems, as well as Red Hat Linux, Solaris, AIX, and HP-UX platforms. Telephone and e-mail-based technical support can be purchased from FICO. The solution is CPU intensive. Xpress is suitable for all common kinds of CPU architectures, in particular for multi-core and multi-core, multi-CPU architectures. These architectures are best utilised by using the built-in parallel algorithms for single optimisation problems or by solving a larger number of optimisation problems in parallel. This can be set up, for example, with one master model and multiple sub-models. Where multiple optimisation tasks need to be run simultaneously, FICO recommends a multi-core, multi-CPU hardware platform. The solution is memory intensive, and the use of virtual memory (paging to and from disk) is not recommended as it hampers solution performance.

FICO considers availability of relevant data, and the ability to formulate the optimisation problem correctly as the two main challenges faced by client organisations, apart from the usual risks associated with software projects. Consultancy from FICO often helps organisations overcome these risks.

PRODUCT STRATEGY

FICO targets OR and Research & Development departments within mid-sized to large-sized organisations across vertical industry segments for its Xpress offering. The product is typically used by Independent Software Vendors (ISVs) who embed Xpress technology in their own software, OR consultants who offer Xpress-based services to their clients, and business analysts or Operations Research team members in large organisations to solve internal optimisation problems. FICO Xpress Optimization suite is aimed at all three of these user groups. FICO Xpress has been sold to organisations from vertical segments such as Manufacturing, Processing, Distribution, Retail, Transportation, Financial Services, and Insurance among others. The vendor is also involved in developing and marketing vertical-specific applications based on Xpress. These efforts are currently limited to Financial Services and Insurance sectors, and applications such as marketing optimisation, insurance pricing, and portfolio optimisation among others. In addition, Xpress is used by FICO's analytic services organisation and is embedded in FICO™ Decision Optimizer, a decision modelling and optimisation application used predominately in Financial Services.

The product is sold directly or indirectly through OEM agreements with various ISVs. Sales through FICO distributor partners and the channel form a small percentage of overall sales efforts. FICO's Xpress-centric business partnerships include ISVs such as Aspen Tech and Jeppesen. FICO's technology partners include Microsoft (Microsoft Solver Foundation) and Artelys which develops the constraint programming engine Kalis. The vendor also maintains strong links with academic institutes, such as universities and research organisations, to foster community-oriented development of its Xpress technology.

The solution's licensing structure includes perpetual and term-based licences as well as annual OEM contracts. Annual licences are also given for departmental or organisation-wide usage. All sales deals include solution maintenance and support for the first year with the average deal size being US$50,000. Ongoing support and maintenance is priced at 18% of the original licence costs and includes product updates and support for building and tuning models at customer end.

FICO's Xpress release strategy is annual: the company releases a major version every year, which is followed by two or three minor releases and patch updates if necessary. Xpress's development roadmap includes remote task extension to the Mosel modelling environment to facilitate clustered and cloud deployments, improvements to CPU utilisation and computation times, an Eclipse-based development environment, and integration with project management and version control systems.

COMPANY PROFILE

FICO provides decision management software to organisations, the most popular among them being FICO scores for credit risk assessment. The company was founded in 1956. FICO is publicly held (NYSE), and headquartered in Minneapolis, USA, with offices in California, Canada, the UK, Spain, China, India, Japan, Singapore, and Brazil. The vendor's growth and direction has also been influenced by a number of acquisitions: prominent among them being Credit & Risk Management Associates, Risk Management Technologies, HNC Software, London Bridge Holdings PLC, Braun Consulting, RulesPower, and Dash Optimisation creators of the Xpress suite. FICO has a large geographic presence, with over 5,000 customers in 80 countries and 600 customers of Xpress. Customers of the Xpress Optimization Suite include American Airlines, Aspentech, Avis Europe, Honeywell, Jeppesen, Procter and Gamble, Oracle, RedPrairie, Amazon.com, and NHL among others. The company has 2,250 employees, two-thirds of whom are based out of offices in North America. EMEA and APAC are other major geographies, with Latin America accounting for the rest. 20% of FICO employees are engaged in research and development, 15% in sales and marketing, 55% in sales and services, and 10% in administration. The USA accounts for two-thirds of total FICO revenue, with the UK and the rest of the world contributing 9% and 25% respectively. FICO revenue figures for the last three years are given below:

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Table 1:	Financial Details		
Year ending September 30	**2008**	**2007**	**2006**
Revenue (US$ M)	744.84	784.19	783.00
Change on Previous Year	-5.02%	0.15%	-1.96%
Total Net Income (US$ M)	83.95	104.65	103.49

Source: FICO   **DATAMONITOR**

SUMMARY

FICO Xpress solves large-scale optimisation problems, enabling better business decisions and resulting in financial benefits in areas such as Supply Chain Management, operations, logistics, and asset management. It has been applied in sectors as diverse as Manufacturing, Processing, Distribution, Retailing, Transportation, Finance, and Investment. FICO is an established provider of predictive analytics and decision management software. With the acquisition of UK-based Dash Optimisation, the vendor has strengthened its product portfolio. Butler Group believes that optimisation software is a necessity for many industry segments. The offering can add value in day-to-day operations and can aid strategic decision making.

Although FICO Xpress Optimization Suite is a mature offering, Butler Group believes that its reach and range could be extended even further by the addition of more information visualisation facilities. FICO Xpress Optimization Suite provides a strong modelling environment, and will aid those organisations with complex business decisions to make. Coupled with an easy-to-use development environment, multiple solver engines, and a tuner module, FICO's offering is comprehensive and will appeal to a wide range of optimisation scenarios.

Table 2:	Contact Details	
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Source: FICO   **DATAMONITOR**