Improving operational decision making for competitive advantage

WebSphere ILOG decision management capabilities for communications service providers
Executive summary

These are challenging times for global telecommunications. Communications service providers (CSPs) are facing simultaneously:

- Severe pressure on their revenues due to intense competition and declining demand growth.
- The need to expand and maintain complex network and IT infrastructures.
- The potential threat from nontraditional competitors entering the telecom space with web-based value-added services.

Decision management software can help CSPs respond to those challenges and benefit from the emerging opportunities they create by improving capabilities related to three key competitive imperatives: Becoming more customer centric, improving cost efficiency and enabling new business models.

IBM WebSphere® ILOG® decision management capabilities help CSPs automate and manage operational decisions with business rules and maximize resource utilization with mathematical optimization. This paper provides practical use cases that illustrate the specific business benefits that can be obtained across the strategic and operational processes of a CSP. In particular, special attention is paid to application areas, including:

- Promotions and loyalty management
- Product design and recommendation
- Order-to-cash process improvement
- Context-based services
- Revenue maximization of outbound campaigns
- Network design and planning
- Workforce management
Introduction
Responding to today’s challenges of CSPs
In recent years, consensus has grown in the telecommunications industry that to successfully respond to today’s challenges and to benefit from the emerging opportunities they create, Communications Service Providers (CSPs) need to focus their attention on three key competitive imperatives:

- **Improved customer experience:**
  - Improving customer satisfaction and customer loyalty by providing value to customers through personalized interactions
  - Launching flexible bundle offers tailored to customer needs with fast time to market
  - Improving the customer shopping experience
  - Streamlining the order-to-cash process to eliminate delivery failures and delays that negatively impact customer satisfaction
  - Providing customer-centric service assurance
  - Implementing differentiated pricing, e.g. for corporate customers

- **Improved cost efficiency:**
  - Exploiting economies of scale at the network infrastructure level
  - Exploiting economies of scale at the IT infrastructure level by standardizing OSS/BSS processes and reducing redundancies with shared services across mobile and fixed systems
  - Improving process efficiency by automating manual decisions

- **Generating additional revenue streams from new business models:**
  - Content distribution
  - Context-based services, ad on mobile
  - Public cloud computing services

The following sections will explain how IBM WebSphere ILOG decision management (i.e. business rules, optimization and advanced visualization) software contributes to enhancing those capabilities.

**Business rules capabilities**
How better operational decisions deliver key process improvements
CSPs make many operational decisions as part of their day-to-day activities. For example, if we consider customer-facing activities as shown in Figure 1, we see different types of day-to-day decisions that are crucial to well-managed customer interactions across fulfillment, assurance and billing.

On one hand, the quality of the customer experience with the CSP depends largely on how those decisions are made:

- Are those decisions made in a consistent manner across different channels?
- Are the decisions based on leveraging the knowledge the CSP has of its customer (profile, behavior, needs)?

On the other hand, given the quantity of repetitive “micro decisions” to be made, a CSP needs to find a cost-efficient way to automate those decisions and manage changes over time.
Traditional approaches to decision automation typically consist of hard-coding decision logic in multiple applications or processes by using a technical programming language. The lack of flexibility and transparency of this approach can create a number of serious business drawbacks:

- Long time to market to adapt to new business demands
- High cost of maintenance
- Inconsistent decisions made across various contact channels or systems
- Capacity to innovate and differentiate is constrained by rigid IT systems

Another source of expensive and poor decisions often derives from the fact that a considerable amount of decisions are not automated and therefore require a human intervention from a call center agent or a support engineer. Human agents tend to have disparate level of business expertise (i.e. knowledge of best practices to achieve a given business goal) and frequently base their decisions on incomplete information and subjective criteria.
Table 1 provides an overview of some key telecommunications business processes and identifies the main opportunity areas to improve those processes by making decisions in a consistent and business-centric manner.

<table>
<thead>
<tr>
<th>Telecom operational process or functional area</th>
<th>Business objectives</th>
<th>Operational micro decisions</th>
<th>Improvement opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotions management and loyalty</td>
<td>Acquire Retain Grow share of wallet</td>
<td>Which customer is eligible for which promotion (possibly based on real-time consumption data)? Which customer is eligible for this loyalty program? How much value should be granted?</td>
<td>Shorten time to value from weeks to days. Perform market testing to improve campaign success rates. Provide incentives to customer to consume more. Improve customer satisfaction.</td>
</tr>
<tr>
<td>Dealer commissioning</td>
<td>Design sales incentive plans</td>
<td>Which commissions should be paid based on complex conditions?</td>
<td>Increase sales. Perform what-if simulation of new commission plans being negotiated.</td>
</tr>
<tr>
<td>Product design</td>
<td>Capacity to quickly launch targeted offerings to market and to adapt to changing market conditions (demand and competition) Provide incentive and discounts to boost purchase of various customer segments</td>
<td>Which customer is eligible for an offering? At what price?</td>
<td>Move from product-centric to customer-centric pricing. Define bundle pricing structures and eligibility conditions that can be easily changed.</td>
</tr>
<tr>
<td>Cross-selling/up-selling</td>
<td>Extract value from customer interactions</td>
<td>Which additional service to sell to existing customer?</td>
<td>Maximize sales by recommending personalized offers that fit customer’s needs.</td>
</tr>
<tr>
<td>Offer configuration and recommendation</td>
<td>What is the best fit offer (based on customer needs and budget) that is compatible with the existing customer subscription?</td>
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<tr>
<td>Order to cash</td>
<td>Improve customer experience by eliminating provisioning errors and delays</td>
<td>Is this order valid? How to decompose an order? What is the next suborder to execute? Are customer SLA conditions violated?</td>
<td>Reduce failure rates and cycle times.</td>
</tr>
<tr>
<td>Telecom operational process or functional area</td>
<td>Business objectives</td>
<td>Operational micro decisions</td>
<td>Improvement opportunity</td>
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<tr>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Customer care</td>
<td>Differentiated customer support</td>
<td>During problem handling, which questions to be asked to customer based on profile.</td>
<td>Scarce support resources are used to serve best customers first.</td>
</tr>
<tr>
<td>Differentiated billing</td>
<td>Provide customer-specific pricing conditions to business customers</td>
<td>Which discounts should be applied based on monthly service consumption?</td>
<td>Ability to negotiate and implement customer-specific conditions.</td>
</tr>
<tr>
<td>Bill shock avoidance</td>
<td>Preserve brand and customer trust, respond to new regulations protecting customers</td>
<td>Have we reached a threshold on service consumption based on customer profile and tariff plan?</td>
<td>Ability to notify customers proactively and protect them against bill shocks.</td>
</tr>
<tr>
<td>Assurance—Alarm filtering and correlation; Impact analysis and SLA management</td>
<td>Monitor service levels and improve customer satisfaction in a cost-efficient manner</td>
<td>Correlate infrastructure-level information in real time, including network alarms and performance data, to provide the service-level status of network operations. What is the impact of a network failure on services? Are my customer’s SLAs violated?</td>
<td>Improve productivity of network supervisors by filtering out irrelevant alarms. Automatically identify SLA violations and correct them.</td>
</tr>
<tr>
<td>Revenue assurance</td>
<td>Reduce revenue losses derived from fraudulent calls and service usages</td>
<td>Monitor CDRs to identify calls that are suspicious and should be blocked or monitored by an administrator. Generate alerts when a fraud pattern has been identified by matching CDR fields regarding the duration of call, the frequency of call and the time and day of the call.</td>
<td>Reduce loss rate by detecting fraud proactively. Adapt faster to new fraud behavior and reduce exposure to fraud when introducing a new service.</td>
</tr>
</tbody>
</table>

Table 1: Improving operational processes
A rule-based approach is a way to implement customer-centric strategies and to achieve consistent decision making. A business rule is a representation describing what to do (the action part of a business rule) in a given situation (if given business conditions apply) based on information coming from multiple operational systems.

Business rules can automatically trigger smart actions across various functional areas and systems (e.g. sales and marketing, customer care, promotions, billing). A good example is event-based marketing: Upon receiving a customer complaint, the customer support should trigger a targeted retention offer in real time once it has become clear that the risk of losing a valuable customer becomes too high.

**A practical example: Promotions management**

Let’s imagine a marketing manager creating a new promotion with the objective to boost SMS traffic among teenagers. Our manager knows by experience that teenagers tend to send each other much more messages when some specific events occur in their friends’ network. As a way to stimulate SMS consumption, she wants to offer free messages during a short period of time before the birthday of the targeted subscriber.

Figure 2 shows how those eligibility conditions are implemented as a business rule. It states that the promotion, identified as “Promo_TeenageBirthday_MV” in the existing operational systems, is only eligible for customers belonging to the consumer segment, whose age is between 12 and 20, whose birthday will occur in coming 5 to 10 days and whose monthly consumption of mobile voice exceeds 10 currency units.

In a second step, our marketing manager defines the type and the amount of “promotion value” that should be granted to an eligible customer, here depending on her existing monthly SMS usage and her churn probability. Figure 3 shows a decision table defining the SMS credit to be granted and the validity period for this SMS credit. This output result will later on be passed to the billing system to activate the promotion for a given period of time.

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**Figure 2:** A business rule example—Promotion eligibility

```sql
# definitions
set 'promotion' to a promotion in the requested promotions of 'the application'
where the id of this promotion is Promo_TeenageBirthday_MV;
set 'mobile voice service' to a service in the services of the subscribed offer of the customer
where the type of this service is MobileVoice;
if
the segment of the customer is Consumer
and the age of the customer is between 12 and 20
and the birthday of the customer is between [now + 5 days, now + 10 days]
and the average monthly consumption of 'mobile voice service' is at least 10
then
make it true that promotion is eligible;
```
Business rules provide a common communication language between business and IT and can play an important role in aligning IT with business. This is because a business rule is an executable piece of business knowledge:

- **On one hand**, a business rule represents an atomic element of knowledge about how to run the enterprise business and it can be managed as an enterprise asset. It is self-documented and easy to understand. Various technical and business stakeholders will be able to collaborate in the rule management life cycle (from creation, testing and simulation, deployment and maintenance) by using a Business Rules Management System (BRMS).

- **On the other hand**, a business rule is an “executable” representation, i.e. a promotion eligibility service can be built simply by assembling all the promotion rules modeled by our marketing managers in a project. There is no need to translate our promotion eligibility rules in a technical programming language.

In additional to bridging the communication gap between business and IT by using a business rule language, a BRMS also provides:

- **A centralized repository** that acts as a single point of truth for all the business policies that drive the operational decisions of the enterprise. This is a key architectural element to eliminate decision inconsistencies across channels, systems, regions, organizational units.

- **An execution server** to expose business rules as well-defined reusable services so that a rule set can be easily integrated with various existing systems. Rule-based decision services enable a progressive transformation where business rules are gradually externalized from existing systems.
- Effective tools to align with business and to become demand driven. Advanced rule governance capabilities (such as version management, rule queries, consistency checking, role and permission management) contribute to significantly reduce the cost of maintenance of a business rules project.

In the traditional approach that consists of hard-coding decision logic, the implementation of a customer-centric and differentiated strategy is usually expensive. By contrast, implementing mass personalization strategies with business rules is the way to achieve differentiation while simultaneously reducing total cost of ownership of IT systems.

### Case study: Slashing down time to value of new promotions for an Asian CSP

<table>
<thead>
<tr>
<th>Before</th>
<th></th>
<th>Solution</th>
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</tr>
</thead>
<tbody>
<tr>
<td>We consider the case of an Asian CSP operating in a highly competitive market dominated by prepaid services. The customer had always considered that promotions were a key tool to improve customer satisfaction and loyalty but was suffering from the following limitations:</td>
<td></td>
<td>First, IBM WebSphere Process Server was used to define the standard processes for the launch and execution of promotions. By standardizing on a few well-structured processes able to hide away the complexity of the underlying intelligent networks, the CSP was able to significantly reduce implementation time of new promotions to 4 weeks. Then, WebSphere ILOG JRules was used to implement all the decision logic regarding eligibility and promotions value. As a result, implementation time is now between 1 to 5 days for a new promotion. Marketing managers have the possibility to author new promotions rules using a tailored business rule language and to simulate how many subscribers would be targeted by those promotions rules. IBM InfoSphere™ Streams was used to implement high-performance filters and thresholds based on real-time consumption data. When those thresholds are reached, they trigger the business rules to evaluate if the customer has become eligible for a new promotion. Finally, WebSphere Business Monitor is used to measure the success rate of the launched promotions and is a key component to enable market testing.</td>
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<tr>
<td>• Time to value for new promotions was too long. On average, it took 6 months to implement a new promotion. There are several causes to this long time to market: There is no standard process to define how a promotion should be orchestrated with three different types of intelligent networks (NSN, Ericsson and Huawei), the decision logic about promotions eligibility and value to be granted to customers is hard coded in SQL database queries. • As a consequence of a long implementation time, only a limited number of promotions (1 or 2) can be launched each month and promotions are not targeted enough to be truly effective</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>After</td>
<td></td>
<td>The following benefits have been delivered:</td>
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</tr>
<tr>
<td>The following benefits have been delivered:</td>
<td></td>
<td>• Time to value reduced from 4 months to 2 days • Every week, 10 new promotions can be launched • Promotions are targeted to fine-grained customer segment</td>
<td></td>
</tr>
</tbody>
</table>


Improving operational decision making for competitive advantage

Launching flexible bundles to market

Over the last decade, CSPs have responded to competition by launching a considerable number of new product offerings. As competition intensifies, the pace of product introduction is likely to accelerate. CSPs try to boost their revenues by targeting new bundle offerings to specific customer segments. It is especially important to rely on fine-grained segmentations to grow revenue derived from high-value subscribers purchasing high-margin offerings.

The definition of a bundle offer is therefore two sided: On one hand, a bundle is defined by its structural information, i.e. the subproducts it contains and their characteristics. On the other hand, a bundle is targeted to a customer segment and is also characterized by a number of much more volatile conditions, such as pricing and eligibility conditions. While the structural facet of a bundle is well managed by a product catalog, a BRMS is better suited to store and manage those changing and customer-centric conditions.

Business rules bring flexibility to bundle definitions because they can express the pricing relationships of the individual products that constitute a bundle. Then, in order to provide discounts and incentives to specific customer segments, business rules can implement customer-centric pricing by adjusting the bundle price based on some customer information.

Later on during the life cycle of the product, business rules will determine if a customer request to adapt some characteristics or options of the bundle can be accepted, i.e. if the change is allowed and technically feasible.

Improving the customer shopping experience

While product differentiation is important, it is unlikely to become a long-term competitive advantage since competitors can (and sooner or later will) copy product bundles. Over the long term, personalized customer service is probably a stronger differentiating factor. Therefore, improving the customer experience is becoming a business imperative in fulfillment, from shopping to service delivery.

Let us consider the shopping experience first. The selling process is often too complex to be efficient. Complexity typically derives from siloed product catalogs and IT systems fragmented by product types and channels. Customers then get frustrated by the fact that the CSP does not recommend the same offering depending on the used channel. Also, having to select a complex product from a very large catalog of offers, customers are faced with difficult choices. As a result, the customer shopping experience is so complex that this becomes an inhibitor for purchases, in particular through the web where no human assistance is provided.

There are three major aspects to providing a simplified, consistent and needs-driven shopping experience:

- Building a single view of product information
- Tracking all customer interactions across channels so that customer does not have to provide the same inputs several times
- Providing a single centralized recommendation engine

A rule-based centralized recommendation engine is a way to boost purchases by providing the capacity to recommend and configure an offer that suits customer needs. While providing multiple product choices to customers that like having a variety of options, it can also come up with a simple default choice for customers that prefer simplicity over choice. Because business rules define fine-grained segments, they can propose the right bundle at the right price for a given customer.

The engine applies recommendation rules based on all customer, product and channel information that is relevant and available. Customer-centric recommendations are multidimensional and need to take into account a variety of data points, including:

- The subscriber profile: Demographic data, usage data, LTCV, ARPU and behavioral data such as propensity scores or churn probability
The current customer interaction of the customer (and possibly information about past interactions)
The existing subscription of the customer: The type of bundle and tariff plan subscribed, the customer existing inventory
The eligible offers in the product catalog and the available promotions that can be activated in the billing system
The history of trouble tickets opened for this customer

A business rule is the elementary building block to match data coming for multiple sources and make the best business decisions in that context. With ILOG BRMS, a CSP can design tailored decision services to support its business objectives and requirements. This is an interesting alternative to having to adapt the CSPs business model to the proprietary data models and processes of a packaged solution.

Business intelligence and customer analytic systems can provide a CSP with a wealth of information about customer usage, consumption behavior and needs. This knowledge tends to be centralized in a consumer data asset (or 360-degree customer view) but the question remains about how to best exploit this knowledge into multiple operational touchpoints. As we have seen in our example shown in Figure 2 and Figure 3, business rules can consume data produced by business intelligence (usage data regarding mobile voice average consumption) and predictive analytics tools (behavioral data about churn probability).

Business rules indeed provide a mechanism to combine expert knowledge (marketing and sales expertise, best practices), domain knowledge (operational constraints about what can e done or not, e.g. for regulatory compliance reasons) and knowledge extracted from historical data (usage or behavioral consumer data). When it comes to operationalizing decisions, business rules are therefore the mechanism of choice and close the virtuous loop of analytics and decision management: “Collect/understand/decide.”

Streamlining service delivery
The rapid pace of new product introductions has put considerable pressure on back-end order management and provisioning systems. Legacy order management infrastructures, frequently organized around data and applicative silos, typically cause the following serious issues:

- Service delivery times are too long, generating customer frustration and negatively impacting customer satisfaction and loyalty.
- Order failure rates are too high, increasing operational costs due to expensive onsite interventions or time spent by support engineers at solving exceptions.

In order to reduce cycle times and order failure rates (“getting it right first time”), order management systems must:

- **Build a single view of product information**, including a mapping of commercial offers into technical services and resources. This is the notion of “active catalog” promoted by the TeleManagement (TM) Forum: A layered representation of all the structural information needed to perform a catalog-driven order decomposition.
- **Eliminate application silos** by defining well-structured processes that orchestrate reusable services defined in the OSS layer. This is a way to improve efficiency through a progressive transformation based on BPM and SOA technology.
- **Leverage industry standards.** Leveraging the TM Forum SID schemas implemented in the IBM Websphere Telecom Content Pack (TOCP) is a good way to accelerate rule projects by creating standard-base rule vocabularies and to improve service reuse by providing standard service interface definitions. For rule-based decision services, a rule vocabulary can be built by combining business concepts coming from standard industry schemas and custom data models (CSPs unique view about its customers).
- Be able to accurately determine if an order is valid. Business rules can be used to perform automatic validation across multiple channels.
- Manage the resource dependencies in a provisioning plan. Business rules can be used to generate a build plan that lists all the activities to be performed and the dependencies between those activities. They can also facilitate the dynamic orchestrating of the build plan by determining the next step to be performed, i.e. which process to launch or which technical service to invoke.

### Enabling new business models

As a response to declining revenues in traditional telecommunications services, CSPs are also exploring new business models to generate additional revenue streams, such as content distribution and advertisement. A key capability required to be successful in those activities is personalization:

- **In content distribution**, targeted recommendations can deliver higher conversion rates
- **In mobile advertising**, proposing personalized offers is crucial so that the subscriber perceive value in ads

As mentioned before, a must to achieve efficient mass personalization is to combine analytics and business rules technology.

<table>
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<tr>
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<th>Operational micro decisions</th>
<th>Improvement opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content recommendation</td>
<td>Generate new revenue from multimedia content distribution (IPTV, VoD, mobile video)</td>
<td>Which content to recommend to a subscriber? Decisions are taken by combining expert knowledge modeled as business rules (best practices about what works well in practice in a given situation) and knowledge extracted from data (analytic scores such as propensity to buy, association models)</td>
<td>Leverage unique content recommendation capabilities across multiple channels to deliver targeted recommendation with high conversion rate.</td>
</tr>
<tr>
<td>Real-time context-based services</td>
<td>Generate new revenue from location-based services and mobile advertising</td>
<td>First, complex event processing (WebSphere Business Events or InfoSphere Streams) filters relevant business events out of the customer context (who is the customer, where he is, what he is doing or intends to do and when). Then, ILOG business rules decide if a business event should trigger an action such as a customer communication or an offer recommendation. Given there is a huge catalog of third-party offerings, business rules can dynamically build a catalog query based on catalog metadata that best matches the customer context.</td>
<td>Deliver personalized offers so that subscribers perceive value in ads and not just annoyance. Solving the technical complexity issue of having to match a huge number of situations with a huge catalog of offers from third-party providers.</td>
</tr>
</tbody>
</table>

*Table 2: Enabling capabilities for new business models*
Resource optimization capabilities

Introducing mathematical optimization

Optimization technology can quickly determine how to most effectively allocate resources, automatically balancing trade-offs and business constraints. It eliminates the need to manually work out plans and schedules, so you get maximum operational efficiency.

For example, optimization can be used to maximize the profitability of outbound marketing campaigns. A typical business problem is: We want to plan a set of commercial actions within a set campaign budget. An action is an outbound recommendation about an offer to a customer through a given channel (mail, web or call center). It is easy to see that for a campaign with many different products, a large number of customers and different channels, the number of possible campaign plans is huge.

But on the other hand, not all combinations of actions are valid since our campaign plan must respect operational constraints, such as the maximum capacity of each channel and the minimum period of time between two outbound communications to a customer. The objective is to find a feasible campaign plan that maximizes the potential revenue by taking into account the propensity of each customer to buy a given offer and the expected amount of the purchase they will make. This statistical data is provided as input to the optimization model.

IBM ILOG Optimization technology provides a sound mathematical approach to model such large and complex problems and a robust optimization engine (ILOG CPLEX®) to quickly solve them. The obtained results are high-quality plans that are optimal or close to optimality. Once implemented in operations, such solutions directly deliver high ROI: Since revenue is maximized for a given budget, any improvement in the generated plan directly contributes to improving the profitability of a campaign.

Additionally, ILOG Optimization Decision Manager (ODM) provides an intuitive environment to enable a business user to define various business scenarios and compare them by running what-if simulations. For instance, he could measure the impact of a budget change on generated revenue.

Optimization applications in telecommunications

Companies from all industries around the globe use market-leading ILOG Optimization technology in order to cut operating costs, avoid capital expenses, shorten delivery times or maximize profitability. The following table shows the most common applications of mathematical optimization in telecommunications and the delivered business benefits.
### Table 3. Use cases for mathematical optimization

<table>
<thead>
<tr>
<th>Telecom strategic and operational processes</th>
<th>Business objectives</th>
<th>Optimization decisions</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outbound campaign planning and execution</td>
<td>Maximizing campaign profitability and return on marketing investment (ROMI)</td>
<td>What is the optimal campaign in terms of revenue generation taking into account all customer segments, all product offerings under budget and operational constraints?</td>
<td>Budget constraint, channel capacity constraints, incompatibilities between channels, customer segments and product types</td>
</tr>
<tr>
<td>Network planning</td>
<td>Minimize CAPEX</td>
<td>Decide where to add capacity to the network to service demand forecast</td>
<td>QoS constraints, survivability constraints</td>
</tr>
<tr>
<td>Network design</td>
<td>Minimize OPEX</td>
<td>Design how capacity should be assigned to service some specific demands</td>
<td>Survivability and QoS constraints, constraints related to the ease of management and implementation</td>
</tr>
<tr>
<td>Equipment configuration</td>
<td>Minimize OPEX or risk of network failure</td>
<td>Decide how to configure equipment (which subcomponents to include, which configuration parameters to use)</td>
<td>Operational constraints: compatibility constraints, routing constraints, QoS constraints</td>
</tr>
<tr>
<td>Network creation</td>
<td>Maximize network expansion for an assigned budget</td>
<td>Prioritize budget allocation across various network creation projects then managing project schedules taking into account complex operational constraints</td>
<td>Resource utilization constraints, budget constraints</td>
</tr>
<tr>
<td>Project portfolio management and project scheduling</td>
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</tr>
<tr>
<td>Field technician scheduling for service activation</td>
<td>Minimize OPEX with respecting customer SLAs (negotiated time windows for visits)</td>
<td>Robust optimization engine to provide high-quality solutions while respecting complex operational constraints. SLA vs. cost minimization</td>
<td>Customer visits with negotiated time windows, matching skills and competency levels</td>
</tr>
<tr>
<td>Supply chain management—warehouse location</td>
<td>Minimize cost</td>
<td>Decide where to locate warehouses (decisions = open or close a warehouse)</td>
<td>Operational constraints—capacity, delivery times</td>
</tr>
<tr>
<td>Supply chain management—Inventory management</td>
<td>Minimize inventory cost</td>
<td>Decide the stock levels needed at different points along the supply chain network. Optimize replenishment strategies for the shops</td>
<td>Reduce working capital while managing risk of running out of stock</td>
</tr>
</tbody>
</table>
Optimizing telecommunication networks: Planning, design and configuration

Network planning is a key tool for improved investment in network infrastructure. The purpose of network planning is to determine which resources should be installed in order to satisfy traffic requirements while minimizing operational costs and respecting engineering constraints.

When looking at the economics of telecommunications networks, there are opportunities in network infrastructure for large economies of scale. Careful planning can make these opportunities become reality. With respect to network access, these economies can be obtained by carefully deciding where to locate equipment and how to cluster the demands. In backbone optical networks, large savings are possible through the cost structure of fiber-link capacities.

The network planning process is typically comprised of three phases. Equipment location is the first step and consists of deciding where to locate equipment and how to cluster and connect the customers. The second step involves determining the topology and capacities to be installed in the backbone network. Finally, the switching elements need to be configured so that they can support the traffic requirements. All three steps—equipment location, backbone planning and equipment configuration—pose challenging optimization problems. The power and robustness of ILOG Optimization are crucial for providing quality solutions to these problems.

While network planning is about deciding where to add capacity to the network, network design is about deciding how to use that capacity by assigning it to specific service demands. Figure 4 shows an example design of a private network for a corporate customer, taking into account multiple requirements regarding whether the network should be resilient to failures, QoS delay requirements, ease of implementation (e.g. if routes have to be symmetric) and ease of management (e.g. maximum number of ports used at a given node).

Figure 4: Assigning capacity to specific service demands, e.g. a private network for a bank
Next, we consider an equipment configuration problem that occurs in signaling networks: The goal is to obtain an optimal load balancing configuration of signaling equipments. Signaling is the nervous system of a telecommunications network and is vital to operations. A breakdown in the signaling network typically causes customer service failures, which result in lost revenue and unsatisfied customers. The objective for the operator is to prevent local overloads and node-link failures from disrupting signaling by finding an optimal load-balancing configuration.

Optimization models aim at obtaining optimally load-balanced reconfiguration of the routing processors used in signaling equipments of a SS7 network. The following figure shows a typical traffic load before and after optimization. The results produced by ILOG CPLEX cope with failures and changes in traffic patterns. In mobile networks, the need to manage sudden signaling traffic loads has become critical due to the high growth rate of short message services.

The optimization models to be solved are large integer programs containing several thousand integer variables and constraints. Despite this complexity, computational results show that the ILOG CPLEX mixed-integer optimizer is able to produce optimal solutions in a matter of minutes.

As a result, resource utilization is improved with better traffic load balancing. ILOG Optimization technology helps to minimize the probability of unsatisfied customers and a loss of revenue due to service failures while maintenance costs are reduced since the optimization engine generates operational solutions that minimize the number of manual changes to be implemented by network engineers.

**Figure 5:** Traffic load for routing processors before and after optimization
**Advanced visualization capabilities**

As a complement to business rules and optimization, ILOG Visualization tools provide advanced and tailored graphical user interface:

- Gantt charts to manage network creation projects or service provisioning plans and perform critical path analysis
• Network displays and advanced graph layout algorithms to deliver custom network and service monitoring capabilities, and to build intuitive front ends to network design and planning tools
Conclusion
Communication service providers today are faced with tough challenges. This paper has explained how IBM WebSphere ILOG decision management can significantly contribute to improving customer experience, improving cost efficiency and generating additional revenue streams from new business models.

IBM has a proven track record in delivering smart solutions for CSPs by bringing a unique combination of software capabilities (business rules, mathematical optimization, business intelligence and analytics, complex event processing, master data management, business process management). For CSPs, these solutions can make a difference by delivering tangible ROI and becoming key assets to successfully manage short-term and longer-term competitive imperatives.

For more information
To learn more about the IBM WebSphere ILOG Business Rule Management System (BRMS) and IBM ILOG Optimization solutions, please contact your IBM marketing representative or IBM Business Partner, or visit the following websites:
- ibm.com/software/websphere/products/business-rule-management/
- ibm.com/software/websphere/products/optimization/

Additionally, financing solutions from IBM Global Financing can enable effective cash management, protection from technology obsolescence, improved total cost of ownership and return on investment. Also, our Global Asset Recovery Services help address environmental concerns with new, more energy-efficient solutions. For more information on IBM Global Financing, visit: ibm.com/financing

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