End-to-End Business Analytics and Optimization in Ingram Micro’s Two-Tier Distribution Business
Global Leader in Technology and Supply Chain Services

Access to 80% of the World’s IT Spend
World-Class Global Marketplace

1,700+ Vendors

200,000+ Customers

IT • Mobility • Cloud • Supply Chain

Supply Chain Expertise
Lifecycle Services
Sales and Marketing
Technical and Pre-Sales Support

Inventory Management
Business Intelligence and Analytics Tools
Vendor Relations Financing
Private Label Services

Managed Services
Configuration
Communities
Deep Understanding of Customer Needs

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Managed Services
Configuration
Communities
Deep Understanding of Customer Needs
One Of Our Corporate Goals: Data Driven Organization

Cumulative Measured Benefits in North America using Operations Research & Predictive Analytics

<table>
<thead>
<tr>
<th>Year</th>
<th>Incremental Product Revenue (USD)</th>
<th>Incremental Gross Profit$ (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>imprime™</td>
<td>imsmart™</td>
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<tr>
<td>2011</td>
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Jeet Mukherjee
Executive Director, Global Analytics & CRM
Building A Data Driven Organization

Operations Research & Predictive Analytics

Ingram Micro Business Intelligence Center

Infrastructure & Data

People & Capabilities

Tools to Disseminate

Foundation of BI Capabilities

• MS and PhDs in quantitative disciplines
• Best practices
• Intellectual property
• 125+ years of consulting experience

Programs

>$1.1B in revenue over the last 4 years
Three Patent Pending Decision Automation Solutions

100% home grown IP

- **imprime™**
  - Price Matrix Optimization (North America scope: $8B revenue, >450M price calls/year)
  - Negotiation guidance & cross sell app

- **imsmart™**
  - Predictive Analytics-on-demand for Sales, Marketing & Vendors
  - Uncovers customer and end customer level opportunities
  - Integration with Intelligence platform

- **Intelligence**
  - Analytics-driven digital marketing platform
  - Single sign on for resellers and Ingram associates
  - Integration with Eloqua (Marketing Automation Platform)
imprime™ End-to-End Process

Customer Segmentation
- Go-to-market segmentation (Choice Advantage)
- Dynamic segmentation (Opaque)

Business Rules UI
- Scope
- Objectives
- Constraints
- Bounds
- Duration

Demand Modeling
- Price elasticity estimation
- Calibration
- Causal forecasting

Optimization
- Quadratic program
- Multi-choice Knapsack

Review UI & Price Loads
- Accept/Reject/Edit
- Load price recommendations to Price Management System
Predictive Analytics-on-demand: imsmart™
Analytics-driven marketing programs:

- Partner Loyalty
- End User Lead Generation
- Whitespace
- Open Demand Follow-up
- Attach
- Up-Sell
- Renewals + +
- Partner Recruitment
Testimonial: APC by Schneider Electric
Microsoft Rebate Optimization: FY 2011-2012

Average Daily Sales (ADS$)

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre (YoY)</th>
<th>Post</th>
<th>Chg%</th>
<th>Net Lift %</th>
<th>Cuml. Lit $ (40 wks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>$608,107</td>
<td>$653,392</td>
<td>7%</td>
<td>31%</td>
<td>$44,847,298</td>
</tr>
<tr>
<td>Control</td>
<td>$889,565</td>
<td>$676,843</td>
<td>-24%</td>
<td></td>
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</table>

Machine Margin %

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre (YoY)</th>
<th>Post</th>
<th>Chg (BPs)</th>
<th>Net Lift (BPs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>2.25%</td>
<td>1.76%</td>
<td>-49</td>
<td>-34</td>
</tr>
<tr>
<td>Control</td>
<td>2.72%</td>
<td>2.58%</td>
<td>-15</td>
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</table>

Daily Machine Margin$

<table>
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<tr>
<th>Group</th>
<th>Pre (YoY)</th>
<th>Post</th>
<th>Chg%</th>
<th>Net Lift %</th>
<th>Cuml. Lit $ (40 wks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>$13,705</td>
<td>$11,500</td>
<td>-16%</td>
<td>12%</td>
<td>$523,631</td>
</tr>
<tr>
<td>Control</td>
<td>$24,234</td>
<td>$17,454</td>
<td>-28%</td>
<td></td>
<td></td>
</tr>
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</table>

Performance Based Rebate$ Attainment

<table>
<thead>
<tr>
<th>Product Segment</th>
<th>Pre (YoY)</th>
<th>Post</th>
<th>Net Chg$</th>
<th>Net Chg%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core (Mature)</td>
<td>$427,000</td>
<td>$1,074,000</td>
<td>$647,000</td>
<td>152%</td>
</tr>
<tr>
<td>Growth</td>
<td>$1,138,000</td>
<td>$1,397,000</td>
<td>$259,000</td>
<td>23%</td>
</tr>
<tr>
<td>Incubation</td>
<td>$454,000</td>
<td>$674,000</td>
<td>$220,000</td>
<td>48%</td>
</tr>
<tr>
<td>Total</td>
<td>$2,019,000</td>
<td>$3,145,000</td>
<td>$1,126,000</td>
<td>56%</td>
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</tbody>
</table>
Case Study: VMware End User White Space Lead Gen
Solution Architecture & Analytical Models
imprime™

B2B Price Optimization & Analytics
Ingram’s Pricing Evolutions...

**Price Management (Strat Pricing)**
- Customer segmentation (choice advantage)
- Model-based ‘dynamic’ price settings (excel based)

**Zilliant Price Optimization**
- Automated system for granular price settings
- Business inputs incorporation
- Improved, scalable and robust ‘models’

**imprime™**
- Even better and scalable ‘models’
- Incorporation of additional external variables
- Product lifecycle pricing
- Rebate optimization
- Flexibility around future business needs (web merchandizing, deal optimization etc.)

**Next Gen Pricing Platform**

**Modular:**
- Global
- SAP
- More data
- More Strategies
- Interaction with other applications
**imprime**™ innovations

*Patent Pending*

- Market response model (MRM) utilizes panel data (external) & internal (CRM)
- Practical hierarchical Bayesian framework
- Direct account for negotiation, price offers, and Bill of Material (BOM) effect.
- Price elasticity calibration: short term vs. long term

**Demand Modeling**

- Multi-level price setting
- Multiple objectives
- 2-stage price optimization for scalability
  - Efficient frontier optimization as Quadratic Program (QP)
  - (0-1) multi-choice Knapsack with cross-segment constraints

**Optimization**

- Flexible UI capturing business rules (vendor management), rebate letters (vendors)
- 8-10M price changes end-to-end < 45 minutes
Different Price Settings Objectives: **imprime™**

### SYSTEM (a.k.a. LIST) PRICING

- **CUSTOMER SEGMENT SPECIFIC**
  - REGULAR PRICE OPT: Market Share
  - Lifecycle Pricing
  - Volume Discount Optimization
- **REGULAR PRICE OPT: Machine Margin$**
- **Rebate & Gross Margin$ Optimization**
- **Web Price Optimization**

### CUSTOMER SPECIFIC

- **Customer VLP Opt**
- **Price Alignment**

### NEGOTIATION GUIDANCE

- **Negotiation Guidance**
- **Hard Floors Setting**

### PROGRAMS

- **Freight & Fees Optimization**
- **Credit Optimization**
- **IMT Pipeline: Pricing Touch**
- **Attach via coupons**

**In house solution (home grown IP)**

**Manual**

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Demand Modeling Hierarchy for Panel Data: imprime™

\[ q_{i,t}^{IM} = Q_{g,t} \cdot \alpha_{i,t} \cdot S_{i,t}^{IM} \]

- **Category:**
  - Computer Systems
    - **Technology:**
      - Portable Computers
        - **Subcategory:**
          - Notebooks
          - Chromebooks
          - Blade Servers
          - Rackmount
    - **Subcategory:**
      - Servers
    - **Cost Bins:**
      - Cost <$425
      - Cost $425-$855
      - Cost >$855

Ridge Regression

\[ \min_{\beta} \sum_{i} (y_i - x_i^T \beta)^2 + \lambda \sum_{j=1}^{p} (\beta - \beta_0)^2 \]
Demand Modeling Hierarchy for CRM Data: imprime™

Category

Sales Division

Business Unit

Customer Spend

Computer Systems

Core VARs

National Accounts

Small VARs

Mid-tier VARs

Direct Marketers

E-tailers

Tier 1

Tier 2

Tier 7
Blending of Price Elasticity Signals & Price Setting:

**imprime™**

- Price setting levels (combinations) are determined dynamically using bias-variance trade-off.

- Price elasticity is imputed as a point estimate at current price by blending 4 demand model parameters.

\[ \varepsilon_{\text{Blended}} = \varepsilon_Q + \varepsilon_{\text{MNL}} + \varepsilon_{\text{LR}} \]

- Entity-level elasticity is calculated by offsetting blended elasticity by customer (or customer segment) level elasticity.

**Low volume, stable, over aggregation**

- Vendor Code – Customer Segment
- Vendor Code – Customer
- SKU – Customer Segment
- SKU – Customer

**High volume, high noise, highest price resolution**
Price Optimization: **imprime™**

\[
\max_m J = \lambda \frac{E[\pi]}{\pi_a} + (1 - \lambda) \frac{E[R]}{R_a}
\]

\( s.t. \ m_{LB} \leq m \leq m_{UB} \)

- Entity level, optimizing convex combination (exogenous \( \lambda \)) of expected Profit \& Revenue lifts
- Demand(win) curve linearized around current demand \( \rightarrow \) Quadratic Program with box constraints (closed form)
- Price consistency requirements \( \rightarrow \) Linear constraints \( \rightarrow \) KKT conditions \( \rightarrow \) System of Linear Equations

**Efficient frontier optimization**

\[
\max_x J = \sum_{j \in J} \sum_{i \in S} \pi_{i,j}^* \cdot \pi_a \cdot w_i \cdot x_{i,j}
\]

\( s.t. \ \sum_{j \in J} \sum_{i \in S} R_{i,j}^* \cdot R_a \cdot x_{i,j} \geq \Gamma \\
\sum_{j \in J} x_{i,j} = 1 \ \forall i \in S \\
x_{i,j} \in \{0,1\} \)

**Joint Optimization**

- Cross-entity risk tolerance constraints enforced as multi-choice (0-1) Knapsack problem
- Solved using a greedy approximate algorithm
imprime™ Negotiation & Cross Sell Guidance

• 70% of business @ list price, 30% negotiated
• For negotiated orders we provide additional guidance to inside sales reps
  – Floor and Target price guidance (weighted percentile on peer groups)
  – Cross sell opportunities (market basket)
• Invoice-level profitability
• Integrated with CRM (single sign on)
Predictive Lead Scoring for B2B2B
Evolution of B2B(2B) Lead Generation

Tele-marketing a ‘list’

- Time consuming, expensive process
- Low yield (<1%)

B2B Lead Scoring

- Prioritization of prospects based on their digital response
- Rule based, limited causation
- Weighted sum of activities

B2B Predictive Lead Scoring

- **Prospect has to visit site to be qualified**
- Mine install base and CRM data as external clues as for which leads are most likely to convert

B2B2B Predictive Lead Scoring

- Uses external non-PII active buying intent signals as additional clues
- Blends CRM, marketing, and intent data
- Self-learning

*Patent Pending*
# Predictive Lead Scoring in B2B2B

## VMWare Virtualization White Space Campaign

<table>
<thead>
<tr>
<th>B2B purchase Intent (% of content consumption) bins of relevant topics</th>
<th>1: higher consumption, 4: no consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>High touch</td>
<td>27 (1.2%)</td>
</tr>
<tr>
<td>Medium touch</td>
<td>27 (1.2%)</td>
</tr>
<tr>
<td>Low touch</td>
<td>25 (1.1%)</td>
</tr>
<tr>
<td>No touch</td>
<td>14 (0.6%)</td>
</tr>
</tbody>
</table>

Ingram Tech-Index based propensity bins
A: highest propensity, D: lowest propensity
Purchase Propensity Bins (A through D)

End User Technology Index
- Layer I
  - General
  - Product Category
  - Prediction
  - Logistic Regression
  - Model
- Bayesian Statistical
- Model

Layer II
- Product
  - Bayesian Statistical
  - Model

Layer III
- Vendor
  - Product and Vendor
  - Level Prediction
  - Logistic Regression
  - Model

Factors:
1. EU Firmographics
2. Adjacency tech purchases
3. Web scraping triggers

Purchase Probability Prediction Logistic Regression Model

Virtualization Technology Index

Virtualization Tech Index Bin

Propensity Tier: A
Propensity Tier: B
Propensity Tier: C
Propensity Tier: D

% of total

0%
5%
10%
15%
20%
25%
30%

0 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Data Center

Detect data size < threshold

Y

Positive Subset
Response Variable = 1
Purchase target Product category from distributor within certain time period

Negative Subset
Response Variable = 0
Not purchase target Product Category, and purchased other product from distributor within certain time period

Model Building Population
For each Product Category

End User Information
- Transactional Information

Logistic Regression
Layer II

Sampling

Y

No

Strategy

Product Information (Top 10 trigger Product Subcategory)

End User Information
Transaction Information
Logistic Regression
Layer II

Layer I General Level Technology Index

Layer II Product Level Technology Index

Layer III Vendor Level Technology Index

Web scraping triggers
(Top 10 trigger Product Subcategory)

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Purchase Intent Bins (1 through 4)
End-to-End B2B2B Lead Generation with PLS

- Automated Qualified Leads (AQLs)
- Marketing Qualified Leads (MQLs)
- Sales Qualified Leads (SQLs)

**Outbound**
- Vendor direct sales and/or third party outcalls
- Vendor end user-facing marketing collateral

**Inbound**
- Drip Campaign to EUs + Pred. Lead Scoring
- Tele Qualification (BANT)

**Target List**
- with Intent and Propensity
- Vendor and Ingram Micro produce target account list

**Reporting**
- Pipeline and Sales Out
- Lead Distribution
  - Marketing-Qualified
  - Vendor partner incentives

**AQLs**
**MQLs**
**SQLs**
End User Activity/Buying Center: Schlumberger Tech Corp (www.slb.com)
5599 San Felipe St # 1700
Houston, TX 77056

PLS in action
## Wrap-up

<table>
<thead>
<tr>
<th>Year</th>
<th>Imprime&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>Imsmart&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>Total</th>
<th>Imprime&lt;sup&gt;TM&lt;/sup&gt;</th>
<th>Analytical Consulting Revenue</th>
<th>Total</th>
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**Thank you!**
Thank You.