DBA5102 – Business Analytics Capstone Module

Lecture 1: Introduction

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Class Plan

1	Course Overview and Assessment Model

2	Fundamentals of Business Analytics

- **Analytics Landscape**

- **How to select the Right Analytics Techniques**

- **Key Elements of a Successful Business Analytics Solution**

Introduce Myself

Academic Researcher   **Industry Practitioner**

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Consultation time: Wed 2pm ~ 6pm (pls liaison with Yuenice)

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Which industry are you from? (e.g. finance, manufacturing, IT, Oil & gas, consulting, etc.)

Key Components of DBA 5102

- Industry Business Analytics Seminars/Workshops
    - Thursday afternoon and evening
    - Learn from industry practitioners and experts
    - Compulsory for all full-time students (part-time students are required similar effort but spread into 2 years)
- Capstone Lectures
    - Thursday evening
    - Contents: Sem 1 – Blockchain Technology; Sem 2 – Explainable AI
    - Compulsory for all full-time students (part-time students are required similar effort but spread into 2 years)
- Analytics Innovation Challenges
    - Once a year
    - Develop solutions for the real business use cases from our industry partners
- Capstone Internship Project
    - Work with our industry partners
    - Follow the capstone project engagement process and guideline

Industry Analytics Seminar
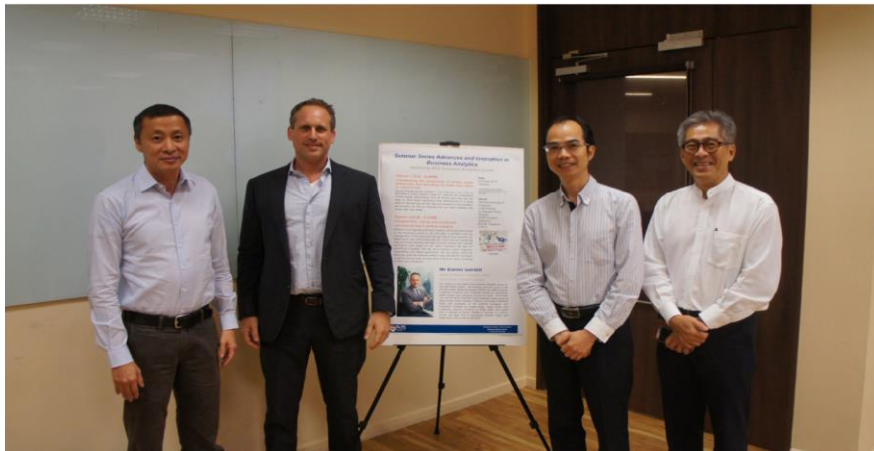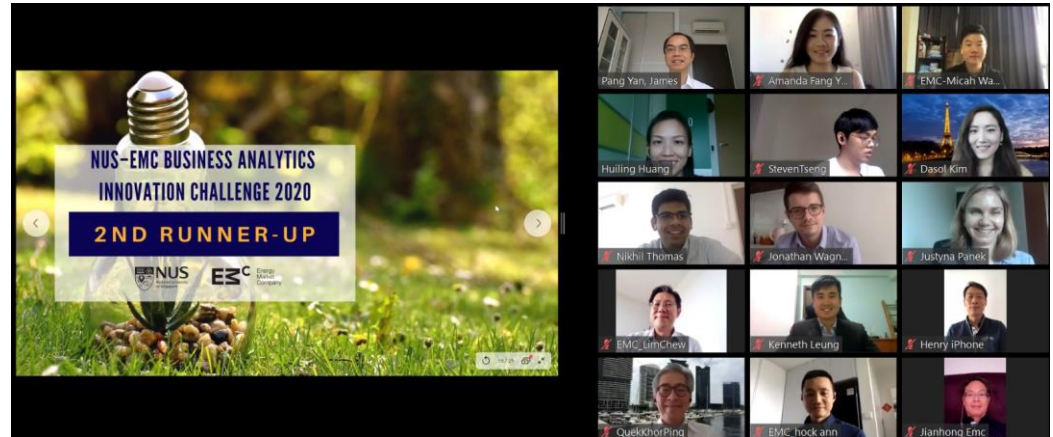
NUS - PSA UNBOXED Innovation Challenge
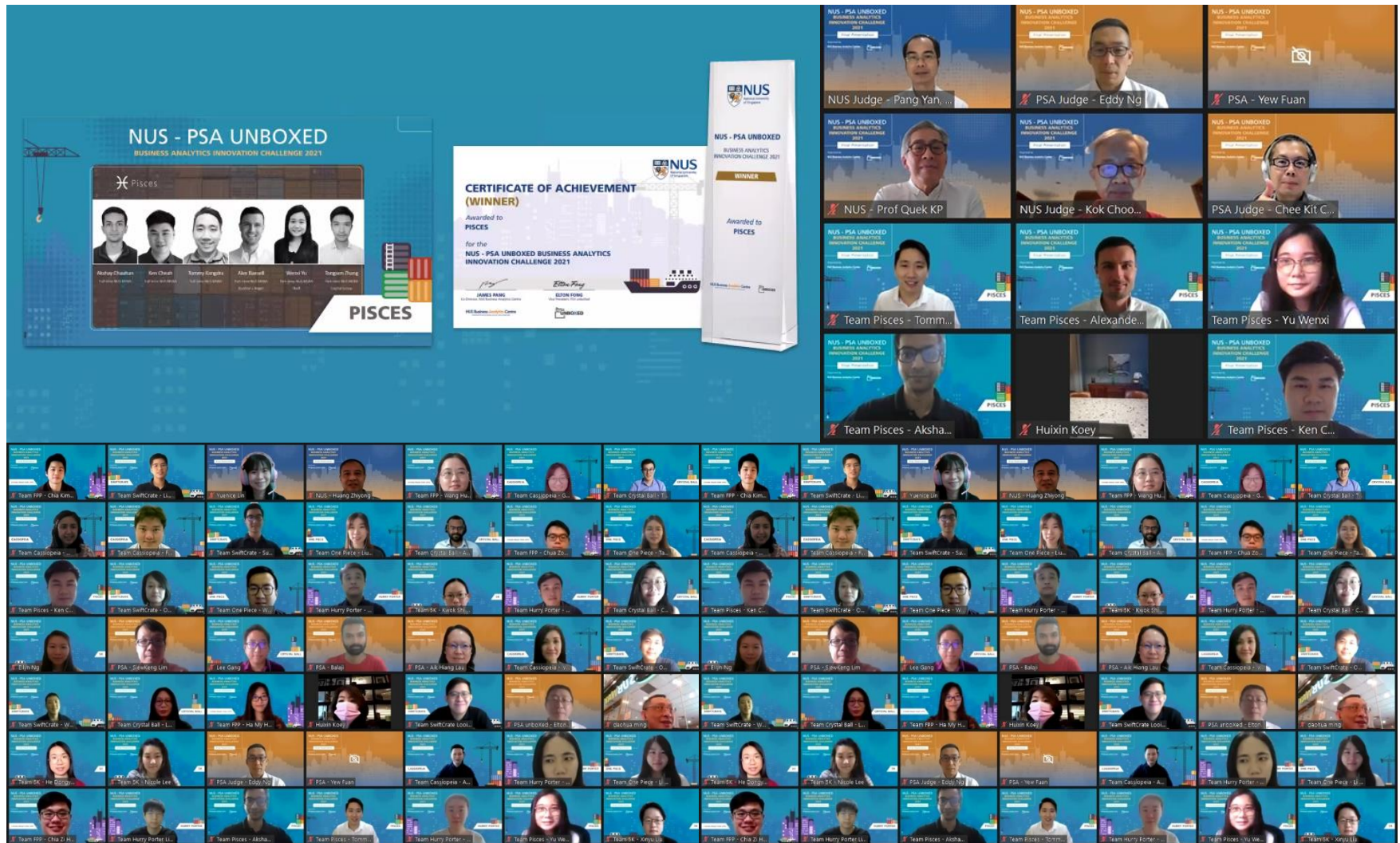
Guideline for Part-time Students

- You have 2 years to complete the capstone module!

- Industry business analytics seminars/workshops

    - Some analytics seminars/workshops are arranged in the evening

- Capstone Lectures

    - You can decide whether you join it in first year or second year

- Analytics Innovation Challenges

    - You must join at least 1 innovation challenge during your MSBA candidature

- Capstone projects

    - Try to find a suitable capstone project in your company, or

    - Conduct a research project with NUS faculty

Semester 1 Class Schedule

DBA 5102 Business Analytics Capstone Module (AY 2021/2022, Semester 1)					
Week	**Date**	**Day/Time**	**Topic**	**Format**	**Venue**
1	12-Aug-2021	Thursday			
		6:30PM - 9:30PM	1. Class Overview 2. Fundamentals of Business Analytics	Lecture	LT 19
2	19-Aug-2021	Thursday			
		4:00PM - 6:00PM	Industry Analytics Seminar - Eastspring	Seminar	LT 19
		6:30PM - 9.30PM	BlockChain Lecture 1	Lecture	LT 19
3	26-Aug-2021	Thursday			
		4:00PM - 6:00PM	Industry Analytics Seminar - NCS	Seminar	LT 19
		6:30PM - 9.30PM	BlockChain Lecture 2	Lecture	LT 19
4	2-Sep-2021	Thursday			
		4:00PM - 6:00PM	Industry Analytics Seminar - Swiss Re	Seminar	LT 19
		6:30PM - 9.30PM	BlockChain Lecture 3	Lecture	LT 19
5	9-Sep-2021	Thursday			
		4:00PM - 6:00PM	Industry Analytics Seminar - ByteDance	Seminar	LT 19
		6:30PM - 9.30PM	BlockChain Lecture 4	Lecture	LT 19
6	16-Sep-2021	Thursday			
		4:00PM - 6:00PM	Industry Analytics Seminar - ConvaTec (Story telling training workshop)	Seminar	LT 19
		6:30PM - 9.30PM	BlockChain Lecture 5	Lecture	LT 19
Recess Week	18 Sep 2021 ~ 26 Sep 2021				
7	30-Sep-2021	Thursday			
		4:00PM - 6:00PM	Industry Analytics Seminar - Huawei	Seminar	LT 19
		6:30PM - 9.30PM	BlockChain Lecture 6	Lecture	LT 19

- There might be some changes in the future, and you will be informed in advance
- Will update the schedule on Luminus

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Business Analytics Centre Symposium (BACS)

- Platform to showcase students' capstone internship projects
  - Poster presentations, etc.
  - Interaction with industry and academic leaders, experts

Student Moderators for BACS 2021

- BACS 2021 will be hosted online on **25 September at 9am~6pm**.

- **We are looking for 6~9 volunteers to moderate these parallel sessions!** This will give you a first-hand experience of what your fellow seniors have gone through and provide you with opportunities to network and expose yourself to participating industry practitioners.

- Responsibilities of BACS session moderators:
  The moderators need to introduce the speakers, encourage the audience to post their questions in the Q&A Chatbox, choose 1-2 questions for the speakers to answer based on relevancy, then move on to introduce the next speaker.

- **Kindly express your interest by filling up this form by 13th August 2021 – Friday: https://forms.gle/1AJJtNwnyodL1i33A**

Process of Capstone Project Engagement (Full-time Students)

- Project proposals from BA Centre industry partners
  - Seminar
  - Proposal write-up

- Announcement of capstone project opportunity
  - Once the company's projects are confirmed, the project information and CV submission folder will be open **on Luminus**
  - Students will be informed the opportunity by email (company, project description, deadline for the CV submission)

- Students submit the updated CV for capstone companies
  - Students **cannot** submit their interest to **more than one "open opportunity" at the same time**
  - Students need to submit the CV timely before the **deadline** (Luminus folder will close automatically)

- Faculty will share the students' CVs with the company
  - Consider **students' interest**
  - **In some cases, the faculty will assign the students who do not indicate their interest for the company if the students' expertise matches company's project requirements**

Process of Capstone Project Engagement (Full-time Students)

- Company will shortlist the students for **interview** or **roundtable discussion**
  - For companies to interact and interview with students
  - For students to understand more about the projects
- **"Lock Period"**
  - Once a student submit his/her CVs for a company opportunity, he/she **cannot** submit her/his CVs to other companies before the final selection results are out
- Outcome
  - After the interview/roundtable discussion, companies will confirm the students' capstone residence
  - The selected students **cannot reject the company's capstone offer** (you can reject the return offer for permanent job later on)
  - The students who are not selected by the company will submit their CVs for other capstone opportunities

Process of Capstone Project Engagement (Full-time Students)

Industry Seminars/Project proposals from BAC industry partners

- Once the companies' projects are confirmed, we will open a folder in Luminus for CV submission

Students submitted CVs and Prof will share students' CVs with companies

Companies select and invite students for roundtable/interview

Students are **locked**

Roundtable /interview outcome

Students are not selected

Students are selected

Prepare for your capstone starting on May!
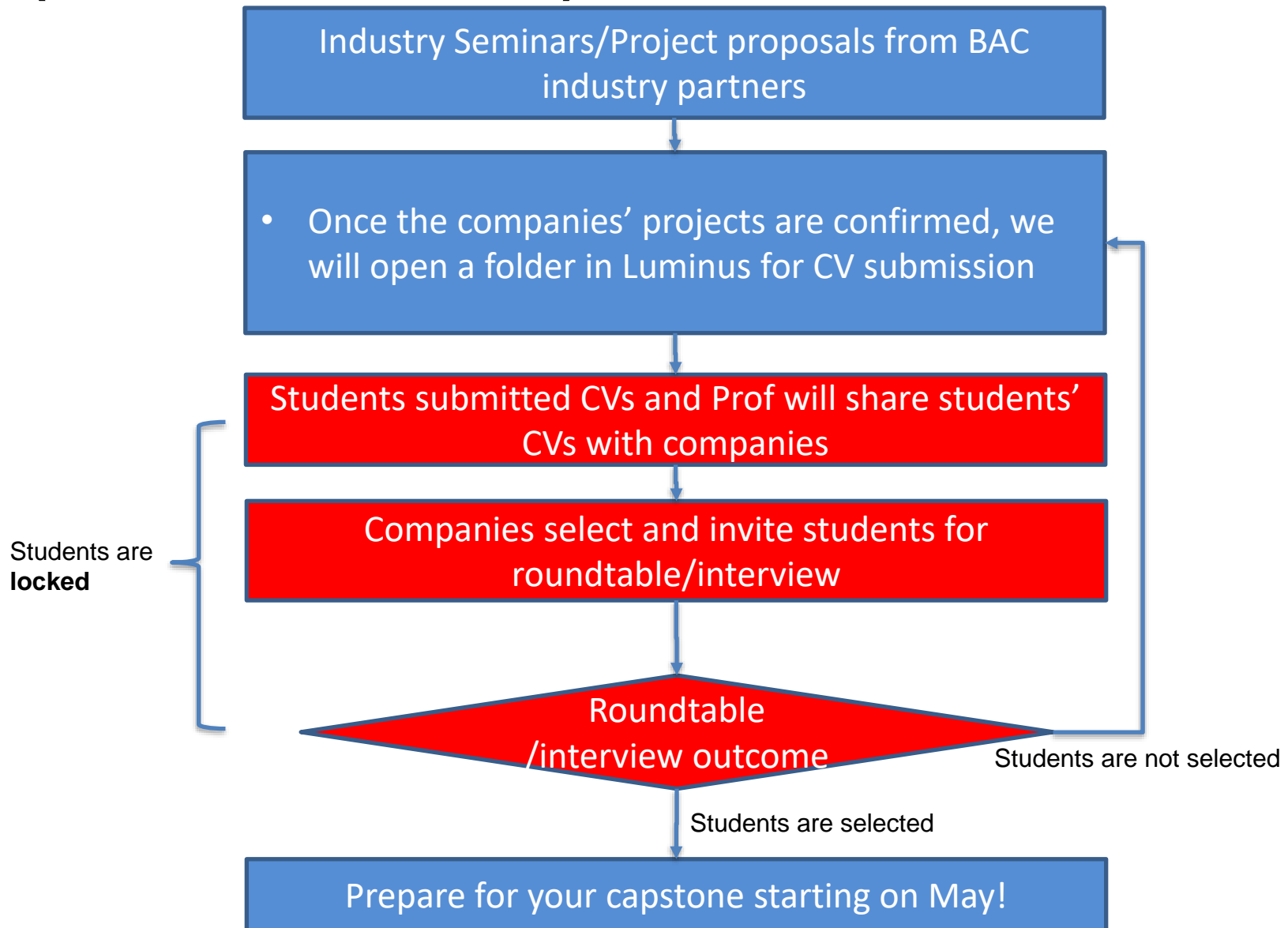
Process of Capstone Project Engagement (Full-time Students with sponsor organizations)

- *Step 1*: Discuss with potential project stakeholders in your organization

- *Step 2*: Get a project proposal template from Luminus and fill in the details

- *Step 3*: Discuss with me for the capstone project scope and get my approval (**before mid of Apr**)

- *Step 4*: Start capstone project and update your academic supervisor regularly

- *Step 5*: Get your academic supervisor's approval and submit the project report and poster

Guideline of Capstone Project Engagement (Full-time Students)

- Objective of capstone project
  - The **main purpose** of capstone project is to **learn** and **contribute**
  - A successful capstone project will be very valuable for your future job opportunity; no matter in your capstone company or other companies
- Do not engage the BAC industry partners by yourself for capstone projects
  - These are our long-term partners and we need to take care of the relationship carefully
  - Keep the faculties in the loop for the interaction with the capstone company
- Polish your CV
  - Always spend time to polish and update the CV timely (opportunity could come anytime!)

Guideline of Capstone Project Engagement (Full-time Students)

- You have the flexibility to **propose the project and company** to work with (**before 31 Jan, 2022**)
  - Students have connection with companies and want to work with them for the capstone project
  - Help to link up the company and BA Centre to further discuss the capstone project arrangement

- Students should not send their CVs directly to our capstone companies
  - Most of the long-term partners do not like receive and engage with students individually

- Behavior professionally
  - Communication
  - Commitment
  - Adapt to the real world

Capstone Project Timeline (Full-time Students)

Feb ~ Apr	May ~ Aug/Sep	Sep
Student-company & Student-supervisor matching	Capstone project	BACS (Business Analytics Centre Symposium)

31 Jan

- Students have to **make a decision** whether you are going to **source the capstone project by yourself**.

Mid of Aug

- **Capstone paper submission**

End of Sept

- **Capstone project showcase**
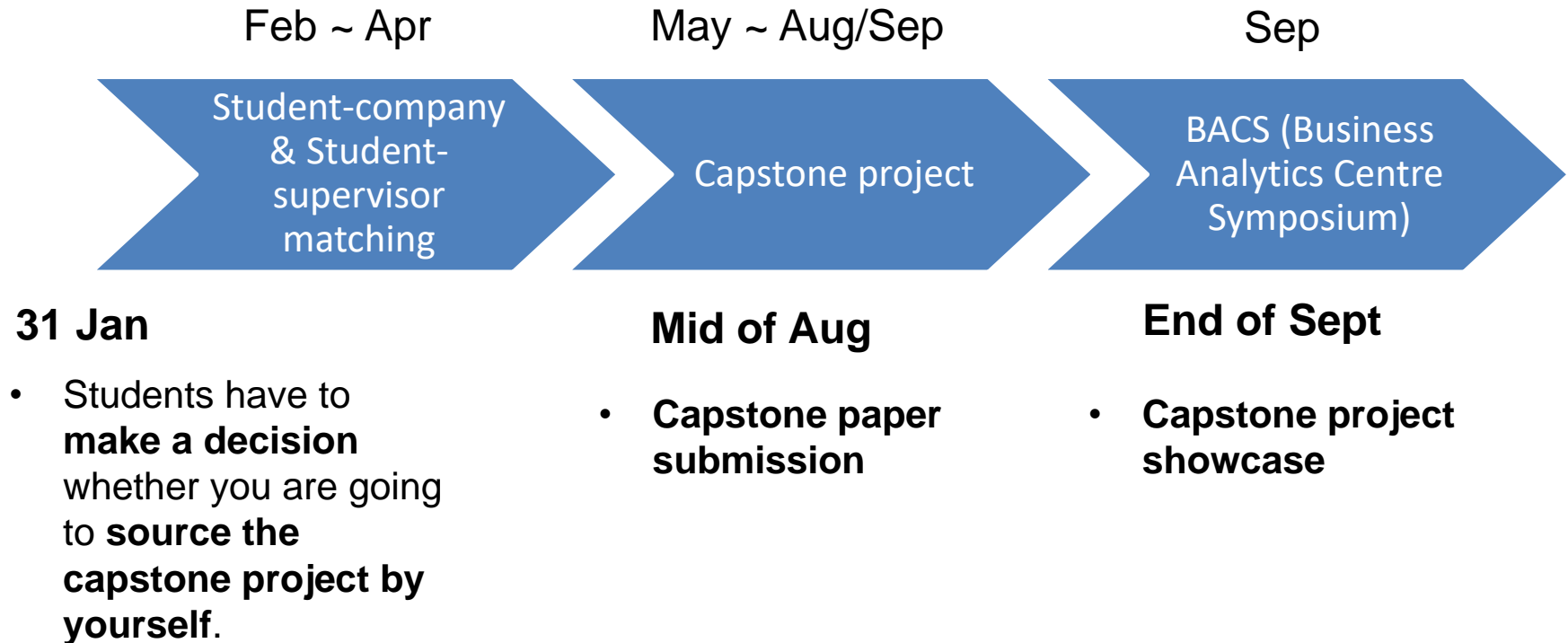
Some Lessons Learned

- Wrong information in the CV

- Security violation
  - Leaving the laptop on a table without locking it

- Leaving Singapore without informing key project stakeholders
  - If you need to go outside Singapore for urgent family/personal issues, **you MUST inform both your capstone company and BA Centre**

Process of Capstone Project Engagement (Part-time Students)

- Part-time students are encouraged to **explore capstone projects in your current company**
  - "Kill two birds with one stone"
  - Avoid "conflict of interest" issue
  - Leverage on university resource (e.g. faculty) for your career growth
- If you cannot find suitable capstone project in your current company?
  - Work on a NUS research project
  - Work on a Kaggle project
  - …
- Duration of part-time student capstone projects
  - Similar amount of effort as full-time students
  - If you work on the project part-time, it usually take 6~8 months to complete the project
  - If you work on the project full-time (your main responsibility in the company), it usually take 3~5 months to complete the project

Process of Capstone Project Engagement (Part-time Students)

- Capstone Process (conduct capstone project **within your current company**)
  - *Step 1:* Discuss with potential project stakeholders in your company
  - *Step 2:* Get a project proposal template on Luminus and fill in the details
  - *Step 3:* Discuss with me for the capstone project scope and get my approval
  - *Step 4:* Start capstone project and update your academic supervisor regularly
  - *Step 5:* Get your academic supervisor's approval and submit the project report and poster

Process of Capstone Project Engagement (Part-time Students)

- Capstone Process (conduct capstone project **outside your current company**)
  - *Step 1:* Talk to NUS faculty for the research project opportunity, or look for good projects in Kaggle platform
  - *Step 2:* Get a project proposal template on Luminus and fill in the details
  - *Step 3:* Discuss with me for the capstone project scope and get my approval
  - *Step 4:* Start capstone project and update your academic supervisor regularly
  - *Step 5:* Get your academic supervisor's approval and submit the project report and poster

Capstone Project Timeline (Part-time Students)

- Part-time students are not restricted by the summer period for capstone project
  - You can start talk to me once you have a project idea
  - Better to start the project after you have learned enough analytics skills (i.e., 2nd year)

Part-time Industry Internship Opportunity During Semester

- You can look for part-time internship opportunity by yourself during semester study
  - Based on government policy, student pass holder can work maximum 16 hrs/week during semester
  - You can work full-time during holiday

- Some our industry partners will also look for part-time internship
  - We will share with you through Luminus/email

- This is **NOT** capstone project

Assessment Model

- Class Participation, Interaction, and Activity 10%

- Class Assignment and Presentation   20%

- Analytics Innovation Challenge   20%

- Capstone Internship Project   50%

- You will only get your capstone module grade after you complete all the requirements
  - You will see "IP" (In Progress) in NUS systems after semester 1 and semester 2

Class Feedback

- You will receive the class feedback survey from university
  - You feedback will be the **overall experience for the whole module**, including evening lecture, industry seminars, Business Analytics Centre Symposium (BACS), innovation challenges, capstone projects, etc.

Class Plan

1	Course Overview and Assessment Model

2	Fundamentals of Business Analytics

- Analytics Landscape

- How to select the Right Analytics Techniques

- Key Elements of a Successful Business Analytics Solution

- Some Important Trends

What is Analytics?

Analytics is broadly defined as the process of deriving **insight** from **data** in order to make better **decisions (actions)**

Data	Insights	Decisions

Data:
- Historical
- Simulated
- Text
- Video, Images
- Audio

Insights:
- **Dashboards, visualizations**
- **Reports and queries on data aggregates**
- **Predictive models**
- **Simulations**
- **Scenarios**
- **Entity relations**
- **Recognition**
- **Sentiments**
- **…**

Decisions:
- Option 1
- Option 2
- Option 3
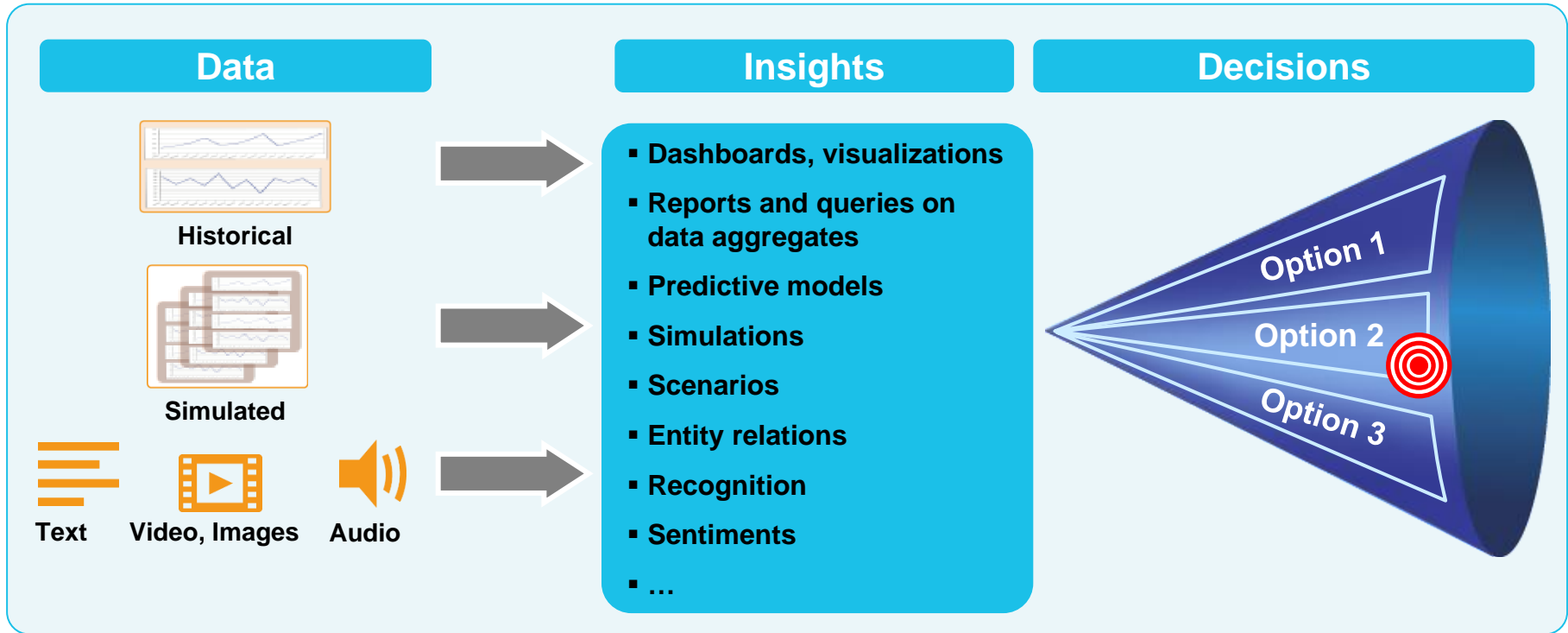
Use case	Data	Insight	Action/Decision
Pricing optimization	Past sales, price levels, etc	Predict sales level from price	Set prices in order to maximize profit/revenue
Outcome Based Management	Social data	Social context for each case	Select best social program

Traditional Analytics Landscape

Vertical axis: Competitive Advantage

Method	Question	Category
Stochastic Optimization	How can we achieve the best outcome including the effects of variability?	**Prescriptive** (Decide and Act)
Optimization	How can we achieve the best outcome?	
Predictive modeling	What will happen next if ?	**Predictive** (Understand and Predict)
Forecasting	What if these trends continue?	
Simulation	What could happen…. ?	
Alerts	What actions are needed?	
Query/drill down	What exactly is the problem?	**Descriptive** (Report)
Ad hoc reporting	How many, how often, where?	
Standard Reporting	What happened?	

Horizontal axis: Degree of Complexity

Based on: Competing on Analytics, Davenport and Harris, 2007

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Dimensions of Analytics **Solution**

Data Sources
– Internal data
– External data

Maturity Level
– Descriptive, predictive, prescriptive, etc.

Insight
– Trends, patterns, sentiments, etc.

Decision Automation
– Decision support vs Decision automation

Genericity
– Industry specific vs Cross industry

Analytics

Business Process
– Analytics need to be integrated with business process

Granularity
– Component, asset, full solution

Usage
– Inward/IT vs Outward/LOB

Computation Complexity
– Simple (e.g. reporting), complex (predictive, optimization), very complex (NLP + machine learning + scoring, etc.)

Users
– Business user, Data scientist, Business Analyst/Consultant, Application developer

* NLP – Natural Language Processing
* LOB – Line of Business

A New Big Data Era

- **90%** of the world's data is created in the last two years
- **80%** of the world's data today is unstructured
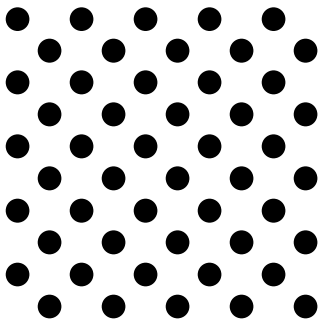- **1 Trillian** connected devices generate 2.5 quintillion bytes data / day

Volume	Velocity	Variety	Veracity
Data at Scale	**Data in Motion**	**Data in Many Forms**	**Data Uncertainty**
Terabytes to exabytes of existing data to process (e.g. CRM, ERP data, etc.)	Streaming data, milliseconds to seconds to respond (e.g. data from smart sensors, mobile device, etc.)	Structured, unstructured, text, multimedia (e.g. rational DB, images, free text, video, etc.)	Uncertainty due to data error, inconsistency & incompleteness, ambiguities, model approximations (e.g. manual errors, device errors, models errors, etc.)
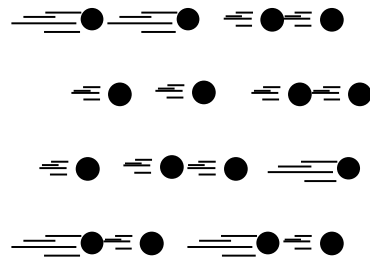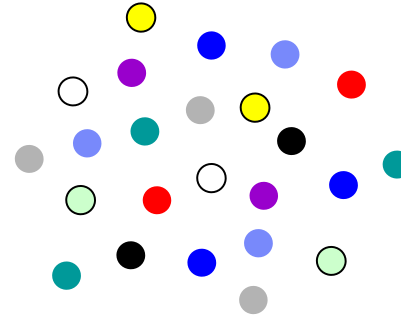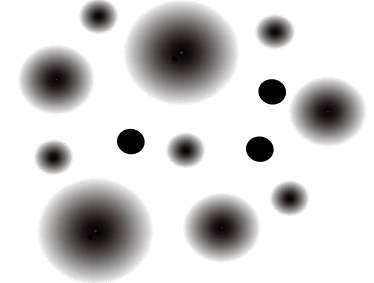
Source: IBM GTO 2012

Big Data Brings New Opportunity and Value

The value of analytics grows by incorporating **new sources of data**, composing a variety of **analytic techniques**, spanning organizational silos, and enabling iterative, user-driven interaction

New format or usage of data

Sources and types of data

Intent-to-buy trends

Multi-modal demand forecasting

Segmentation-based market impact estimates

Price-based demand forecasting (own & competitors)

Sales-based demand forecasting

Structured or standardized

Low

Scope of decision

High

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Big Data Requires to Expand the Analytics Landscape

New Methods			
Adaptive Analysis	*Responding to context*	➢	*Learn*
Continual Analysis	*Responding to local change/feedback*		*In the context of the decision process*
Optimization under Uncertainty	*Quantifying or mitigating risk*	➢	**Prescriptive**
Optimization	Decision complexity, solution speed		**(Decide and Act)**
Predictive Modeling	Causality, probabilistic, confidence levels		
Simulation	High fidelity, games, data farming	➢	**Predictive**
Forecasting	Larger data sets, regression		**(Understand and Predict)**
Alerts	Rules/triggers, context sensitive, complex events		
Query/Drill Down	In memory data, geo spatial		
Ad hoc Reporting	Query by example, user defined reports	➢	**Descriptive**
Standard Reporting	Real time, visualizations, user interaction		**(Report)**
Entity Resolution	*People, roles, locations, things*	➢	*Collect and Ingest/Interpret*
Relationship, Feature Extraction	*Rules, semantic inferencing, matching*		*Decide what to count; enable accurate counting*
Annotation and Tokenization	*Automated, crowd sourced*		

Traditional (spans the middle group)

Extended from: Competing on Analytics, Davenport and Harris

Select the Right Analytics and Optimization Techniques to Make Smarter Decisions

- The five commonly used business analytics and optimization techniques are shown below:

Visualization

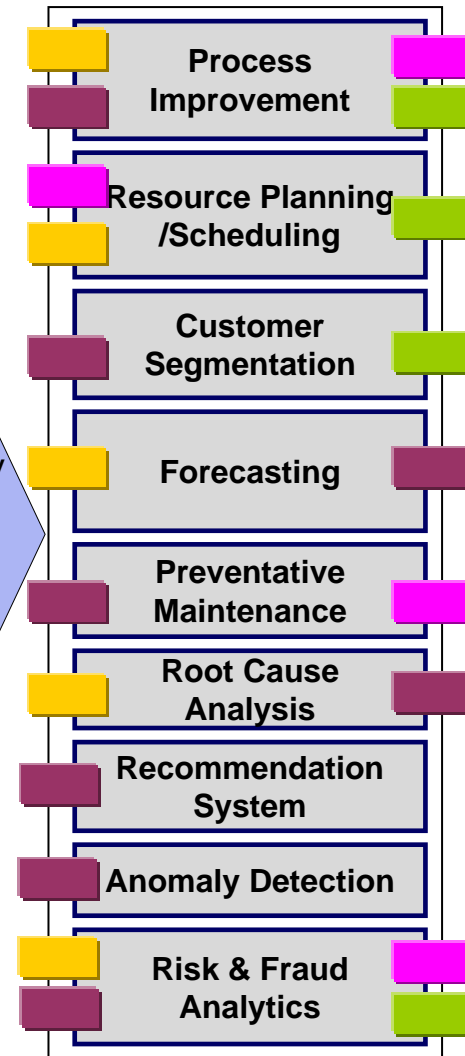Allows users to visually gain insight from data and modeling results, e.g. data exploration, dashboard, BI reports

Advanced Statistics & Machine Learning

Transform complex data into business insight through identifying the data patterns and trends

Optimization

Mathematically finds the best solution to complex problems with many decision options and constraints

Simulation

Simulate and analyze a system, process, behaviour, or business problem

Rule Engine

Creates, manages and executes business rules in robust repositories, for use across wide applications

Commonly used for following purposes

Typical Analytics Use Cases

- Process Improvement
- Resource Planning /Scheduling
- Customer Segmentation
- Forecasting
- Preventative Maintenance
- Root Cause Analysis
- Recommendation System
- Anomaly Detection
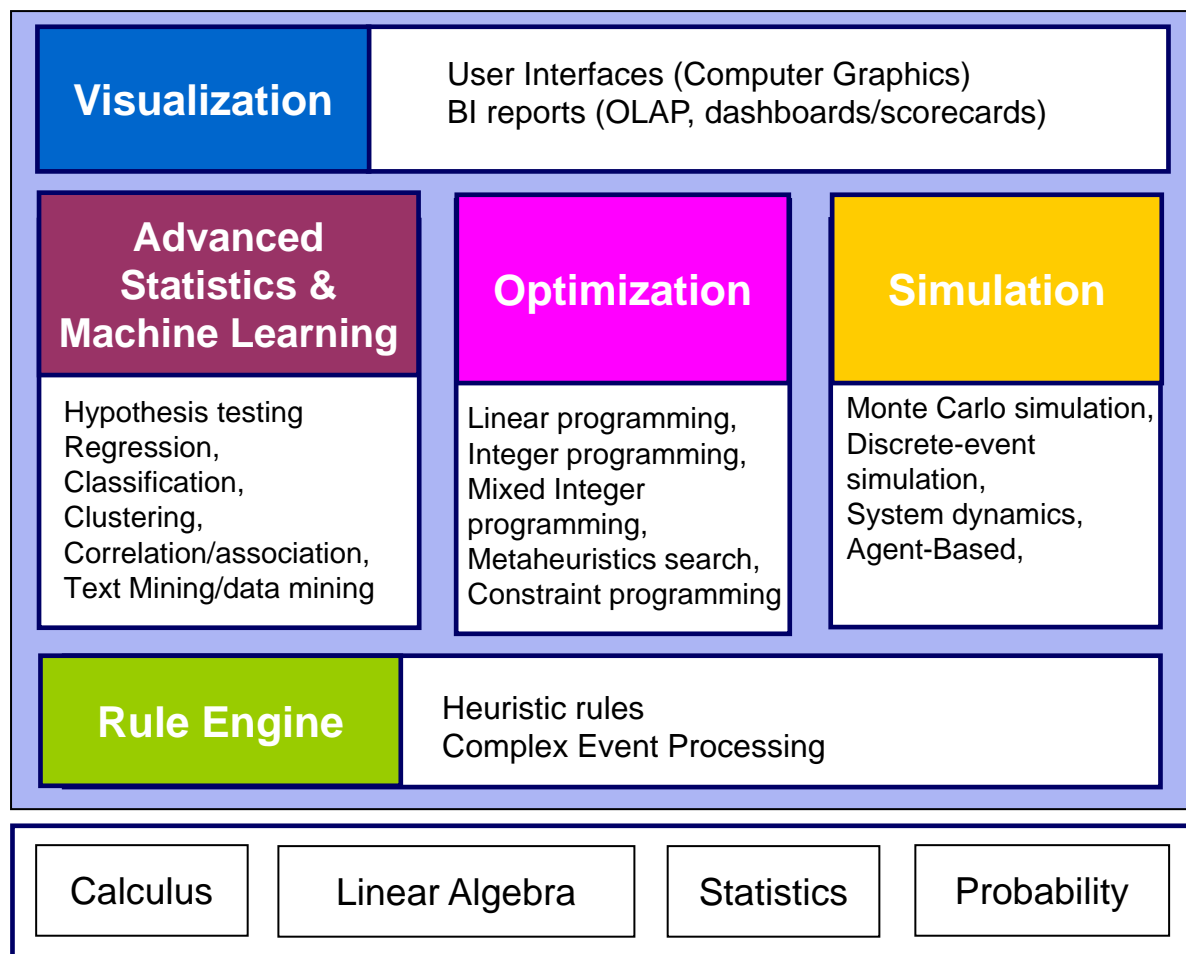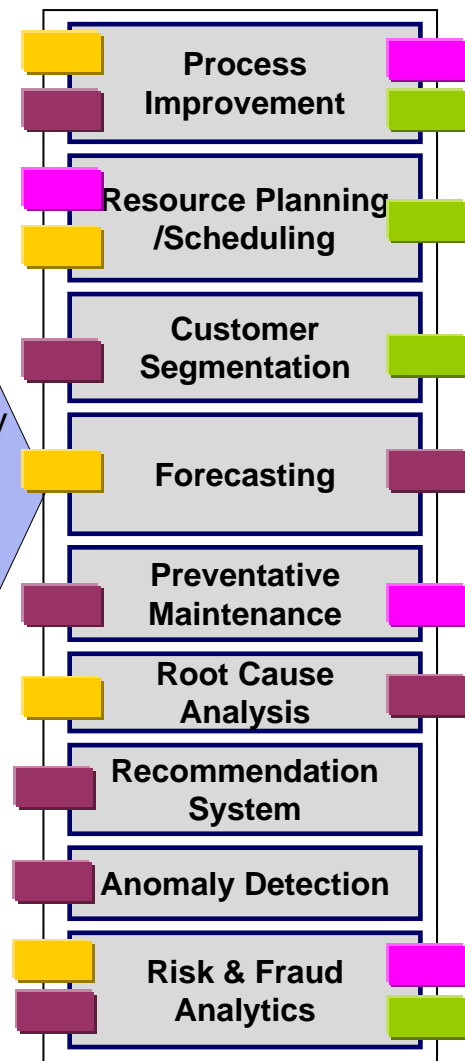- Risk & Fraud Analytics

Mathematics Techniques behind Key Analytics and Optimization Services

- The common mathematical techniques within each of the five analytics and optimization service offerings are show below:

Typical Analytics Use Cases

Visualization
User Interfaces (Computer Graphics)
BI reports (OLAP, dashboards/scorecards)

Advanced Statistics & Machine Learning
Hypothesis testing
Regression,
Classification,
Clustering,
Correlation/association,
Text Mining/data mining

Optimization
Linear programming,
Integer programming,
Mixed Integer programming,
Metaheuristics search,
Constraint programming

Simulation
Monte Carlo simulation,
Discrete-event simulation,
System dynamics,
Agent-Based,

Commonly used for following purposes

Rule Engine
Heuristic rules
Complex Event Processing

| Calculus | Linear Algebra | Statistics | Probability |

Process Improvement

Resource Planning /Scheduling

Customer Segmentation

Forecasting

Preventative Maintenance

Root Cause Analysis

Recommendation System

Anomaly Detection

Risk & Fraud Analytics

Your experience in analytics

Statistics and Machine Learning (classification, clustering, regression, association, etc.)

Optimization (Linear Programming, Mixed Integer Programming, etc.)

Simulation

Visualization/BI Reporting
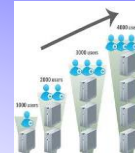
Heuristic rules/rule-based analytics

Others

Only Analytics Techniques are Not Enough

Integration

System Scalability
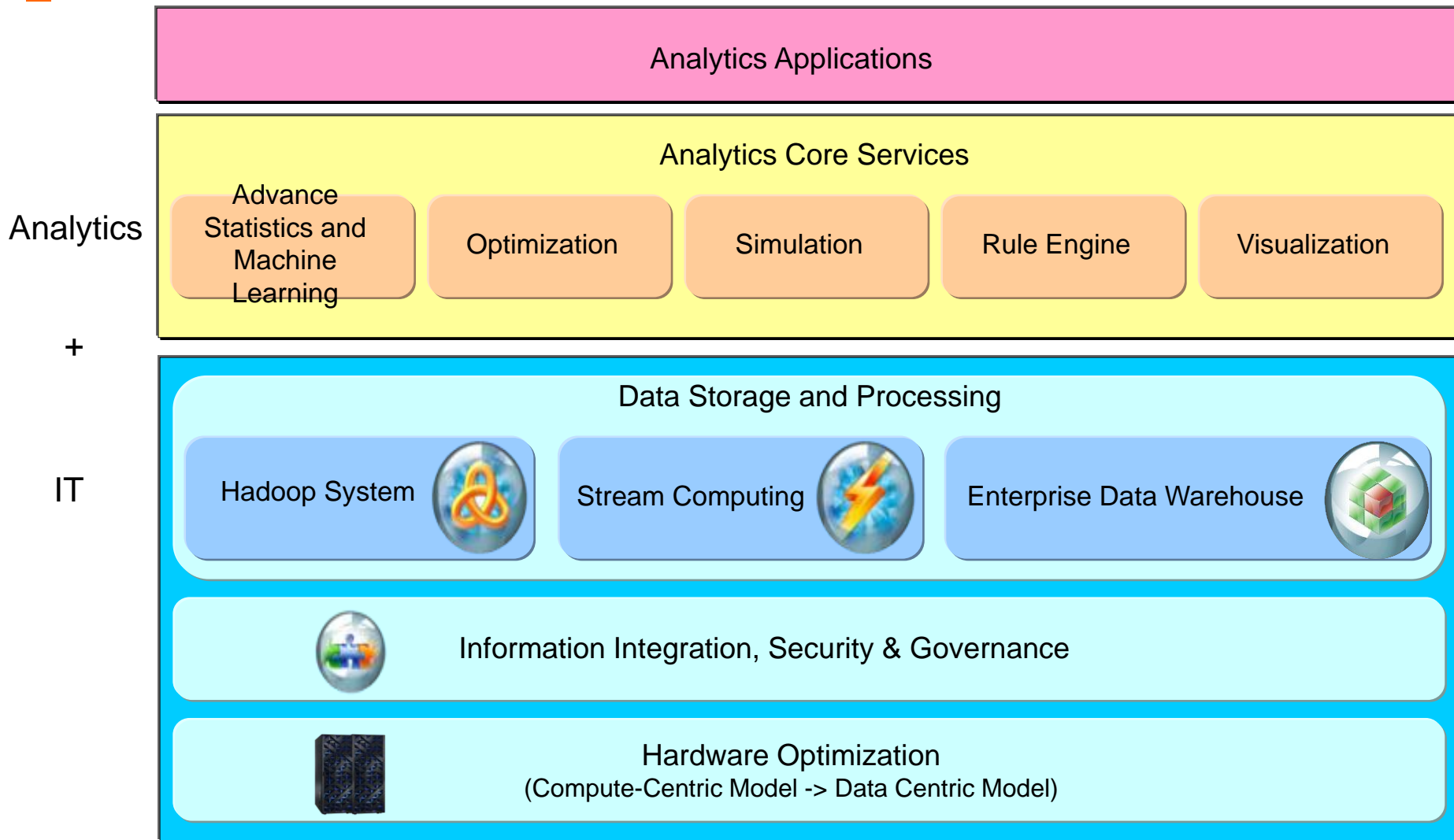
Hardware Infrastructure

Information Technologies (IT)

Security

Data Storage & Processing

Integrate Analytics Techniques and IT

Analytics

+

IT

Analytics Applications

Analytics Core Services

| Advance Statistics and Machine Learning | Optimization | Simulation | Rule Engine | Visualization |

Data Storage and Processing

| Hadoop System | Stream Computing | Enterprise Data Warehouse |

Information Integration, Security & Governance

Hardware Optimization
(Compute-Centric Model -> Data Centric Model)
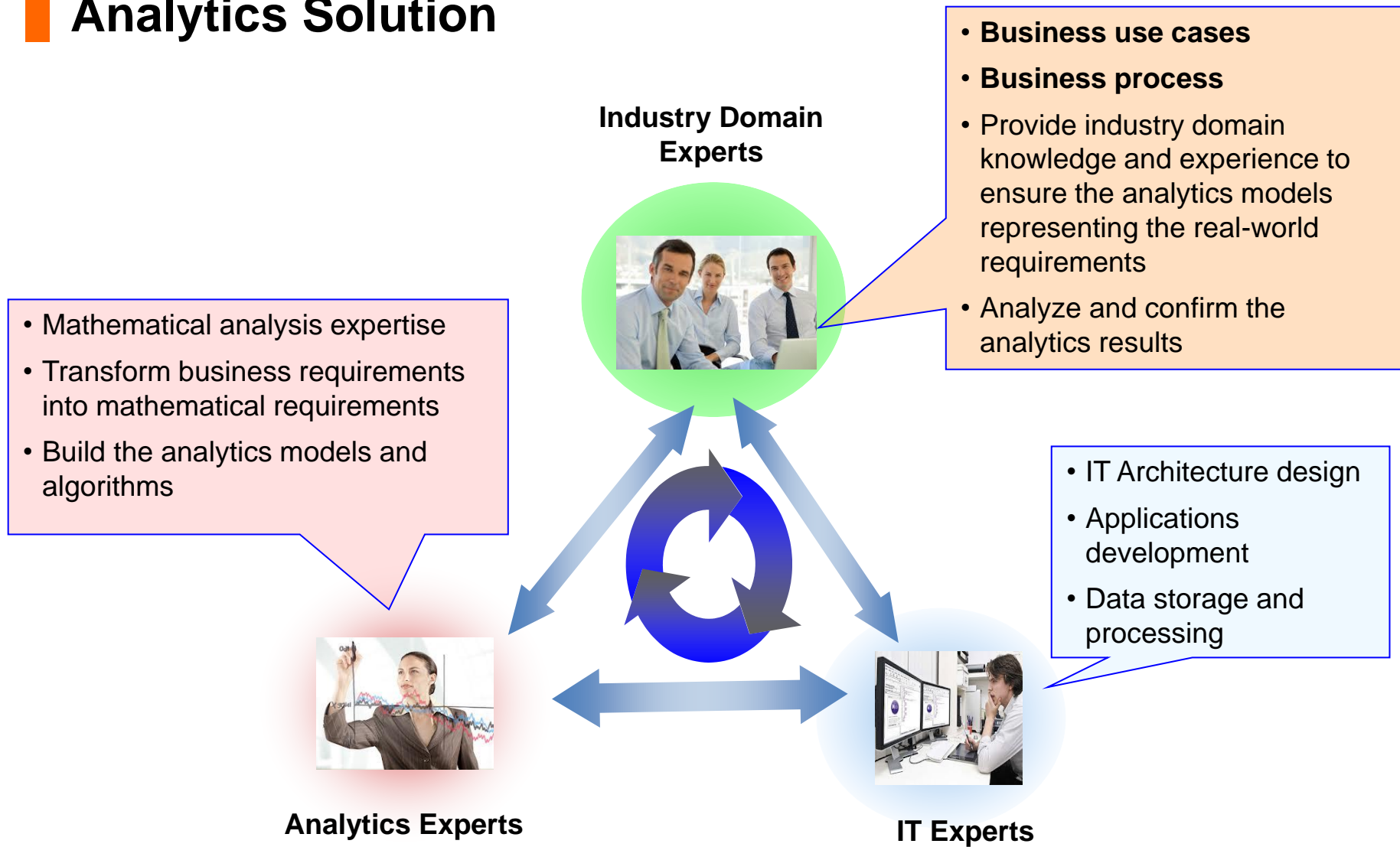
What is your IT expertise? (e.g. database, solution architecture, application development, big data platform, cloud computing, security, etc.)

3 Key Elements of a Successful Business Analytics Solution

Industry Domain Experts

- **Business use cases**
- **Business process**
- Provide industry domain knowledge and experience to ensure the analytics models representing the real-world requirements
- Analyze and confirm the analytics results

- Mathematical analysis expertise
- Transform business requirements into mathematical requirements
- Build the analytics models and algorithms

- IT Architecture design
- Applications development
- Data storage and processing

Analytics Experts

IT Experts

Industry Analytics Project Delivery Trend

Project 1: 11 years ago

Project duration: **14 months**

Standardize IT components

Project 2: 8 years ago

Project duration: **9 months**

Standardize analytics components

Project 3: 5 years ago

Project duration: **6 months**

Industry Domain Experts
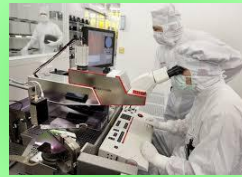
10% of total team effort

25% of total team effort

50% of total team effort

20% of total team effort

50% of total team effort

25% of total team effort

Analytics Experts

IT Experts

70% of total team effort

25% of total team effort

25% of total team effort
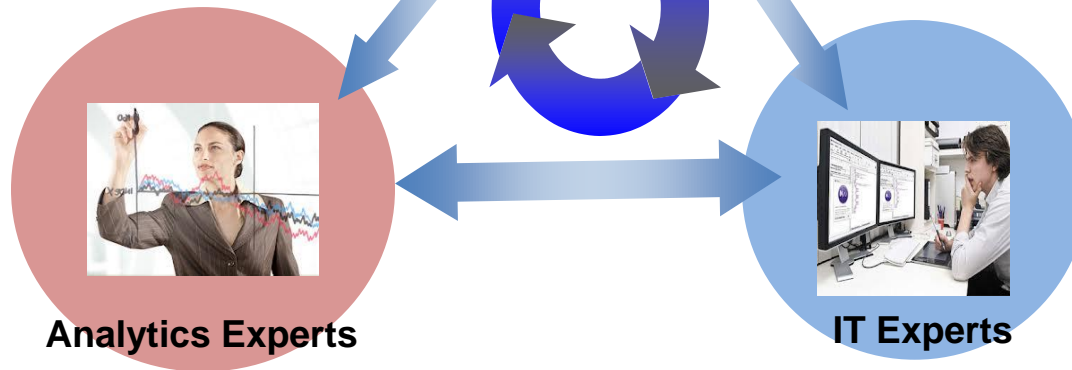
Platform as a Service (PaaS) for Analtyics

Industry Knowledge

+

Analytics

+

IT

Industry Analytics Applications

| **Finance / Banking** | **Retail / E-Commerce** | **Healthcare** | **Telecom** | **Manufacturing** | **...** |

Analytics Core Services

| Advance Statistics and Machine Learning | Optimization | Simulation | Rule Engine | Visualization |

Data Storage and Processing

| Hadoop System | Stream Computing | Enterprise Data Warehouse |

Information Integration, Security & Governance

Hardware Optimization
(Compute-Centric Model -> Data Centric Model)

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