DESIGN & IMPLEMENTATION OF TOWER AIR TRAFFIC CONTROL SYSTEM

RAPID COGNITION & AUGMENTED COGNITION
TEAM MEMBERS

- COLONEL (RET) DAVID TAN
- TEH SHI-HUA
- HUANG WEIXUAN
- TEW TZE HONG
- TAN BOON TAT
- OLIVER TAN
- LEE WEI HONG
- SEAH KAI TING
SCOPE

- PROBLEM SPACE
- CONTEXTUAL CHALLENGES
- CREATIVE IDEAS
- INNOVATIVE SOLUTIONS
- DISCOVERY
- GAME-CHANGER
PROBLEM SPACE

☐ CLUTTERED ENVIRONMENT

☐ COMPLEXITY

☐ PERTURBATIONS
CONTEXTUAL CHALLENGES

- UNIQUELY SINGAPORE
- SPACE
- TIME
- LOAD
- AVIATION HUB (SIMPLE-COMPLICATED-COMPLEX)
UNIQUELY SINGAPORE

CHANGI INTERNATIONAL AIRPORT
OUR SIZE

20 by 40 KM
IMPLICATIONS

HIGH DENSITY POPULATION
HIGHLY URBANIZED
CITY STATE
RESTRICTIONS OF FLYING OVER POPULATED, PROHIBITED & RESTRICTED AREAS
TIGHT & NARROW AIRSPACE
From a single terminal in its formative years, Changi Airport now operates four terminals – Terminals 1, 2 and 3, as well as the Budget Terminal. The latest addition to Changi Airport, Terminal 3, commenced operations on 9 January 2008 and increased Changi Airport’s passenger handling capacity by 22 million passengers per annum. With a total handling capability of 70 million passengers per annum, Changi Airport is well-positioned to serve Singapore’s future aviation needs well into the future.
The Leading Aviation Gateway to Asia Pacific

Singapore is an excellent springboard for travel around the region. Within a **seven-hour radius**, Changi Airport has the potential to reach **2.8 billion people** living in Southeast Asia, Australia, China and India. With some **84 airlines flying to and from more than 188 cities in over 60 countries worldwide**, operating more than 4,500 flights per week, Changi Airport remains well-positioned as the international **gateway to Asia Pacific**, with superior connectivity to the Southwest Pacific and **Southeast Asia**.

GROWING PREMIUM AIR HUB
## CHANGI INTERNATIONAL AIRPORT TRAFFIC VOLUME

<table>
<thead>
<tr>
<th>VOLUME</th>
<th>Dec 07</th>
<th>Jan - Dec 07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Movements</td>
<td>3,514,000 (+2.8%)</td>
<td>36,702,000 (+4.8%)</td>
</tr>
<tr>
<td>Airfreight Movements</td>
<td>165,000 (-0.6%)</td>
<td>1,895,000 (-0.9%)</td>
</tr>
<tr>
<td>Aircraft Movements</td>
<td>19,000 (+1.9%)</td>
<td>221,000 (+3.0%)</td>
</tr>
</tbody>
</table>
## CHANGI INTERNATIONAL AIRPORT TRAFFIC VOLUMES

<table>
<thead>
<tr>
<th>VOLUMES</th>
<th>Dec 08</th>
<th>Jan - Dec 09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Movements</td>
<td>3,490,000</td>
<td>37,203,978</td>
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<tr>
<td></td>
<td>(-0.6%)</td>
<td>(+2.7%)</td>
</tr>
<tr>
<td>Airfreight Movements</td>
<td>129,000</td>
<td>1,633,791</td>
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<tr>
<td></td>
<td>(-21.4%)</td>
<td>(-0.2%)</td>
</tr>
<tr>
<td>Aircraft Movements</td>
<td>20,000</td>
<td>240,360</td>
</tr>
<tr>
<td></td>
<td>(+7.4%)</td>
<td>(+5.1%)</td>
</tr>
</tbody>
</table>

Figures are rounded to the nearest thousand
Growth % are in comparison with the same period last year

**SKYTRAX**

“WORLD BEST AIRPORT 2010”
GROWING UP TO 4 TERMINALS WITH MULTIPLE RUNWAY OPERATIONS

Premier Airhub of region
CREATIVE IDEAS

- WHAT SO GREAT ABOUT VAPS?
- LOGIC BEHIND
  - AUGMENTED COGNITION
  - RAPID COGNITION
- VAPS DEFINED
  - VIRTUAL ASSISTANTS
  - PERSISTENT SENTINELS
CREATIVE IDEAS

- AUGMENTED COGNITION

- CIRCUMVENTING HUMAN COGNITIVE LIMITATIONS & AIDING HUMAN’S ABILITIES TO PROCESS, STORE & RETRIEVE INFORMATION
CREATIVE IDEAS

☐ RAPID COGNITION

■ RAPID INFORMATION INGESTION AND ASSIMILATION WITH CONTEXTUAL KNOWLEDGE THROUGH SMART USE OF VISUALISATION TECHNIQUES.
INNOVATIVE SOLUTIONS

VAPS

SMART BOLTS THAT PERSISTENTLY & PERVERSIVELY AID AIR TRAFFIC CONTROLLERS BY PERFORMING SIMPLE LOW-LEVEL COGNITIVE TASKS & ANALYSIS WHILST ANALYSING & CUEING ON 1ST & 2ND ORDER CONSEQUENCES OF REAL-TIME DECISIONS
INNOVATIVE SOLUTIONS

- ONE GLANCE
  - ENHANCING ABILITY OF TOWER CONTROLLERS TO ACHIEVE COMPREHENSIVE AWARENESS QUICKLY AND IN CONTEXT.
  - SPEED UP INFO INGESTION, IMPROVE INFO ASSIMILATION AND SA FOR RAPID DECISION MAKING.
  - PROVIDE VISUAL ENVIRONMENT THAT CORRESPONDS TO ATC MENTAL MODELS
ONE-GLANCE SNAP SHOT

- 2D & 3D WIDGETS
- 3D VIRTUAL WORLD
- PiP VIEW-THE WORLD AT FINGER-TIP
- CRITICAL CUES
- ENHANCED DISPLAY
- WAM ME!!
- CONFLICT MANAGEMENT
- ANOMALY DETECTION
DISCOVERY

- RESULTS (OBSERVATIONS & FEEDBACK)

- BANDWIDTH
- WORKLOAD

- BANDWIDTH & HANDLING CAPACITY (Feedback)

- SITUATION AWARENESS (POC Trials & Self-Rated)

- DECISION-MAKING (SME RATINGS & OBSERVATIONS)

- QUALITY OF DECISIONS (e.g. manage perturbations, safety..)

- ~15% SA
- “A BETTER SENSE OF SITUATION”
GAME-CHANGER?

- CIVIL DOMAIN
  - GEOGRAPHICAL SEPARATION
  - MULTI PLATFORMS OPERATIONS
  - MANAGING PERTURBATION
  - SUSTAINING LOAD
  - ANTICIPATORY ACTIONS
  - MULTI AIRPORT OPERATIONS