Innovation Arms Race
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Report By:
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INTRODUCTION TO
THE CENTER FOR ADVANCING INNOVATION
Key Focus Areas

- **Due Diligence**
- **Operational Capabilities Transformation**
- **Growth Strategy**

Team Capability:
- Leader: Led IBM’s Innovation Strategy Practice Globally
- Capability: End-to-end from invention to maximizing commercial potential of inventions

Qualifications and Experience:
- Track record of working with private equity, investment firms, serial entrepreneurs and Fortune 500 firms to identify the right investments to realize value quickly
- Key Clients: MedImmune/AstraZeneca, Danaher, Welch Allyn, Medtronic, Pfizer, GSK, Novartis, IBM, Nokia, Microsoft, Alcatel Lucent etc.

Trade Secret Methodologies:
- Trade secret models for growth strategy & due diligence, operational optimization and maximizing commercialization
CAI - Partial Innovation Assessments

*Tech transfer, innovation and commercialization*

- **Global**
  - Benchmark countries innovation performance globally

- **Industry**
  - Assess industries global innovation performance

- **State**
  - Benchmark US state-by-state innovation performance

- **University, Govt, & Hospital**
  - Evaluate federal lab, university and hospital innovation performance

- **Deep Dives**
  - Identify, analyze and forecast ROI for all key innovation levers
GLOBAL INNOVATION PERFORMANCE ANALYSIS
Global Patent Applications – West has Lost Leadership

While the US and EU volume remains high in patent applications, they have lost their leadership to China* since 2011

*All China numbers includes Hong Kong and Macau

Source: CAI Analysis Model, World Bank, WIPO Patent Database
Global Patent Grants – West Lags Growth

In 2015, US and EU lost their competitive stance in patent grants to China, and are behind in growth compared to East Asia.
The US, EU and UK’s ability to convert patent applications to patent grants, or Patent Effectiveness, is flat or declining. South Korea, China and Singapore lead in growth of quality patents.

Source: CAI Analysis Model, World Bank, WIPO Patent Database
Global Patent Effectiveness Index – 2015 Snapshot

Indexing global Patent Effectiveness on a per capita and GDP basis shows the US, UK and EU are trailing; they are not focused on innovation that turns into GDP...

Key Insights

• Per capita the EU and UK rank #10 and #7, respectively; the US ranks #9, more than 6-times lower than South Korea at #6
• China and India are in the bottom 2 on a per capita basis due to their large population size
• The US is last in effectiveness per GDP, approximately even with China (#12), but over 12-times behind South Korea (#6)

Source: CAI Analysis Model, World Bank, WIPO Patent Database

*Numbers adjusted by Purchasing Power Parity (PPP) to 2010
Global Patent Effectiveness Index – 1995 Snapshot

...and there has been little change in rankings since 1995; China and South Korea improved marginally and the US and UK declined

Key Insights

• In 1995, on a per capita basis, the US, EU and UK rank #9, #11, and #7, respectively; China, India, and the EU were in the bottom 4
• The US and EU are last in effectiveness per GDP

Source: CAI Analysis Model, World Bank, WIPO Patent Database
Global Patent Efficiency Index – 2015 Snapshot

Analyzing Patent Efficiency, converting $1B in R&D to patent grants, illustrates that Switzerland and South Korea generate the highest number of issued patents per R&D dollar; it costs too much per patent for the US, EU and UK.

Key Insights

• The US, EU and UK rank #7, #4 and #10 in Patent Efficiency; he US, EU and UK are 2.5 to 3 times behind the leader, Switzerland
• The US and UK rank below all top performing patenting countries (China, EU and South Korea)

Source: CAI Analysis Model, WIPO Patent Database, UNESCO Institute for Statistics
Global Patent Efficiency Comparison – West Decline

The US, EU and UK Patent Efficiency dropped in rankings, overtaken by China and South Korea, from 1995 to 2015

Key Insights

- Russia and Switzerland led in efficiency, but Russia dropped in efficiency rankings since 1995
- The US, EU and UK all dropped in efficiency rankings, losing its position to China and South Korea
- China and Singapore have the greatest growth improvement in efficiency with a 10% and 18% CAGR, respectively

Source: CAI Analysis Model, WIPO Patent Database, UNESCO Institute for Statistics
**GERD Volume and Growth – Is this the Issue?**

*The decline in quality patents in the West theoretically could be due to lower Gross Domestic Expenditure on R&D (GERD) volume and growth however, China and South Korea both outperform the West in patenting metrics*

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**Key Insights**

- Although the volume of US and EU GERD rank highest, the US ranks #4 and EU ranks #10 in R&D spending per capita.
- The EU and UK have modest GERD expenditure per capita and are growing at a steady rate.
- China has explosive growth in GERD overall; the US and EU has also lost GERD volume to BRIC.

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**GERD CAGR (‘95–’15) and GERD AAGR (‘95–’15)**

<table>
<thead>
<tr>
<th>Region</th>
<th>GERD CAGR (‘95–’15)</th>
<th>GERD AAGR (‘95–’15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>11.0%</td>
<td>17.3%</td>
</tr>
<tr>
<td>US</td>
<td>3.4%</td>
<td>3.1%</td>
</tr>
<tr>
<td>EU</td>
<td>3.0%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Korea</td>
<td>2.7%</td>
<td>7.8%</td>
</tr>
<tr>
<td>UK</td>
<td>2.3%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

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Source: CAI Analysis Model, WIPO Patent Database, UNESCO Institute for Statistics
GDP from R&D – East Asia’s Investment Drives GPD

East Asian countries are consistently investing more on innovation/GERD relative to GDP, compared to the static investment trends in the West.

Key Insights

- GERD/GDP for the US, EU and UK has remained relatively flat since 1995.
- From 1995 to 2015, Asian countries saw rapid increases in GERD/GDP, notably South Korea with a GERD/GDP of 5.5% in 2015.
- From 2004 to 2005 China surpassed the US in R&D investment per GDP and maintains a 1.3% gap in 2015.

IMPLICATIONS
WIPO Global Patent Forecast

Forecasts based on a global view predict Asia will continue to outperform the West; China will continue to widen the gap, with South Korea poised to overtake the US.

Key Insights

- China has the highest growth rates for patent applications (22%) and grants (24%) – together with the large increases in historical volume ('95 to '15), this creates forecasted volumes massively larger than any other country.
- By 2035 China will have grown to 40x the US patent application volume and 25x the US patent grant volume.
- Volume of patenting by China has already outpaced US, EU and UK volume combined.

Source: CAI Analysis Model, WIPO Patent Database
Global patent data shows the US, EU and UK will lose ground to Asia in Patent Effectiveness if current trends continue.

**Key Insights**

- The US will be overtaken by South Korea in Patent Effectiveness, while the EU and UK will drop below China.
- Given the growth rate of patents issued is lower than the growth rate of patent applications, the US, EU and UK will lose ground to China in **volume of quality applications that convert to issued patents**.

Source: CAI Analysis Model, WIPO Patent Database
Key Insights

- The gap in GERD investment between the EU and the US will **widen** and the US will be **overtaken** by China in 2029
- South Korea’s growth is accelerating

**2015 RE Top 5:**
1. US
2. China
3. EU
4. S. Korea
5. India

**2035 RE Top 5:**
1. China
2. US
3. EU
4. S. Korea
5. India

Source: CAI Analysis Model, UNESCO Institute for Statistics
Key Insights

- China, South Korea, Taiwan, Singapore and Israel will have the largest investments in R&D by 2035, reflecting the faster forecasted growth in GERD compared to GDP.
- The US, EU and UK have low growth due to a mature and constant GERD. If additional GERD is wisely spent, an increase in innovation may occur.

GDP Forecast – China Surpasses the US & EU by 2025

Key Insights

- The US, EU and UK are ranked among the bottom for GDP growth rate out of the 14 countries included in the study – China was #1
- Continuing with the current growth rate, China will overtake the US in GDP by 2025
- Over the last 20 years, the US GDP growth rate is 2.43% versus China, which is 9.06%

GDP Growth Rate

<table>
<thead>
<tr>
<th>Country</th>
<th>2015 GDP</th>
<th>2035 Projected GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>$9.2 T</td>
<td>$52.2 T</td>
</tr>
<tr>
<td>US</td>
<td>$16.6 T</td>
<td>$26.8 T</td>
</tr>
<tr>
<td>EU</td>
<td>$15.2 T</td>
<td>$21.1 T</td>
</tr>
<tr>
<td>UK</td>
<td>$2.7 T</td>
<td>$4.1 T</td>
</tr>
<tr>
<td>South Korea</td>
<td>$1.2 T</td>
<td>$2.9 T</td>
</tr>
</tbody>
</table>

Innovation Arms Race Conclusions

- **Patent Effectiveness declining in the West**: The US, EU and UK’s ability to convert patent applications to patent grants, or Patent Effectiveness, is flat or declining, on a per capita and GDP basis. South Korea, China and Singapore lead in growth of quality patents.

- **Patent Efficiency needs to improve**: Patent Efficiency is the ability to convert one dollar in R&D spend to a patent grant. It costs much more for the US and UK than China, South Korea and Russia to produce a high-quality patent that gets granted; both the US and UK.

- **Research expenditure provides little ROI**: While the US spends twice as much as each of the UK and EU in research expenditure relative to GDP, R&D spend is not driving GDP growth in the US. In other words, one additional dollar of R&D spend in the US does not drive GDP growth.

- **Asia will continue to dominate**: East Asian countries are out-performing the US, EU and UK in growth of patent grants. China and South Korea are consistently in the lead regarding a number of performance metrics. India, Israel and Singapore are expected to see the highest growth in patents granted through 2035.

- **Conclusion: the US, EU and UK needs to harness investments in innovation to drive R&D ROI**