Eight technologies to reshape your world

- 'Magic' glasses, motion sensors, foldable displays, and more
- Once the stuff of science-fiction novels, some of these technologies are shaping up to be profoundly disruptive
- What are the category killers? Who are the potential beneficiaries? And which companies are insulated from the coming revolution?
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Human-machine interfaces

Eight technologies to reshape your world

- Imagine putting on a pair of eye-glasses and instantly seeing, through a virtual display, the day’s weather forecast, traffic blackspots, and news headlines. Imagine using the glasses to instantly book tickets for a concert having just seen a poster for the event or to receive real-time translations when looking at text in another language or listening to a language you don’t understand.

- Imagine standing in front of an augmented reality display and ‘virtually’ trying out clothes and accessories, using hand gestures alone, until you’re happy with your outfit for the day.

- Imagine wearing a foldable device that allows you to access information, connect with friends, family and colleagues, and book tickets for events.

- And imagine your living-room display identifying who you are, pushing only advertisements that interest you, and keeping track of your physical wellbeing (asking if you want to reserve a table or have food delivered when you are hungry, or dispatching paramedics to your home in the case of a medical emergency).

In our second report in Daiwa’s MadeEasy series, we examine eight human-machine interface technologies. Some promise to refine existing solutions to offer a more polished, more intuitive user experience; others to usher in a whole new way of inputting and receiving information. All are designed to make our lives easier.

We look at the underlying technologies in layman’s terms, illustrate potential applications using pictures and videos, and offer our view of the ultimate size of each addressable market, together with likely beneficiaries within the supply chain.

We have chosen these technologies because, as well as offering a tantalising glimpse of how we may interact with devices in the coming years, each has the potential to be disruptive. As Nokia and Research in Motion have discovered, entrenched market positions count for little when a new product brings together technologies that, almost overnight, create new categories and render existing ones obsolete.

We categorise our eight chosen technologies into three major themes:

I. Body gesturing
   1. The Leap by Leap Motion
   2. Floating Touch by Sony
   3. Google’s Project Glass

II. Sensible touch
   4. Haptic Touch by Tatus Technology
   5. Xsense metal-mesh capacitive touch by Atmel

III. Swiping touch: advanced components and materials
   6. Pixel Eyes by Sony
   7. Touch on Display by Chimei Innolux
   8. Willow Glass by Corning

Our conclusions are presented on pages 28-30.
I. Body gesturing

Imagine being immersed in a digital world beyond smartphones and tablets, where you have a wealth of real-world information at your finger-tips — all of which can be manipulated digitally — and presented in an environment known as augmented reality. Within this fusion of virtual and real worlds, imagine interacting with devices through body gestures, hovering touches, and eye blinks, and receiving feedback through vibration, sound, air, and even water.

1. The Leap by Leap Motion
2. Floating Touch by Sony
3. Project Glass by Google
1. The Leap by Leap Motion

What is it?

The Leap is a peripheral device for detecting motion which allows the user to manipulate/interact with objects displayed in games by means of hands, arms, and/or body gestures ‘in the air’.

The Leap promises to go far beyond today’s gesture-driven devices, such as Nintendo’s Wiimote and sensor bar for the Wii game console, and Microsoft’s Kinect sensor for the Xbox 360 console.

The Leap device is quite small in size (pictured in front of a laptop, below), and yet is capable of detecting motion with an accuracy of up to a hundredth of a millimetre — 200 times more precise than the Wiimote and sensor bar or Kinect.

- The Leap: motion-detecting unit placed next to laptop

- The Leap: tracking the movement of all 10 fingers in real time

Source: Leap Motion
How does it work?

Developed by Leap Motion (Not listed), the Leap detector is a small USB peripheral with an optical system that creates a three-dimensional interaction space, roughly 8 cubic feet in size, in which it tracks the movement of fingers, hands, pens, pencils, styluses or even chopsticks with very high accuracy. Leap Motion claims its technology can simultaneously track hundreds of thousands of points and, through the use of a proprietary algorithm, use only 1-2% of central processing unit (CPU) computing power.

We believe the device comprises sensors or complementary metal-oxide-semiconductor (CMOS) cameras (similar technology as that in a digital still camera), a colour camera (for depth sensing), and an infrared light-emitting diode (LED) light projector that captures and interprets the reflections of objects in a three-dimensional space.

As advertised, the device will work with any desktop PC or notebook PC that is installed with the requisite touch drivers (either for a touch pad or touch display). In its press release of 21 May 2012, Leap Motion listed several applications:

- Web browsing or navigating an operating system
- 2D and 3D virtual drawing with high accuracy
- Interacting with 3D data-visualisation systems
- PC games, such as first-person shooting games

Moreover, we think enterprising developers could develop applications such as robotics, computer-aided design (CAD), medical imaging, and augmented reality.

The Leap is now available for pre-order for US$69.99; the actual device is scheduled to come onto the market in 2013.

Click here for demo footage.

Our perspective on the market outlook and potential beneficiaries

For now, we think this technology is most likely to be used alongside desktops for gaming and Web browsing, and as a peripheral for desktops and notebooks — and not so much for tablets and detachable or flip-and-fold Ultrabook displays. We believe it is still more convenient to swipe and tap a display than to make gestures in the air when using a tablet. Also, it is tricky to position The Leap properly for it to detect motion for displays placed horizontally or held in the hand.
Our view is that ultimately this technology is likely to be adopted by smartphone, tablet or TV brand makers as an embedded solution for displays in the above-mentioned applications, in conjunction with voice control similar to Apple’s Siri. Such a set-up would reduce the likelihood of fingerprints caused by users touching the screen.

Embedding the module would also allow users to interact directly with desktop monitors or TV sets. Using this approach, we believe that not only could the sensors in The Leap be used for gaming and giving commands to devices, they could find use in entirely new applications.

For example:
- A digital wardrobe for trying out new outfits/jewellery.

  ![Digital wardrobe](source: Daiwa)

- Recognising a user’s preset and unique gestures to command or interact with the device’s user interface.
- Auto-detecting biological conditions (e.g., when the user feels hungry, the display shows a list of dine-in restaurants or takeaway outlets based on his/her preference; or in an emergency situation, it connects the user with, say, a rescue centre).

We believe potential beneficiaries in the supply chain for The Leap include:

1. **Lite-On Semiconductor (Taiwan, not rated)** – the primary CMOS camera module maker for the Kinect
2. **PrimeSense (Israel, unlisted)** – provides on-range camera technology that, by interpreting specific gestures, allows hands-free control of electronic devices. It uses an infrared projector, a camera and a special microchip to track the movements of objects and individuals in three dimensions.
3. **Micron Technology (US, not rated)** – makes CMOS sensors.
4. **GestureTek (US, unlisted)** – provides a software layer that interprets the data coming in from the 3D camera and can be used in game machines.
5. **Diodes (US, not rated)** – makes discrete logic IC and analogue semiconductor devices for the consumer electronics, computing, industrial, communications, and automotive markets.
2. Floating Touch by Sony

What is it?
Floating Touch allows single-point detection of an end-user’s finger hovering, rather than touching, the display. The user’s finger can be up to 2.2cm from the display surface.

How does it work?
Unlike conventional touch panels using mutual capacitance technology, Sony’s hovering touch makes use of self-capacitance technology. In a self-capacitive touch sensor, each X line and Y line per se is a capacitive sensor, unlike a mutual-capacitive touch sensor where the intersection of the X line and Y line forms a sensor (depicted in the charts that follow).

The individual sensors on the self-capacitive touch sensor are thus bigger (compared with those on the mutual-capacitive touch sensor) and create a larger electrical field. The larger electrical field creates a stronger signal, which makes it possible to detect very small electrical signals, such as the user’s finger hovering above the screen. The technology has one limitation: it does not support multiple-touch due to the ‘ghosting effect’ (explained on the next page).

Our perspective on the market outlook and potential beneficiaries
Sony’s Xperia sola is the first and only smartphone to have adopted Floating Touch so far. However, we believe Floating Touch might be useful in sectors requiring non-direct touch, such as the medical field, and that touch panel makers might develop similar technology or license it from Sony.

In 2011, according to DisplaySearch, touch panels used for medical applications were the world’s second-fastest-growing tech product in terms of shipments and the fifth-fastest-growing in terms of revenue, just behind the tablet PC, all-in-one PC, mobile phone, and digital camera. We believe the segment has plenty of growth potential.
<table>
<thead>
<tr>
<th>Application</th>
<th>Unit growth (%)</th>
<th>Revenue growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tablet PC</td>
<td>210</td>
<td>212</td>
</tr>
<tr>
<td>All-in-one PC</td>
<td>71</td>
<td>182</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>72</td>
<td>96</td>
</tr>
<tr>
<td>Digital still camera/camcorder</td>
<td>19</td>
<td>65</td>
</tr>
<tr>
<td>Medical</td>
<td>107</td>
<td>63</td>
</tr>
<tr>
<td>Desktop monitor (excludes all-in-ones)</td>
<td>22</td>
<td>55</td>
</tr>
<tr>
<td>Factory/industry automation</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Game-consumer</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>(1)</td>
</tr>
<tr>
<td>ATM/financial</td>
<td>2</td>
<td>(2)</td>
</tr>
<tr>
<td>Automobile monitor</td>
<td>16</td>
<td>(3)</td>
</tr>
<tr>
<td>Printer/Office</td>
<td>12</td>
<td>(5)</td>
</tr>
<tr>
<td>Point of Information (POI) and self-check in</td>
<td>(9)</td>
<td>(7)</td>
</tr>
<tr>
<td>Education/training</td>
<td>1</td>
<td>(10)</td>
</tr>
<tr>
<td>Retail and POS/ECR</td>
<td>(19)</td>
<td>(14)</td>
</tr>
<tr>
<td>Game-casino</td>
<td>(8)</td>
<td>(16)</td>
</tr>
<tr>
<td>Portable navigation device</td>
<td>(22)</td>
<td>(21)</td>
</tr>
<tr>
<td>Notebook PC</td>
<td>(8)</td>
<td>(23)</td>
</tr>
<tr>
<td>Ticketing</td>
<td>(15)</td>
<td>(33)</td>
</tr>
<tr>
<td>PMP/MP3 Player</td>
<td>(36)</td>
<td>(42)</td>
</tr>
<tr>
<td>PDA</td>
<td>(47)</td>
<td>(53)</td>
</tr>
</tbody>
</table>

Source: DisplaySearch

**Design limitation: ghosting effect**

Floating Touch only supports single-touch input. On a self-capacitance touch sensor, multi-touch inputs can create a ‘ghosting effect’, making it impossible to discern the actual points being touched, as multiple lines would be activated on both the X-axis and Y-axis. The difficulty for the system is in discerning which two of the four activated points are the ones an end-user has in mind.

We illustrate the ghosting effect in the following charts, in which the points with coordinates (X4, Y6) are touched and detected by a self-capacitive touch sensor and a mutual-capacitive touch sensor.

**Self- vs. mutual-capacitance touch sensor**

![Self capacitance sensor](source: Daiwa)

![Mutual capacitance sensor](source: Daiwa)

When the points with coordinates (X4, Y6) and (X8, Y9) are touched on a self-capacitance sensor, the X4, X8, Y6, Y9 lines are activated. But, the self-capacitance sensor cannot discern whether the coordinates are (X4, Y6) and (X8, Y9) or (X4, Y9) and (X8, Y6).

**Ghosting effect on self-capacitance sensor**

![Self capacitance sensor](source: Daiwa)

![Mutual capacitance sensor](source: Daiwa)

Click here to see Sony's new Xperia sola with Floating Touch.
3. Google’s Project Glass

What is it?
Project Glass is a Google initiative for an augmented reality (AR) heads-up display (HUD). The design allows the user to interact with the headset using natural spoken language and/or potentially blinks of an eye, commanding the device to explore, interpret, and capture information about the surroundings, share things, and stay in touch with people.

How does it work?
Sample functionality includes managing one’s schedule, offering location-specific information like navigation, weather conditions, nearby sales/promotions for an item the user has previously expressed an interest in, evaluation of a restaurant or food the user may want to try, instant translation of a language, and displaying the location of an acquaintance and/or the user’s activity at the moment.

Google is building a portfolio of related patents, including one for a nose-pad sensor that signals to the glasses when they are being worn, one for a function to transform speech into words on the screen, one for a function to display the weather forecast when the user looks up to the sky, and one for a function to show a revised traffic route in the event of subway service suspension or road congestion.
Our perspective on the market outlook and potential beneficiaries

Some sources have indicated the device could be available by the end of 2012 or in 1H13. If the product is embraced by the market, we think it could revolutionise the mobile device industry. Indeed, it seems reasonable to assume that the addressable market and penetration of Project Glass and similar products could follow the growth trajectory of the smartphone segment.

Project Glass and mobile phones share similar key components, use the same mobile computing infrastructure, and have similar software ecosystems. Aside from Google, likely beneficiaries would include component makers, set assemblers, and makers of servers for cloud-based services (the device itself is so small that it will have little data storage of its own, such that upload and download speeds will be key to providing a seamless user experience).

Notwithstanding the reasons why and when people wear glasses (eg, nearsightedness, farsightedness, astigmatism, sun protection, reading, driving, or simply as a fashion accessory), we think the global addressable market is large. As such, we also believe there is a large market opportunity for Google’s Project Glass. Below we provide a quick view on the population wearing glasses globally, by major markets:

**US**: according to a recent study by the Vision Council of America, about 75% of adults or about 177m people used some form of mechanism to correct their vision (64% wore glasses, and 11% wore contact lenses, either exclusively or with glasses). In addition, about a quarter of the people who wore glasses due to nearsightedness will also end up needing bifocals as they grow older. Also, according to the same study, about 85% of all Americans or about 266m people wore sunglasses.

**Western Europe**: according to a study conducted in 2000 by Dr. John H Kempen, MD, around 22m people (or 12% of the population aged 40 or older) were farsighted, while 58m (31%) were nearsighted. By 2020 Dr. Kempen projected that 28m people (around 13%) would be being farsighted, while 67m (around 31%) would be nearsighted.
China: according to an article from Xinhua (3 January, 2010), China’s nearsighted population was around 400m (or 31% of its total population), while the percentage of nearsightedness among college students was especially high, at more than 80%.

The components of Google’s Project Glass device include a camera, a miniature transparent display, a microphone, an application processor, a system-on-a-chip for connecting to the Internet and cellular networks, a touch-enabled frame on the side, and a gyroscope or accelerometer. While the user can input commands by moving his/her head up/down/right/left, blinking his/her eyes, or waving his/her hands in front of the tiny camera, the device could still require touch technology on the side of the frame as an additional way to receive commands, in our view.

### Potential beneficiaries of Google’s Project Glass

<table>
<thead>
<tr>
<th>Components</th>
<th>Potential Google Glass supply chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparent display</td>
<td>Samsung Electronics, LGD (034220 KS, W22,700, Hold [3]), AUO (2409 TT, NT$11, Outperform [2])</td>
</tr>
<tr>
<td>Touch-enabled frame</td>
<td>TPK, Wintek</td>
</tr>
<tr>
<td>Glass frame</td>
<td>Hon-Hai subsidiaries</td>
</tr>
<tr>
<td>Gyroscope</td>
<td>STMicroelectronics (Not rated)</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>Freescale (Not rated), STMicroelectronics, Analog Devices (Not rated)</td>
</tr>
<tr>
<td>Baseband IC</td>
<td>Qualcomm</td>
</tr>
<tr>
<td>Microphone</td>
<td>AAC Technology (2018 HK, HK$23.2, Buy [1]), Merry (Not rated)</td>
</tr>
<tr>
<td>Camera</td>
<td>Largan (3008 TT, NT$576, Buy [1]), Genius (Not rated)</td>
</tr>
<tr>
<td>Assembly</td>
<td>Hon-Hai (2317 TT, NT$87.5, Buy [1]), Pegatron (4938 TT, NT$42.5, Buy [1])</td>
</tr>
</tbody>
</table>

Source: Daiwa

Still, there are issues that could limit uptake of the product: 1) social-cultural obstacles, 2) potential health concerns, and 3) technical difficulties.

1) Social-cultural obstacles

With data being pushed to users in real time, and the display featuring a steady stream of pop-up information, there is a risk that users will be distracted from tasks requiring high levels of concentration (operating a vehicle or machinery). There is also concern that such devices could threaten privacy by allowing users to take photos or record videos unnoticed. Increased penetration of such devices could prompt regulatory changes that weigh on the segment’s growth prospects.

2) Potential health and physiological consequences

Wearing such a device for “too long” could be a health hazard, given that the user’s head would be encased in a device constantly generating electrical current and emitting baseband signals.

3) Technical problems

A regular pair of glasses weighs 25-50 grams, compared with 130-160 grams for an average smartphone. To be comfortable enough to wear, such a device surely shouldn’t weigh much more than a pair of spectacles — but then battery life would likely be an issue, given batteries are typically the heaviest component.

### Weight of smartphones

<table>
<thead>
<tr>
<th>Models</th>
<th>Apple iPhone 4S</th>
<th>HTC One X</th>
<th>Samsung Galaxy S III</th>
<th>Nokia Lumia 900</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grams</td>
<td>140</td>
<td>130</td>
<td>133</td>
<td>159</td>
</tr>
</tbody>
</table>

Source: Daiwa

Other considerations include: sourcing the right component makers for mass production, securing raw materials such as titanium material for the frame, extending the battery life, and settling upon a price point that allows the device to compete with smartphones.
Our view that the addressable market and penetration of Project Glass and similar products could follow the growth trajectory of smartphones stands. Keep in mind, however, that it was five years before smartphone penetration reached 20% as: 1) consumers had to become accustomed to the use of touch panels in mobile phones, 2) it took years to build the accompanying mobile computing infrastructure (eg, 3G Internet coverage), 3) it took years to establish the component supply chain, and 4) it took years to develop the software ecosystem (operating systems, applications and app stores).

Click here to see a typical day for a user of Google’s Project Glass.
II. Sensible touch

Users of today’s displays typically receive feedback through vibration, sound, and/or the display itself showing the typed letter/number/symbol.

In Sensible touch, our term for the next generation of touch technology, new types of display will allow users to feel physical “buttons” only when they are activated, will be foldable, and could be concave or convex in shape.

4. Haptic touch by Tactus Technology

5. XSense metal-mesh capacitive touch by Atmel
4. Haptic touch panel by Tactus Technology

What is it?
The haptic touch panel is an elastic type of touch panel that sits on top of the touch sensor, from which tactile buttons morph out of a flat surface when activated and then recede when not in use, leaving no trace of their presence.

![Haptic touch panel by Tactus Technology](source: Tactus Technology)

How does it work?
The haptic touch panel, developed by Tactus Technology (not listed), is made with a flat, transparent tactile layer with micro-channels and ‘microfluid’ (a special type of oil that runs through the micro-channels).

![Haptic touch panel: micro-channel](source: Tactus Technology, theverge.com)

When the haptic touch panel is activated, microfluid is pumped through the micro-channels to the designated area, raising buttons from the deformable membrane.

![Haptic touch panel: micro-channel](source: Tactus Technology, theverge.com)
Our perspective on the market outlook

In our view, haptic touch panel is ideal for hearing-impaired or sight-impaired users, and people who prefer orientation or confirmation feedback when interacting with devices. We believe the need for touch panels with built-in physical feedback may increase as the size of the ageing population rises.

According to the United Nations, growth in the global population of people aged 60 or above is running at 1.9% pa, significantly higher than the 1.2% annual growth rate for the total population. The gap between the two growth rates is expected to widen by 2025-30, to 2.8% vs. 0.8%, as baby boomers (born between 1946-64) reach their 60-80s. The proportion of senior citizens is largest in developed nations, in which affordability and penetration of smartphones, tablets and notebooks is also highest.

Eyeing this trend, the first related Tactus products will be available by the end of 2H13, according to Tactus Technology. Apple is also making assertive moves in this field. On 3 May 2012, the US Patent and Trademark Office published a patent in which Apple depicts a ‘multi-tiered haptic system’ allowing the display of its devices to deform, providing buttons, arrows, or even 3D geological contours of a map for end-users.

Since a deformable membrane will replace a cover glass as the primary point of contact on a haptic touch screen, we foresee issues with the durability of the screen, as the surface may not be as scratch-resistant as a cover glass made of, say, Corning’s Gorilla Glass. Moreover, it remains to be seen how the membrane will perform if scratched or covered with a layer of protective film.

Another issue to consider is that the tactile buttons are preconfigured for a particular layout, such as a dial pad, numeric key pad, or QWERTY keyboard. In other words, they are not dynamically adjustable in line with the contents of the display.

Click here to learn more about haptic touch panels.
5. XSense metal-mesh capacitive touch by Atmel

What is it?
Atmel’s XSense metal-mesh capacitive touch sensor is a type of capacitive touch sensor that uses metal mesh (copper or silver grid) instead of indium tin oxide (ITO) as the sensor material in order to allow 3D or flexible displays with low resistance.

How does it work?
XSense is a film-based touch sensor made using Atmel’s proprietary roll-to-roll ‘metal mesh’ technology. It uses metal rather than ITO to form the sensor array on a film, giving it the following advantages:

1) Better material
   - Using copper is cheaper, as supplies of ITO, like other rare earth metals, are highly constrained.
   - The ITO manufacturing process requires extra processes to neutralise toxicity.

2) Lower resistance — more immune to noise, less power hungry than ITO
   - Better noise immunity (thus a shorter refresh time).
   - Lower power consumption (around one-quarter of that for traditional ITO).

3) Flexibility
   - The sensor can be used on curved surfaces or even wrapped around the device, allowing for a sleeker and edgeless touch interface.
   - Can replace mechanical buttons on the side of a device with more reliable touch-based button(s).

4) Others
   - Smaller IC and thus a narrower bezel and larger active screen area.
   - Highly accurate for both active (battery-charged) and passive (without battery) stylus performance
   - Thinner sensor stacks, allowing for slimmer devices.
   - Enables large-size screens.

Our perspective on the market outlook and potential beneficiaries
While metal-mesh uses relatively cheap material (copper), we believe the “curveable” nature of the metal-mesh solution will allow brand makers to roll out differentiated products, particularly high-end models. Keep in mind, however, that related technologies, such as curved cover glass and lamination techniques, should also be ready – with the requisite scale economies – in order to drive down overall costs.
The touch sensor layer (XSense film) is positioned between the cover and the display, as with other existing out-cell touch technologies. Therefore, to make best use of the technology, 3D or curved cover glass and a curved display would be needed.

- **Atmel’s XSense**

![Diagram of Atmel’s XSense](source: Atmel)

Among the potential beneficiaries are G Tech, which already supplies curved or 3D cover glass, and Corning, whose Willow Glass (later discussed on page 26) is likely to be used in the production of the curved display. G Tech is in the process of expanding its monthly production capacity for 3D cover glass from 50,000 units in 1Q12 to 1.0m units in 4Q12.

- **Curved cover glass processing techniques**

![Diagram of curved cover glass processing techniques](source: DisplaySearch, Daiwa)

We believe the lamination process between a curved cover glass and a curved display would be quite difficult and require advanced lamination services from touch panel makers. By our reckoning, TPK stands to benefit most from this new type of flexible capacitive touch technology, given its leadership in lamination in terms of both scale and production yields.

[Click here](#) for an introduction to XSense from Atmel.
III. Swiping touch: advanced components and materials

In this section we highlight components and materials that will allow lighter, slimmer and altogether more versatile touch-enabled form factors.

6. Pixel Eyes by Sony
7. Touch on Display by CMI
8. Willow Glass by Corning
6. Pixel Eyes by Sony

What is it?
Sony’s Pixel Eyes is essentially a quasi-in-cell touch solution. The technology integrates the touch sensor into the LCD panel (similar to the in-cell touch solution), thus negating the need for an external touch panel module, and reduces optical reflection between the touch panel and the LCD panel. The result: panel thickness is reduced by 30-50%, while transmittance is improved by 10%. As well as addressing signal interference, Pixel Eyes gets around Apple’s patent on in-cell touch.

How does it work?
Unlike the true in-cell touch developed by Apple (AAPL US, US$606.91, Outperform [2]) with both X-axis (Rx layer) and Y-axis (Tx layer) touch sensors on the TFT-array layer, the Pixel Eyes touch display has one ITO sensor layer on the back side of the colour filter glass substrate and another on the TFT substrate. As such, it is not a pure in-cell but a quasi-in-cell touch solution.

The X-axis ITO for Pixel Eyes is not coated as part of the colour-filter production process, but coated after the thinning of the finished open cell. Because of this approach, the solution does not require production lines to be revamped (the addition of robotic arms for flipping or the adoption of protective measures for the ITO layer or colour filter layer on conveyor belts).

Our perspective on the market outlook
While Pixel Eyes technology is a combination of in-cell and on-cell touch solutions negating the need for a laminated touch panel module, it will still require lamination between the cover glass and open cell. We think it should cost less than US$40 once it attains economies of scale, with panel makers providing a universal solution demanding that brand makers adopt precisely the same size and display resolution (eg, 4-inch qHD resolution) to bring down overall costs. The major cost for such a solution is the development of a new set of photo masks, since each size and resolution requires a new set of photo masks to coat the Y-axis ITO into the TFT layer.
We see this solution targeting mid-range smartphones, such as Sony Xperia P and HTC's EVO Design, featuring 4-inch qHD resolution (960 x 540) displays.

**Sony Xperia P and HTC EVO Designs**

As it stands, Sony is making 4-inch Pixel Eyes displays using low-temperature polysilicon (LTPS) as the backplane for the following resolutions: 960 x 540 (275 dots per inch [dpi])) and 800 x 400 (224 dpi). The company intends to make 1280 x 720 and 1920 x 1080 displays as well.

Because Sony is the only supplier, output is limited. The monthly production run rate was about 46,000 units (4-inch equivalent), equivalent to just 1.4% of the STL Higashiura fab's production capacity, in 1Q12. The potential total maximum monthly capacity would be 3.28m units (only 3 to 4 models at most), assuming all of Sony's existing production lines produce only Pixel Eyes displays with a 90% yield rate.

**Sony TFT-LCD capacity (4-inch equivalent)**

<table>
<thead>
<tr>
<th>Fab generation</th>
<th>Dimension X (mm)</th>
<th>Dimension Y (mm)</th>
<th>Panelization (sqr. mm)*</th>
<th>Motherglass capacity ('000/month)</th>
<th>4.0&quot; capacity ('000/month)**</th>
<th>Current output (4.0&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STL Higashiura #1 (3.25G)</td>
<td>600</td>
<td>720</td>
<td>410,400</td>
<td>15</td>
<td>1,202</td>
<td>46</td>
</tr>
<tr>
<td>STL Higashiura #2 (3.25G)</td>
<td>600</td>
<td>720</td>
<td>410,400</td>
<td>26</td>
<td>2,083</td>
<td>46</td>
</tr>
<tr>
<td>4.0&quot; panel</td>
<td>53</td>
<td>87</td>
<td>4,611</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>39,411</td>
</tr>
</tbody>
</table>

Source: Daiwa estimate

"Notes: *Assuming a glass efficiency of 95%  ** Assuming an overall yield rate of 90%"

We see mid-range smartphones as the fastest-growing segment in the smartphone space. With the shift toward relatively light devices with slim form factors, we think the Pixel Eyes solution could be a viable alternative to the one-glass solution if Sony licenses the technology to other panel makers and brand makers conform to the one-size solution (as opposed to various sizes) offered by panel makers.

**Mid-range smartphones the fastest-growing segment**

Source: Gartner, Forecast: Mobile Devices, Worldwide, 2009-2016, 2Q12 Update, By Annette Zimmermann, Carolina Milanesi, Roberta Cozza, Anshul Gupta, Atsuo Sato, CK Lu, Tuong Nguyen, and Huue de la Vergne
7. Touch on Display by CMI

What is it?
Chimei Innolux’s (CMI) (3481 TT, NT$10.95, Buy [1]) Touch on Display (TOD) is an on-cell touch solution that could be a strong contender in the smartphone market in 2013, offering a touch display solution that does not give up border strength of the touch display in the way that the one-glass solution (OGS) does.

How does it work?
After the display open cell is manufactured and slimmed (if necessary), the touch ITO sensor is sputtered on the back of the colour filter substrate.

Theoretically, when comparing CMI’s TOD with Apple’s in-cell touch and Sony’s Pixel Eyes, the structure is less affected by signal interference at the TFT array layer, and has a simplified production process that should allow for a higher yield rate.

Our perspective on the market outlook
CMI is set to expand its sensor glass production to include: 1) sensor glass for the discrete glass/glass (G/G) solution, 2) a one-glass solution called Windows Integrated Solution (WIS), and 3) its new TOD solution. It is targeting to ramp up for mass production of its TOD solution in late 2012 or early 2013. Below we show CMI’s capacity expansion plans for touch sensor production; it intends for production of the three solutions to be interchangeable, ie, according to client and market demand.

We believe TOD is set to benefit from the trend toward slimmer smartphones and tablets. We see the technology as best suited to mid-range, high-volume models, since it can save on sensor glass (15-20% cheaper BOM and thinner than the discrete G/G solution), as well as offering more border strength than the WIS.
Note: Similar to the one-glass solution (OGS), the WIS faces the issue of a weakened border (by about 30%) upon cutting after ITO coating, even after a second strengthening step for the cover glass. In comparison with other OGS solutions, the TOD also negates the need for sensor glass or sensor film but has strong cover glass like that of the G/G type or TPK’s touch-on-lens (TOL) solution.

Mid-end smartphones – the fastest growing smartphone segment

8. Willow Glass by Corning

What is it?
Willow Glass, produced by Corning, is an extremely thin glass, only 0.1mm in thickness (as thin as a piece of paper), yet is flexible enough to roll into a 5cm radius before exceeding its maximum bending stress. In our view, it could be an ideal material to replace film or PET-based material for G/F or G/F/F out-cell touch or flexible AMOLED touch-enabled displays.

- Willow Glass: bendable glass as thin as a piece of paper

How does it work?
**Willow Glass** is made using Corning’s state-of-the-art ‘fusion draw’ technology. High-purity material for glass is melted in a furnace, and then the liquid-state glass is poured into an ‘isopipe’, where the liquid-state glass flows evenly over the two sides and joins together at the bottom. While cooling, gravity thins the glass, which goes from being 1mm to just one micron thick (0.1mm).

- Willow glass is suitable for the roll-to-roll process

Source: Corning
Our perspective on the market outlook and potential beneficiaries

Flexible glass makes possible flexible displays and flexible touch solutions. The substrate is also suitable for the roll-to-roll process, which makes mass-production relatively inexpensive. We believe this is a critical component for the next wave of touch-display technology, and we envision this technology being adopted by more brand-name makers in 2H13-2014, when flexible displays are likely to be made available by Samsung Electronics (005930 KS, W1,152,000, Buy [1]).

For further information on Willow Glass, refer to page 6 of *TFT-LCD and Components Sectors: Highlights of 2012 DisplaySearch FPD Conference*, published on 24 April 2012, and to pages 4-5 of our 3 November 2011 report, *Highlights from 2011 FPD Exhibition & Convention*

[Click here](#) to see how the Willow Glass is made.
Conclusion

It is important to monitor these emerging technologies now, since one or more of them could change the market dramatically.

We highlight Leap and Project Glass as best placed to change user behaviour and market dynamics. Ultimately, we think the Leap concept could be applied to all kinds of displays, while Project Glass stands as a threat to the smartphone industry as a whole by promising to change the way people stay connected. In the preceding sections we have highlighted potential company beneficiaries within the supply chain.

As we see it, though, this is a medium-to-long-term story, as these technologies must overcome entry barriers — including technical hurdles and in some cases social issues — before finding their way into the realm of blockbuster products.

Across Daiwa’s universe of coverage, which companies are most insulated, in the short to medium term, from the coming revolution? In our view, it is the touch panel makers. We believe TPK (3673 TT, NT$334.0, Buy [1]) and Wintek (2384 TT, NT$14.25, Outperform [2]) stand to benefit the most from the continued adoption of mobile devices worldwide over 2H12-2014.

Crucially, many of these emerging technologies — Floating Touch, Haptic Touch, Xsense Metal Mesh, Pixel Eyes, Touch on Display, and Willow Glass — will require lamination services, the core competence of touch panel makers.

Separately, cover glass is a key component in smartphones, tablets and even touch-enabled Ultrabooks with detachable screens. This range of applications means cover-glass specialist G Tech Optoelectronics (3149 TT, NT$81.3, Buy [1]) should be somewhat sheltered from the coming wave of new technologies, at least initially.

Preferred exposure in the interim

Touch panel makers TPK and Wintek

We favour TPK and Wintek since, as mentioned above, some of these emerging technologies would still require lamination services, the core competence of touch panel makers. While The Leap would be ideal for desktop or gaming applications, we do not see it as well suited for use in touch-enabled Ultrabooks running Windows 8 – and we believe TPK and Wintek’s businesses should benefit the most from the latter over 2H12-2014 (see our 5 June report, In 2013, the majority of Ultrabooks should be touch-enabled).

We favour TPK over Wintek due to the former’s market leadership in the touch panel space. We are not concerned about TPK’s earnings growth prospects, because of the likelihood of in-cell touch technology being used in all future smartphones and tablets. We reiterate our Buy (1) rating with a six-month target price of NT$409, based on our fully diluted 2012 EPS forecast of NT$43.07 and a target PER of 9.5x, as we think its fundamentals will remain solid due to robust top-line growth and improving profitability metrics as its dependency on Apple declines. The major downside risks are a delay in the launch of Windows 8 and slower-than-expected adoption of Ultrabooks with detachable screens.
As for **Wintek**, we expect its profitability to improve as ATT (Advanced Touch Technology, codename for its one glass solution) touch solutions gain scale economies. We reaffirm our Outperform (2) rating and six-month target price of NT$22.5, based on our 2012E BVPS of NT$22.54 and a target PBR multiple of 1.0x. Our target multiple is at the low end of the stock’s three-year band of 0.8-2.1x, which we consider a fair valuation while the TAIEX is being derated due to concerns related to capital gains taxation. Risks include brand makers’ slower adoption of ATT touch solutions and a delay in the launch of Windows 8 Ultrabooks with detachable screens.

**Cover glass specialist G-Tech**

G-Tech, in which Hon Hai has a 33% stake, is expanding quickly on the back of two big market trends: tablets and smartphones. We see cover glass as a key component that will continue to be in strong demand for smartphones, tablets and even touch-enabled Ultrabooks with detachable screens. Perhaps the main long-term threat to these segments is Google’s Project Glass, which is designed to revolutionise the way people stay connected.
We reiterate our Buy (1) rating on **G-Tech**, with a six-month target price of NT$128.00, based on our 2012 EPS forecast of NT$5.13 and a target PER of 25x, at the mid-to-high point of the stock’s 10-32x range over the past 22 months (our target PER is based on a PEG of 1x).

The risks to our view would be lower-than-expected order allocations from a US consumer brand, a slower-than-expected ramp-up of 3D cover glass for smartphones, and fierce price competition from unlisted peers Fuji Crystal and Lens One.

**And what of Sony?**

We have highlighted Sony’s (6758 JP, ¥998, Hold [3]) Pixel Eyes and Floating Touch technology. Daiwa analyst Junya Ayada has a Neutral call on the stock (see his 11 May report, *Low net income target a letdown, but losses in TV ops shrinking*). We see Sony’s TV and mobile phone businesses still making operating losses this year. Overall, our operating profit projection for FY12 (ie, year ending 31 March 2013) is ¥140bn, compared with the company’s forecast of ¥180bn.

Losses in the TV business are steadily narrowing, helped by lower panel costs with the dissolution of the S-LCD joint venture. We think a meaningful upgrade to its profit outlook would require a turnaround in the mobile phone business, but it is not easy to take market share through device technologies alone. That makes an expanded network strategy imperative, in our view. Without such changes, the shares are likely to still hinge on swings in the euro-yen rate, with company-specific catalysts remaining absent.
Samsung Electronics: share price and Daiwa recommendation trend

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Source: Daiwa

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- In addition to the purchase price of a financial instrument, we will collect a trading commission* for each transaction as agreed beforehand with you. Since commissions may be included in the purchase price or may not be charged for certain transactions, we recommend that you confirm the commission for each transaction.
- In some cases, we may also charge a maximum of ¥ 2 million (including tax) per year as a standing proxy fee for our deposit of your securities, if you are a non-resident of Japan.
- For derivative and margin transactions etc., we may require collateral or margin requirements in accordance with an agreement made beforehand with you. Ordinarily in such cases, the amount of the transaction will be in excess of the required collateral or margin requirements.
- There is a risk that you will incur losses on your transactions due to changes in the market price of financial instruments based on fluctuations in interest rates, exchange rates, stock prices, real estate prices, commodity prices, and others. In addition, depending on the content of the transaction, the loss could exceed the amount of the collateral or margin requirements.
- There may be a difference between bid price etc. and ask price etc. of OTC derivatives handled by us.
- Before engaging in any trading, please thoroughly confirm accounting and tax treatments regarding your trading in financial instruments with such experts as certified public accountants.

*The amount of the trading commission cannot be stated here in advance because it will be determined between our company and you based on current market conditions and the content of each transaction etc.

When making an actual transaction, please be sure to carefully read the materials presented to you prior to the execution of the agreement, and to take responsibility for your own decisions regarding the signing of the agreement with us.