



Race to the bottom



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Introduction to Hendy Consulting:

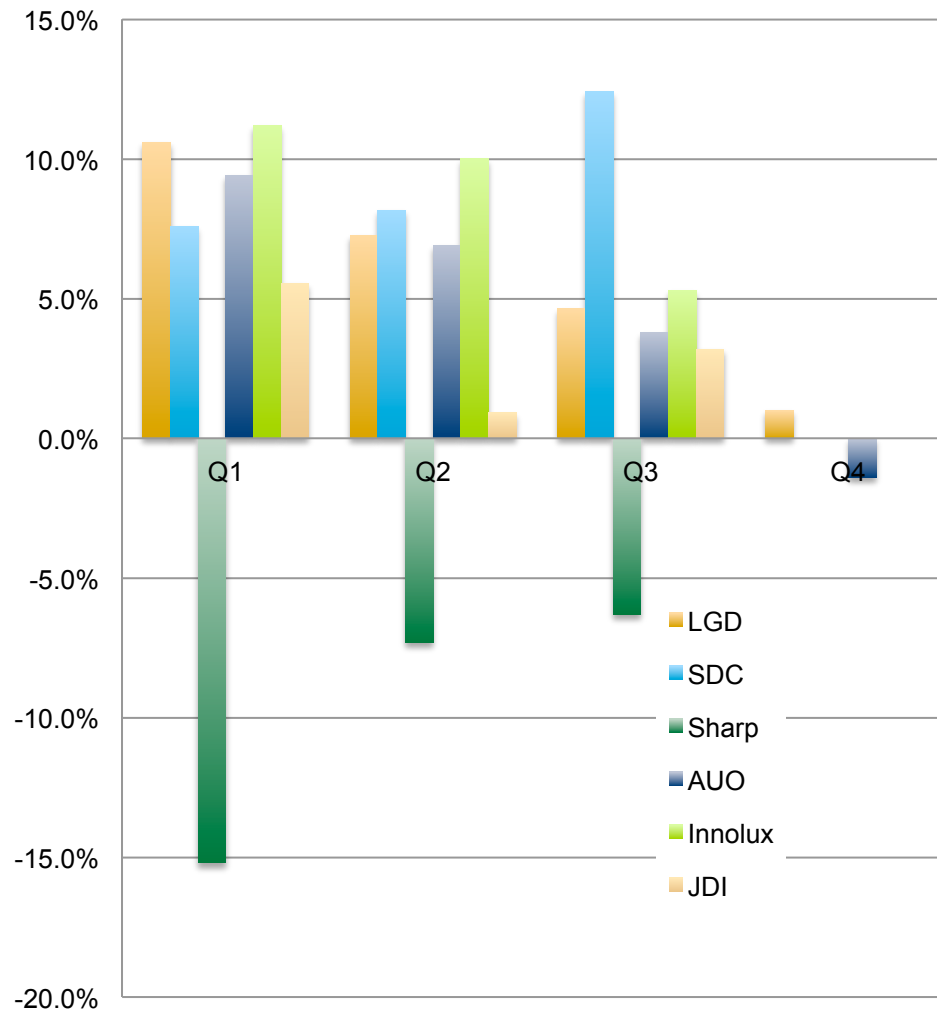
Growth strategy <ul style="list-style-type: none">• Market entry strategy• Business unit strategy• Growth strategies for new technologies	Performance improvement <ul style="list-style-type: none">• Product portfolio management• Pricing strategy• Cost reduction	Equipment and Capex <ul style="list-style-type: none">• LCD/OLED factory capex decisions• Strategies for equipment makers	Sourcing strategy (Purchasing) <ul style="list-style-type: none">• Sourcing strategies, especially LCD and medical detectors• Make/buy decisions
Technology strategy and technology assessment <ul style="list-style-type: none">• Market and commercial strategies for new technology businesses• Market tracking services for corporates monitoring technology	Partnering and alliances <ul style="list-style-type: none">• M&A candidates and assessments• Alliance formation support• Post merger integration planning	Professional advisory and business planning <ul style="list-style-type: none">• Specialist insights for bankers, equity investors and other consultancies• Reviews of business plans and models (Strategic audits)	Strategies for materials providers <ul style="list-style-type: none">• Strategy support for materials providers in the FPD, SSL, and PV markets• IP and pricing plans

Race to the bottom is what has transpired:

	Base case	Tech race	Race to the bottom	a-Si wins since "Good enough"	Display industry saves itself
Metal oxide	Slow roll out for hi-def TV & mobile devices. Retrofit of a-Si	Metal oxide becomes important but coexists with architecture led LTPS	Metal oxide destroys LTPS value proposition but gains no premium over a-Si	Metal oxide fails to be important in comparison to a-Si	Metal oxide and a-Si coexist, with MO positioned above a-Si
AMOLED	2-3 players develop positions mostly in mobile devices	AMOLED flourishes and hits high-end price points in EU, Japan and US	AMOLED survives in mobile apps as MO TFT becomes cost competitive with a-Si	AMOLED flounders and remains a niche technology	AMOLED has a role for mobile devices and some TV and enables flexible
Market development	Mobile devices still more important. TV replacement faster, but not by much	Market is excited by new offerings. Some TV growth delivered in return	Markets grow but at low price points. Prices fall at 20%+	Markets grow but prices continue down	Price declines slow down as newer technology gains ground
Impact on players	Smaller players in Taiwan and Japan close or convert. New BRIC players	AMOLED or LTPS capable players break from the pack	Faster exits from the industry. Customers gain more power in funding future fabs	Niche technologies fail. Legacy transfer continues faster and more new players	Players begin to specialise in technologies or regional markets
Impact on profits	Profits stabilise but at lower levels. Participation in novel tech or materials key	Increasing profits for technology leaders and for AMOLED "all-in" players	Profits remain poor. Apple, Samsung and HP pay for the fabs they want	Profits remain poor, which leads to more vertical models. Merchants are poorer	Profit improves as display value offsets material cost

2015 saw a predicted decline in the display industry, other than for SDC

EBIT 2015 progression



- Three major stories: most players falling, Sharp managing to narrow losses and SDC doing surprisingly well
- On the whole the profits on a like for like basis are falling, except for Sharp and SMD
- Sharp through Q3 continuing to narrow the losses on its LCD component business
- SDC pulls out a high number for Q3 2015
- Otherwise falling profits for AUO, Innolux and LGD and with a weak Q1 2016 expected for all

With the following impact:

The SHARP logo is displayed in a bold, red, sans-serif font.

Deals being discussed with INCJ about merger with JDI or an alternative deal with Foxconn (Hon Hai) could be possible. Spin out of LCD business being considered. Selling IP/ Equipment



Japan Display Inc.

Closing their TDI subsidiary



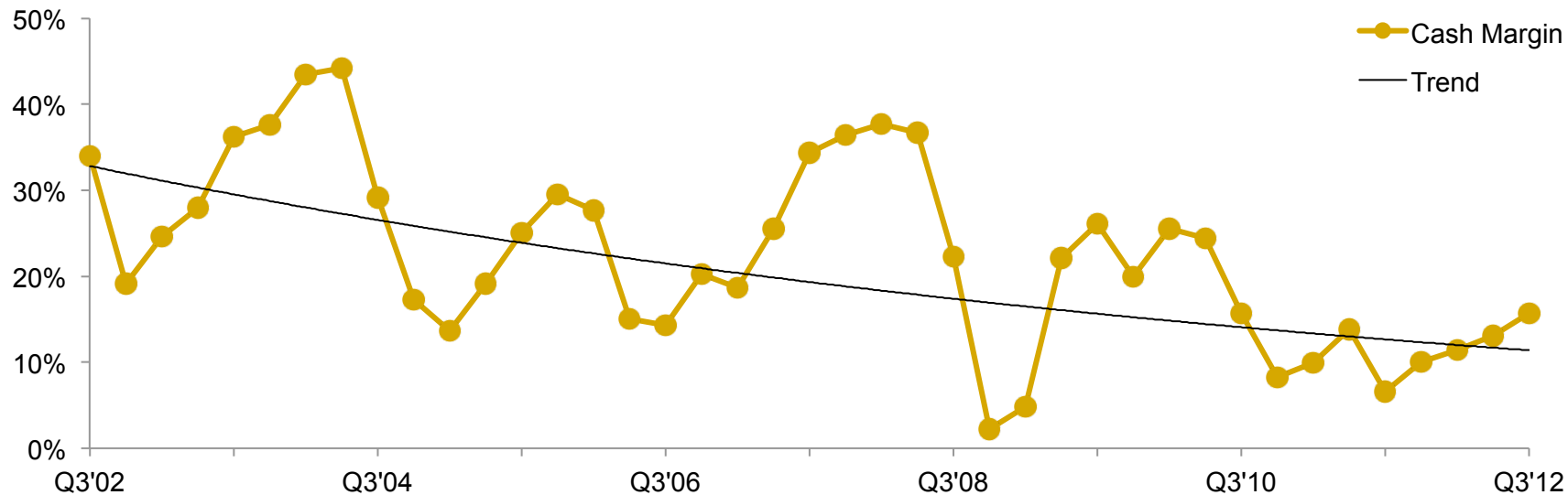
CHUNGHWA PICTURE TUBES, LTD.

Sold one fab (Gen 4) and closed another (Gen 4.5)



1% Profit margin in Q4 2015 based on 5% in LCD and losses in OLED

What has happened at the bottom of each cycle: Quite a bit of M&A type activity in this 10 year snapshot



- 2002 cycle: IBM and CMO Joint Venture (IBM divests), AUO formed
- 2006 cycle: Toppoly acquires Philips MDS business to form TPO
- 2008 cycle: EIH buys Hydis, AGC/Mitsubishi divest of Optrex
- 2010 cycle: TPO and CMO and Innolux merge to make CMI, AUO acquires LTPS assets of TMD in Singapore
- It is clear that a fair amount of the display industry M&A activity happens at the bottom of the cycle

But it is not just M&A activity that happens at the bottom of the cycle: the cycles also spawn technical and market developments

1998-1999

Japan transfers technology to Taiwan and pivots itself to LTPS (Big bet for Japan)

2001-2002

ODF is perfected leading to larger substrates and more panels per substrate. Gen 5 appears

2004-2005

Column spacers and other innovations allow LCD TV to develop. CRT companies begin to fail. LTPS decline. Gen 6 appears

2007-2008

Smartphones begin to appear. Panel makers move capacity into small medium and the touch race begins. Gen 8 appears

2010-2011

Dreams for LTPS II (Samsung) and IGZO (LGD) drive bets. Tablets appear. "OLED TV will be next, I promise"

2013-2014

Panel makers begin to pivot back to large panel displays (4K) whilst still dumping capacity into smartphone displays. Automotive displays becomes an area of interest

So what tends to happen also varies depending on how big the display company is, as the bigger firms have better options:

Top players

- Use the bottom of the cycle to plan the next big investment round
- Top players pull back a bit on their discretionary R&D and other funds but business does continue
- Top companies may trim their capex budgets (to say 80% of previous)
- Reduce utilisation somewhat in the down cycle

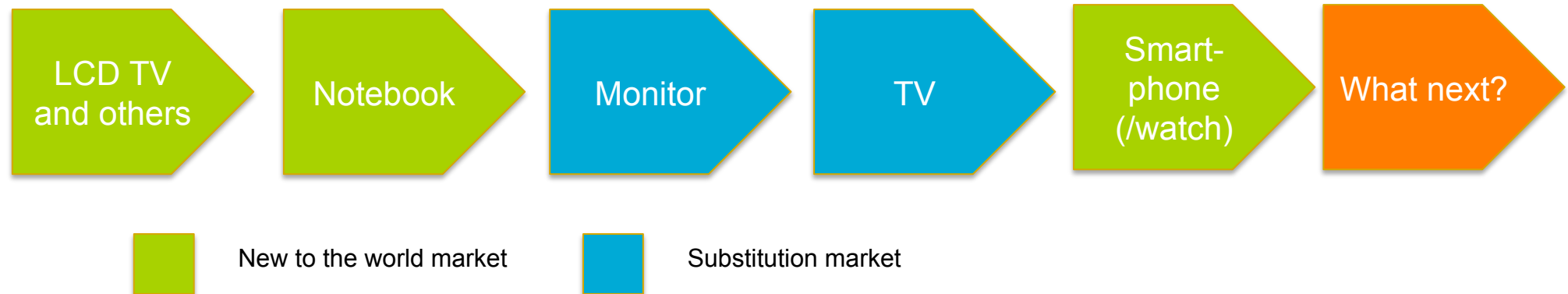
Mid players

- Put workers onto furlough/ reduced hours
- Reduce utilisation
- Sell assets or access to IP (e.g. Sharp)
- Help other firms with technology transfer agreements to help bring in money
- Merge with others

Smaller companies

- Close or sell fabs
- Put workers onto unpaid leave
- Go bankrupt (e.g. Wintek)
- Merger with others
- Exit the business (Fujitsu, NEC, IBM), though overall the number of complete exits has been fairly low

What makes now different is the lack of substitute market opportunities.
Defining new to the world markets is optimised by software and hardware combinations

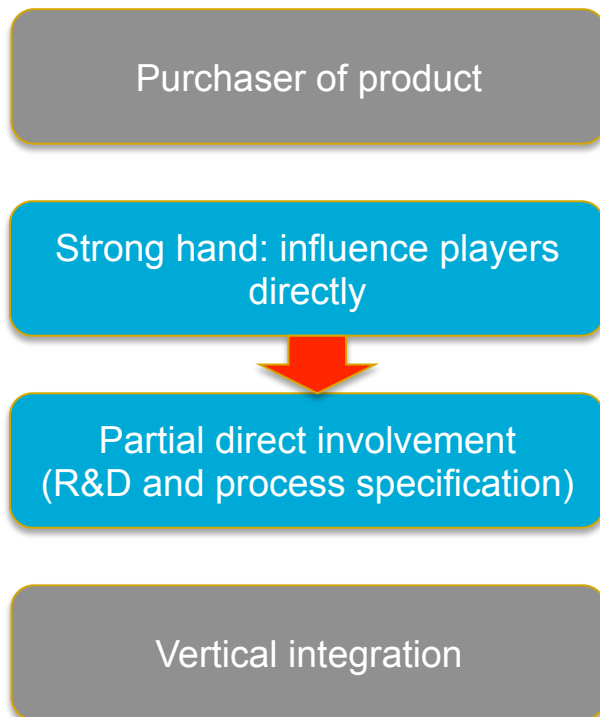


- The original small LCD TV handhelds were the first major market for TFT-LCDs
- While the initial part of the Notebook revolution was substitution of passive matrix STN, most of this was building a new to the world notebook market
- The Monitor market substitution (competing against CRT monitors) was only possible once the notebook market had built up enough capacity to allow competitive cost points
- TV substitution and iPhone like Smartphone revolutions next
- What next: Next big thing is driverless cars with entertainment as the next big enabler?



The major shift that is different now is the behaviour of Apple, who have increased their exposure to the industry. Apple also talking about a bet on AMOLED:

Models for involvement in the industry



Previous behaviours

- Apple used to play the strong hand in the display industry organising the proliferation of technology and adoption of new approaches
 - E.g. FFS technology for IPS
 - E.g. Development of Flex OLED on PI for Apple Watch
- Doing the purchasing for equipment for new factories for key suppliers

Recent moves

- However, the Apple has moved to opening a display centre based on the old Mirasol fab and has hired engineers
- There is also a major shift coming with the potential for Apple to move to AMOLED for iPhone from 2017
- So actively shaping the direction of the display industry at a detail level. Unlikely that Apple will want to go the full way to being a vertically integrated display provider, but will be interesting to see what economic structure evolves if Apple fundamentally specifies both product and process

So how does this impact the chessboard:

Potentially makes LTPS LCD less valuable

- There were 6 LTPS Gen 6 fabs planned for China: expect to see these plans withdrawn or modified. Apple purchases 50% of all LTPS
- Current LTPS facilities may be converted to some degree to small panel AMOLED facilities but this conversion (remove the cell shop and put in smOLED deposition instead) is not so straightforward. Nearly all of the AMOLED capacity in the industry has been greenfield OLED capacity

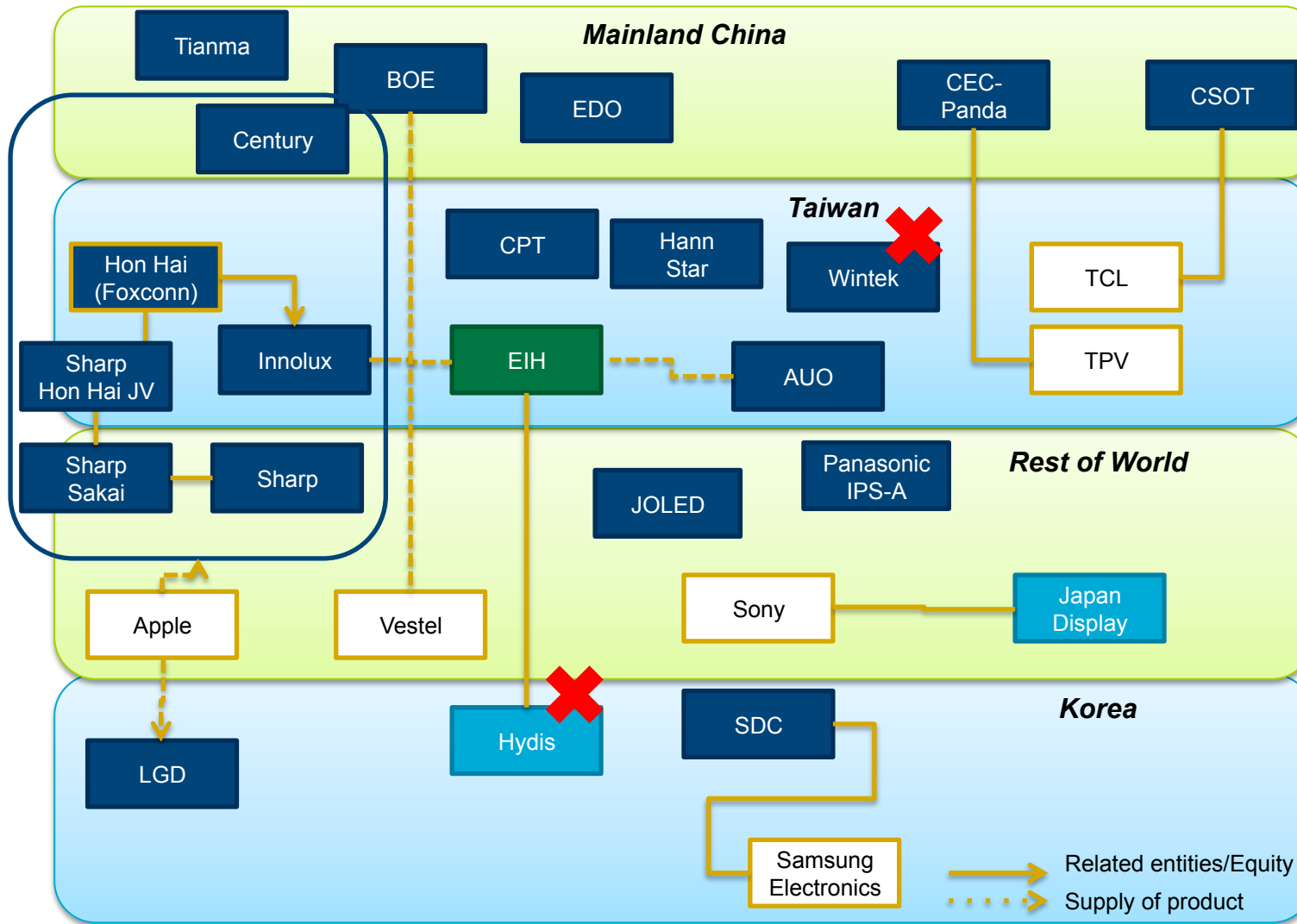
Scramble into OLED

- The Chinese players had pulled back on massive investment announcements into OLED but we should expect to see these again
- JDI has already announced plans to be in the OLED market by 2017 (Merger of JOLED also)
- There have been discussions on AUO being influenced to play in the small panel OLED market also

Smaller companies seek niche moves or exits

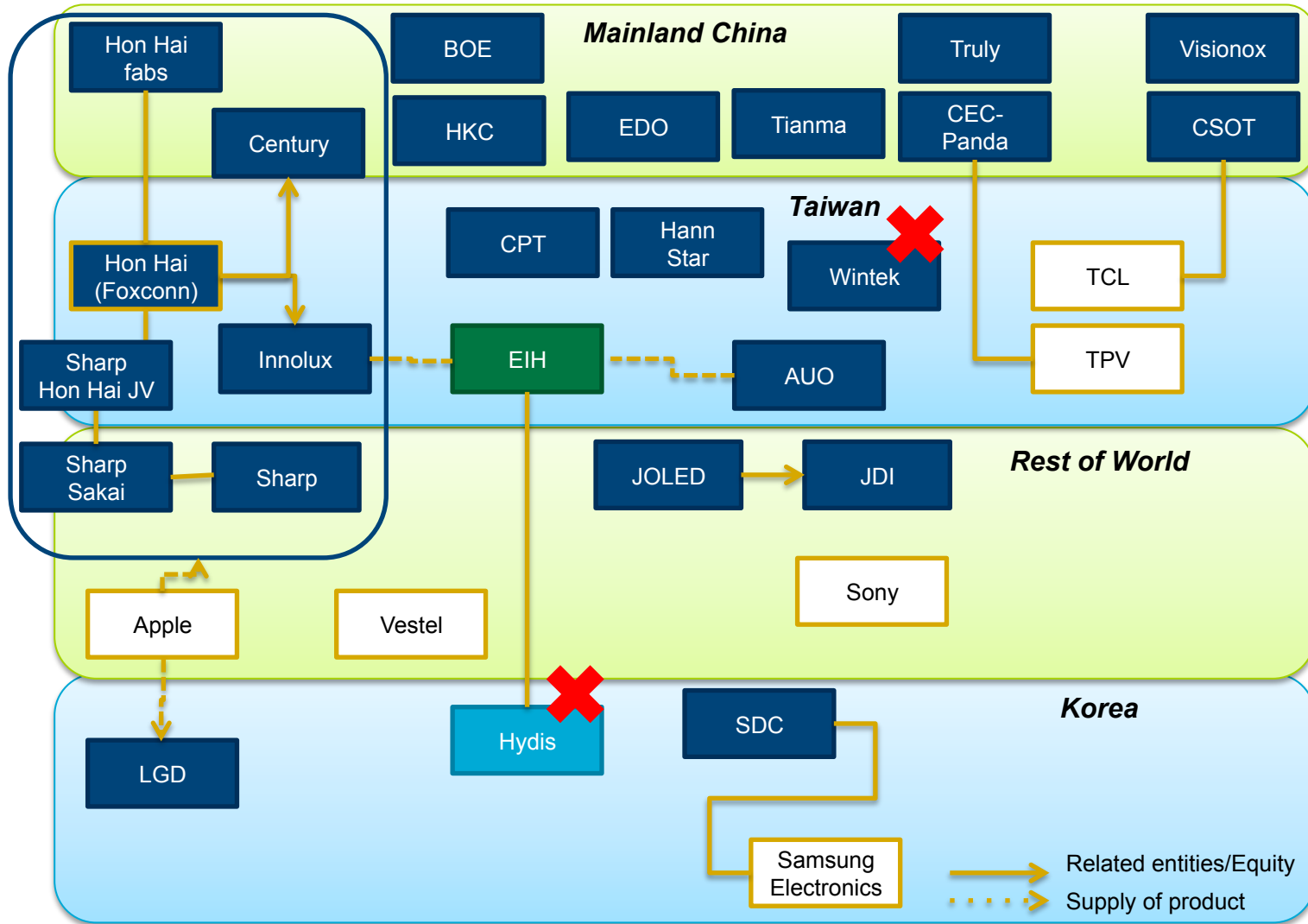
- Companies like CPT selling one fab and closing another. CPT had been implementing a strong innovation story, including work on flexibles and coatable IGZO
- Not clear on the impact on Hannstar
- Smaller players in China may also be put under pressure
- May be some more consolidation

The chess board has changed: Last year





















- The Hon Hai group has aspirations of its own fab but also perhaps with Century
- JOLED established as second INCJ display vehicle
- EIH pretty much stopping the activities of Hydis in Korea (to much noise in the Korean press)
- EDO launching OLED products
- Wintek in financial distress
- JDI using TDI subsidiary in Taiwan as beachhead to attack Chinese market
- Outside of LCD: Complete stoppage of PDP activities

How might it look as the pressure pushes through the industry



- Sharp-Foxconn?
- Proliferation of OLED businesses in China
- Consolidation of capacity and power in the Terry Guo cluster
- LGD and SDC making ballsy investments
- Merge JOLED into JDI-Sharp
- Hannstar and CPT on the edge but CPT planning fab in China based on innovative technology
- Tianma with its emphasis on LTPS may be put under pressure too

















Impact on Sharp for example: Hon Hai the most likely suitor

	Honhai	Intel	HP	BOE	CEC Panda	Apple	Comments
Sakai (Gen 10 TV)							One-of-a-kind white elephant
Kameyama (Tablet, IT)							May be moveable and valuable
Taki and Tenri Kameyama CGS							May be moveable and valuable



- Recent discussions of merger of Sharp into JDI (INCJ involvement)
- Hon Hai have offered almost twice the amount (600bn then 700bn Yen) than the INCJ deal and have agreed to stay redundancies and manage Sharp at arm's length
- Merger of the Sharp household goods section into Toshiba and potential deal also with Hitachi
- Sale of the Sharp solar business perhaps to Showa Shell Sekiyu

The alternative deal is a merger of JDI and Sharp:

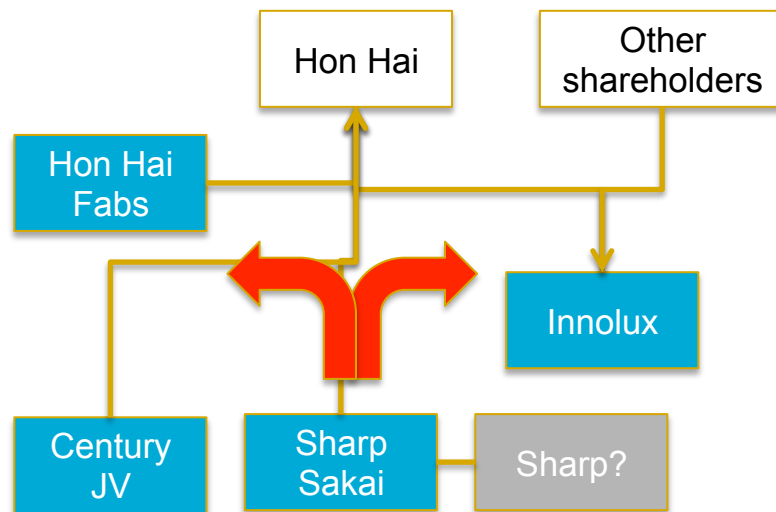
	Small panel	Large panel	a-Si	LTPS CGS	Metal oxide	OLED	Quality of fabs	Quality of technology
JDI								
Sharp								

- Sharp-JDI combination would be very strong in small panels (Wonder if the competition authorities may be concerned)
- Technology strength is very high: the reality is while technology can give a profit advantage for a period of time (up to 3 years) it seldom translates to high profits. Nature of fab structure and scale can help. Overhead structure (middle management bloat) is a negative influence
- However, the merged company is much weaker in large panels and weak overall in OLED (despite JDI's announcement that they plan to be in market by 2017 for small panel OLED and Sharp's OLED R&D)
- Sharp has typically had a very secretive culture: one wonders how well the merger would go through despite two Japanese organisations
- A number of commentators have already been suggesting that Sharp should just be allowed to fail and that the bail out by INCJ is not a good message about allocation of credit in Japan



Terry Guo may bolster his chess pieces if he gets hold of technology from Sharp

Hon Hai relationships and universe



- Terry Guo has been in a big game of technology and LCD chess for close on a decade
 - His goal has always been to capture Sharp technology to infuse into his other display assets (most notably the Century JV and his own planned fabs in Guizhou and Zhengzhou)
 - Has been rebuffed in recent discussions, due to being outside Japan and wanting some management control on personnel
- If this move with Sharp does not come off then we may see him try to secure technology with other means
 - Technology deals, increase R&D, hire engineers aggressively

The Leaders are placing big bets now at the bottom of the cycle waiting for the upturn:

LGD	SDC	BOE
<ul style="list-style-type: none">• LGD have made a massive investment into a Gen 9 campus for additional OLED capability• Considering what their response is to the BOE Gen 10.5 announcement• Investing into flex OLED	<ul style="list-style-type: none">• Considering a Gen 10.6 fab investment for 65"/75" displays• Have announced that they may be making a bet of up to \$7bn into 90k/month of flex OLED (Galaxy and Apple)• SDC is in a surprisingly strong financial position compared to others through 2015	<ul style="list-style-type: none">• Gen 10.5 new factory investment (Hefei, B9 fab, 3370x2940mm)• Fuqing B10 Gen 8 fab additionally• Putting in place a total of 10 fabs across China once these 2 projects are complete, with B11 and B12 being planned

The upside from the bottom of the cycle is often a fundamental new breakthrough:

- A number of innovations have come at the bottom of the cycle in *commercial* development, *technical* development and *equipment/fab* development
- Technical innovations:
 - ODF, big flex OLED scale up, appearance of column spacers for large TV, coatable IGZO
- Commercial/M&A
 - Formation of TPO, AUO and perhaps JDI-Sharp or Sharp-Foxconn
- Equipment and fab development
 - Gen 10+ strategies
 - Gen 5, 6 and 8 emerged on the back of ramping out of the bottom of the trough



Summary:

- 2015 was a year of decline for the display industry in terms of financial performance and 2016 not expected to be much better
 - However, it has also become the time for big bold announcements from the leaders, around expected themes
- The bottom of the cycle leads to expected behaviours that we have seen in previous cycles: new M&A stories, pressure on the weaker players, new fab substrate options, some “big bet” signaling from the leaders
 - There are some new, positive stories and breakthroughs that originate from the bottom of the cycle
- The options for the larger players are better than for the smaller players
- So what shall we in Europe expect?
 - A glut of LTPS: might be good news for automotive and consumer applications
 - Potentially more merchant OLED supply (in 3-4 years time)
 - Continued options to offer innovative materials
 - Some continued trickle down of high end technology into professional markets
 - New suppliers especially from China
- How will the Pheonix rise from the ashes this cycle?



Our offerings:

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