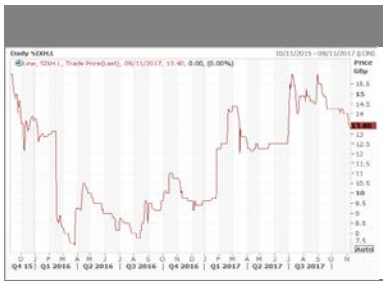
hardman&co



Source: Eikon Thomson Reuters

Market data	
EPIC/TKR	SIXH
Price (p)	13.5
12m High (p)	16.0
12m Low (p)	9.1
Shares (m)	112.9
Mkt Cap (£m)	15.1
EV (£m)	28.7
Free Float*	72.1%
Market	AIM

**As defined by AIM Rule 26*

Description

The 600 Group is a designer and manufacturer of industrial products active in Machine Tools, components and laser marking. The US represents around 65% of group sales.

Company information

Executive Chairman	Paul Dupee
CFO	Neil Carrick

+44 01922 707110
www. 600group.com

Key shareholders

Haddeo Partners	20.8%
Mr D Grimes (MD of ILS)	6.6%
Mr A Perloff and Maland	5.8%
Miton Group	3.4%
Others	63.4%

Next event

June-18	2016/17 Final results

Analyst

Paul Singer 020 7194 7622
ps@hardmanandco.com

The 600 Group

Moving into a new growth phase

The 600 Group ("the Group") is competitively well-positioned with a world class reputation. Business momentum is healthy with growth enhanced by new product launches and new market entry. Cyclicality is being de-risked through further development of repeat business and activities in high margin spares/services. The risk/reward profile is favourable, and the shares are compellingly valued.

- **Competitive positioning:** 600 Group has strong global brand recognition with, as a key differentiator, the provision of high service/customer support. The Group is regarded as well positioned within highly competitive and fragmented industries where barriers to entry are generally low.
- **Growth prospects:** Growth will be driven primarily organically with new product developments in both business areas and new geographical market entry. The Group also intends to further develop its business interests by targeted strategic acquisitions and joint ventures in the high growth industrial laser systems market.
- **Trading update/financials:** the 2017/18 interim trading update was positive and results much as expected reflecting the healthy operating environment. The Group's pension fund is in an accounting surplus with a value of £46m with a cash refund to the group, on insurance buy-out, a medium term possibility.
- **Valuation:** The shares are attractively valued trading on calendar 2018 EV/sales and EV/EBITDA of 0.6 and 7.3 times compared with sector averages of 1.0 and 7.7 times respectively. Recent industry wide M&A transactions further suggest inherent value within the group with a 'sum of parts' valuation of around 35p.
- **Investment summary:** The shares offer the opportunity to invest in a cyclical stock with good operational leverage. The risk/reward profile is favourable, and the shares are compellingly valued on most methodologies.

Financial summary and valuation

Year end March (£m)	2016	2017	2018E	2019E
Sales	45.3	47.0	50.5	53.5
Gross profit	15.4	16.4	18.0	19.2
EBITDA	2.9	3.6	3.7	4.1
Underlying EBIT	2.4	3.1	3.2	3.6
Reported EBIT	-0.3	3.1	3.2	3.6
Underlying PTP	1.5	2.1	2.3	2.8
Underlying EPS (p)	1.7	2.1	2.1	2.3
Statutory EPS (p)	1.6	2.0	3.0	2.3
Net (debt)/cash	(14.3)	(13.6)	(10.6)	(9.7)
P/E (x)	7.9	6.3	6.5	6.0
EV/sales (x)	0.6	0.6	0.6	0.5
EV/EBITDA (x)	-	-	7.8	7.0

Source: Hardman & Co Research

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Executive summary

The 600 Group- world class reputation

Investment conclusion

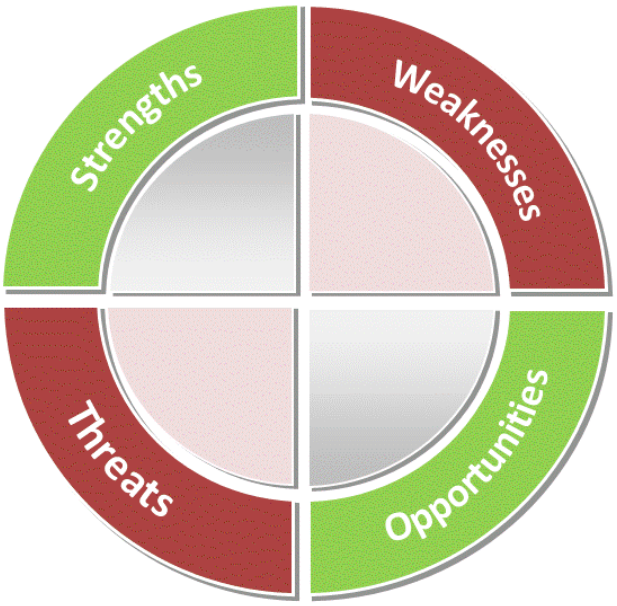
The 600 Group (the Group) is competitively well-positioned with a world class reputation in Machine Tools and Industrial Laser Systems. Business momentum is healthy with growth enhanced by new product launches and new market entry.

Strong competitive standing

Historically, the Group's share performance could have been classified as highly cyclical, but the company has taken significant steps to de-risk the business by focussing on increasing repeat/recurring business and the development of a high-margin, economically less sensitive, spare and services operation.

The risk/reward profile remains favourable and the shares are attractively valued both against its peer group, on a sum of parts methodology and on a DCF basis.

SWOT analysis



Strengths
- Diversified company with good competitive position
- Broad/branded product portfolio
- Good global product distribution
- Loyal customer base -high amount of repeat business
- Solid financial position- emphasis on working capital management, pension fund in surplus
- Experienced management

Weaknesses
- Conglomerate structure not relaseasing inherent business value
- Scale disadvantage vs larger competitors
- Operates in cyclical markets
- Debt level high although on declining trend
- No dividend policy currently in place

Threats
- Exposed to Taiwanese geopolitical developments
- Experienced, well resourced competition in market place
- Threat from lower performance products
- Brexit uncertainly for UK based operations

Opportunities
- Product development within existing markets
- Product extension into new geographies/high growth emerging markets
- New product development in laser markets
- Selected acquisitions/jvs in Industrial laser markets
- Dividend restoration

Source: Hardman & Co Research

Strategic Thrust

The Group has established itself since 1980 with focus on Machine Tools and laser marking with its current activities being operated by the group for over 25 years. We do not see any change overall in corporate structure in the medium term given that the combined operations offer a degree of counter-cyclicality to the group as a whole.

New product development, new market entry

Consequently, the group's strategic objective is to develop its individual businesses through delivering products/service against lead times and quality standards that meet or exceed the requirements of end-user customers.

The Group will continue to pursue an active approach to new product development and foster relationships with chosen supply chain partners. Furthermore, the group will undertake design-led cost reduction activities to maintain or improve its competitiveness,

The Group also intends to further develop its business interests by securing and retaining the right to be the producer of choice for distributors and a programme of carefully targeted strategic acquisitions, joint ventures, license agreements and partnerships especially in the high growth Industrial Laser Systems market

Fundamental prospects

Fundamental prospects encouraging for medium term

Growth is primarily driven by the global economy and the machine tool industry, with 75% of group sales ultimately derived from the US. Most investment commentators are suggesting the global economy will see synchronised growth across almost all developed and emerging markets especially China in the medium term.

Conditions in the US economy remain healthy, Federal Reserve monetary policies remain supportive for future growth with low interest rates. With respect to China we continue to assume health growth in the economy although the pace of growth could slow slightly.

Laser marking growth will be driven by the diversity and range of customer applications within a wide range of industries such as telecommunications and pharmaceuticals. Laser marking is a technologically superior alternative to inkjet marking since the operation requires no consumables and can operate on a continuous high-speed basis when integrated into customers' production lines.

Consequently, we believe the fundamental outlook for both the Machine Tools and Industrial Lasers Systems business is most encouraging for the medium term.

Cyclicality

Group cyclicality being de-risked

The group's businesses are considered as capital goods, which makes them part of an industry that has historically been highly cyclical. Management has reduced the cyclicality of the group's business through the development of repeat/recurring business and the development of the high margin spares and services business. The latter businesses currently represent around 15% of sales

Development of spares and services business

Certain parts on machines wear out, fail, or need to be replaced over time. Customers will buy parts throughout the life of the machine, which typically extends over many years. While customers may not purchase high cost machines during a down cycle, their factories are operating with their existing equipment and therefore accessories are still needed as they wear out or they are needed for a change in production requirements. Sales from these activities are expected to contribute 20% of group sales in the medium term.

Trading updates

Positive trading update from 600 Group

The Group's interim trading update continues to view prospects for improved performance.

"Market conditions have improved generally over the previous year and both our divisions have been able to increase revenues and have much improved order books. These factors give us greater confidence going into the second half of our financial

year and will be complemented by new product launches and an increasing focus on new sales activity in other geographical areas.

Whilst there remain a number of uncertain world events beyond our control which could affect our markets, the Board continues to believe that the process of leveraging our industry recognised brands such as Colchester, Harrison, Clausing, TYKMA and Electrox through new product developments and an increased worldwide distribution network will lead to continued revenue growth in the future."

Competitor Hardinge 9M trading update positive for Machine Tools

Hardinge Inc, a machine tools competitor based in the US, has similarly released a positive 9 month trading update recently (9/11/17)

…..we continue to expect 2017 will be a solid year, even as orders have varied considerably from quarter to quarter. For the nine-month period, orders were up 9% and we ended September with backlog remaining very strong at $135 million and, similar to the second quarter, at a level we have not seen in five years, supporting our expectation for the year." ……

Finances

Interims reflect improving operating environment

2017/18 interim results reflected the improving operating environment and were much as expected. Gross margins were 34.8%, EBITDA £1.5m and underlying EBIT at £1.27m with margins at 5%. Net debt stood at £12.1m on 30/09/17 compared with £13.7m at April 2017.

Our forecasts suggest 7-8% pa group sales growth over the medium term, led by the Industrial Laser business with growth at close to 10% p.a. Underlying EBIT should attain £3.7m with margins at 7%. Net debt is expected to decline to be around £10.6m at current year end and maintain the declining trend.

Pensions

Pension fund in surplus – options being considered

The group's pension fund, unlike that of many other UK corporates, is in a technical surplus on an actuarial valuation basis of £12.2m and on the balance sheet to the value of £46m. There continues to be no requirement for any cash funding from the company and various options for the scheme are being investigated. This includes a buy-out which could result in cash refund to the company. Any such refund would be used to pay down UK debt.

Dividends

Possible dividend restoration

The group has not paid a dividend since March 2004 as management believes that retention of earnings for deployment in the business is the most appropriate use of financial resources. However, if there is a cash refund to the group owing to the pension fund surplus, then, subsequent to reducing/paying off debt a restoration of the dividend or a special dividend payment is possible. We note that a cash outlay of around £0.4m per annum is required to give the stock a sector average yield of 2%,

Risks

Taiwan geopolitical risk specific to Group

There are a number of potential risks and uncertainties which could have a material impact on the group's performance- the global macro-economic environment, Taiwan geo-political issues and Brexit developments. Other risks include competition developments with the industry, foreign currency and raw material price fluctuations as well as specific market deterioration and production failures. (For a fuller description of risks see p39)

Technology developments

If the technologies or standards used in 600 Group products become obsolete or fail to gain widespread commercial acceptance, business would be materially adversely affected. Although we believe that the Group have the technological capabilities to remain competitive, developments by others may render some products or technologies obsolete or non-competitive

Risks being effectively mitigated

Overall, we are confident that management is taking appropriate action to mitigate these risks.

Valuation

Attractive valuation compared with peer group

The shares are attractively valued trading on calendar 2018 EV/sales, and EV/EBITDA ratios of 0.6 or 7.3 times respectively, compared with sector averages of 1.0 and 7.7 times respectively. The stock is trading on a prospective 2018 PE multiple of under 8 times, most attractive compared with that of the UK market.

Recent M & A transaction values suggest significant inherent value of businesses

Most recently and relevant to the Laser Systems business was Coherent's acquisition of Rofin-Sinar in 2016. At a value of $942m transaction multiples were around 1.8 times sales', over 10 times EBITDA and over 15 times EBIT.

In the Machine Tools Business area Hurco (US) recently acquired Milltronics for $13m and Takumi Machinery for $7m. We estimate that the transaction multiples were around 1.1 times sales', over 9 times EBITDA and over 10 times EBIT. Consequently, using similar multiples for valuing the two divisions within the Group suggest an inherent value of around 30p.

Hardinge, a leading Machine Tools, corporate, to be taken private at around 9 times EV/EBITDA

Furthermore, on November 2nd, 2017 Privet Fund Management proposed to acquire all the outstanding shares of Hardinge Inc at $17.25 per share. Based upon consensus 2018 forecasts for Hardinge, this transaction valued the group at over 0.8 times sales and around 9 times EBITDA

S-o- P valuation suggests around 30p/share valuation

Sum of Parts valuations- calendar 2018 basis

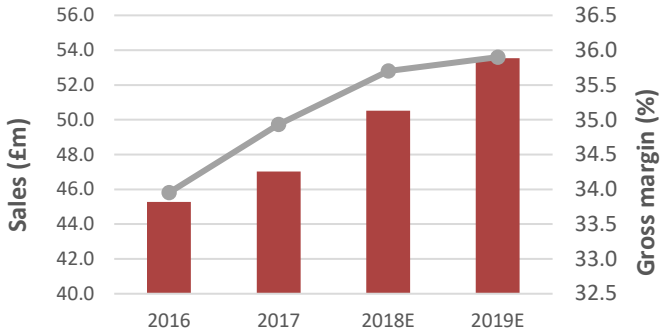
Methodology	Equity value per share (p)
EV/Sales	31.5
EV/EBITDA	36.2
Average	33.9

Source: Hardman & Co Research

DCF valuation suggests significant undervaluation

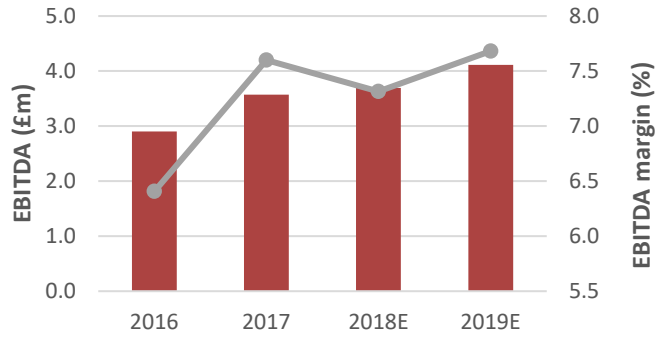
Our DCF valuation, using a WACC of 10% suggests that the shares are undervalued with a fair value estimated at over 30p.

Sales (£m) & Gross margin (%)



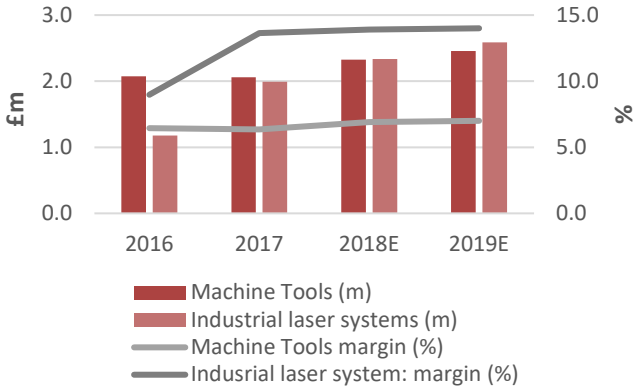
- Underlying sales are driven by the global economy and Machine Tools division, new product launches and new markets entered. We forecast 6-7% p.a. group sales growth over the medium term, led by the Industrial Laser business with growth at close to 10% p.a.
- Gross margins are currently around 35% in line with competitors- and are likely to remain close to this level, reflecting the launch of high margin products and continued operational improvements and cost reductions.

EBITDA (£m)/EBITDA margin (%)



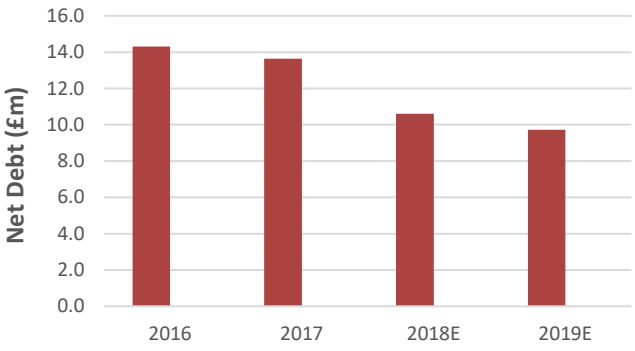
- Group achieved EBITDA of £3.6m in y/e April 2017 and is forecasted to attain a marginally higher level in the 2017/18 financial year with margins at over 7%
- Over the medium-term we expect EBITDA margins to remain at this level.

Divisional Operating income (£m) and margins (%)



- At year end 2016/17, group operating margins- after corporate costs- were 6.5%, with Machine Tools operating margins at 6.4% and the Laser Systems at 13%
- Over the medium term helped by new contract wins, group operating margins should improve to close to 9% with Machine Tools attaining 10% and Industrial Lasers Systems at mid-teen level of around 15%

Net debt position (£m)



- Group has a net debt position at 30 September 2017 of £12.1m (£13.7m at 31st March 2017.
- The group has benefitted in H1 2017/18 of a cash injection of £1.12m before expenses from the issue of 8.32m shares and £1.5m proceed from sales of stake in ProPhotonix.
- The Group will though remain in a net debt position but on a declining trend post 2017/18.

Source: Company data; Hardman & Co Research

Commercial opportunity- the key markets

Machine tools- forecast growth of 3% p.a.

Machine Tools- a $75bln industry

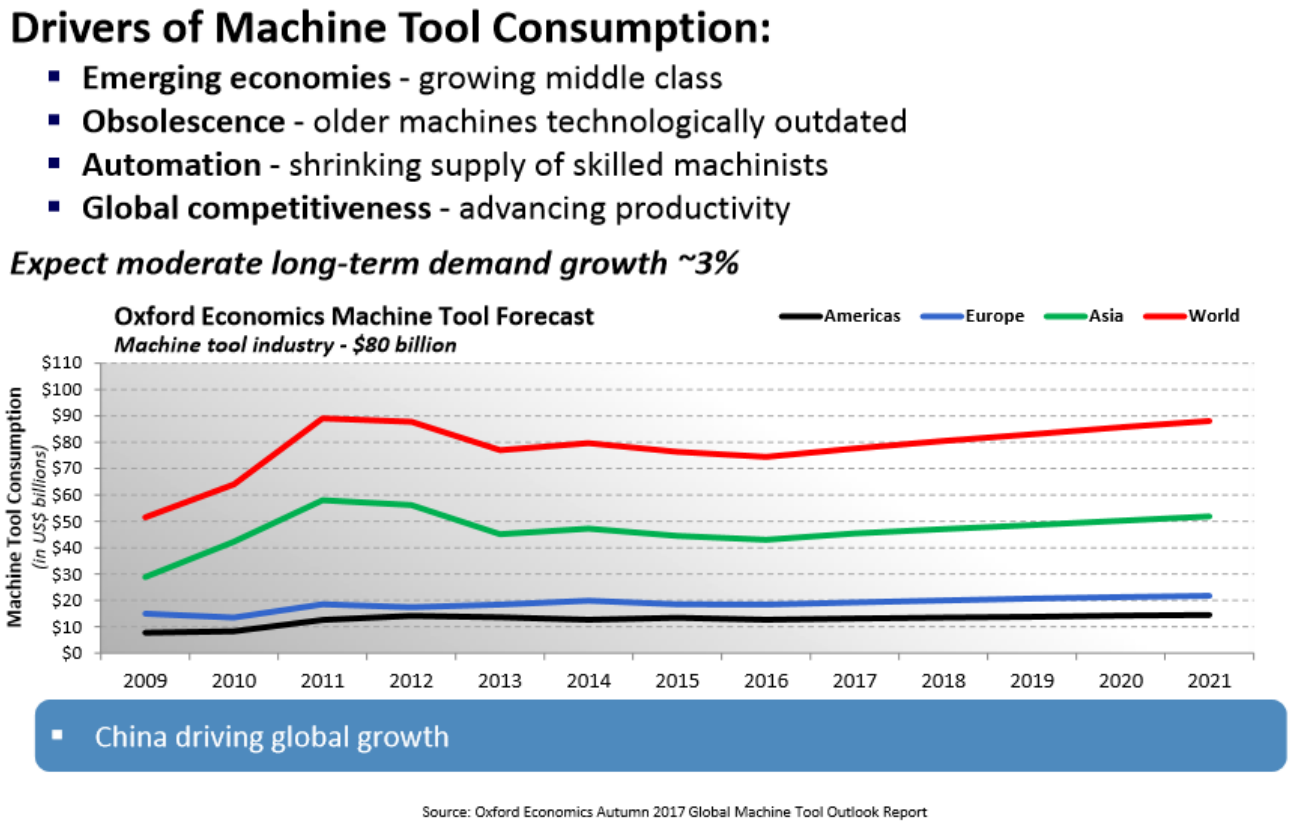
The worldwide machine tool industry was estimated by consultancy Oxford Economics at over $75bn in annual sales in its Spring 2017 report. The market is driven by the investment intentions of manufacturers, and is sensitive to changes in the economic and financial climate. Demand responds to economic trends and typically lags the main cycle of the economy.

Growth is primarily driven by the global economy.

Growth is primarily driven by the global economy. Most investment commentators are suggesting the global economy will see synchronised growth across almost all developed and emerging markets in the medium term. Conditions in the US economy remain healthy. Central bank monetary policies remain supportive for future growth with low interest rates and ongoing quantitative easing programmes.

With respect to China, following China's Communist Party 19th National Congress this Autumn, Xi Jinping is likely to continue with economic reforms. We continue to assume healthy growth in the economy although the pace of growth could slow slightly from current levels

Drivers of World Machine Tool Consumption 2015-22(E)



Source: Oxford Economics

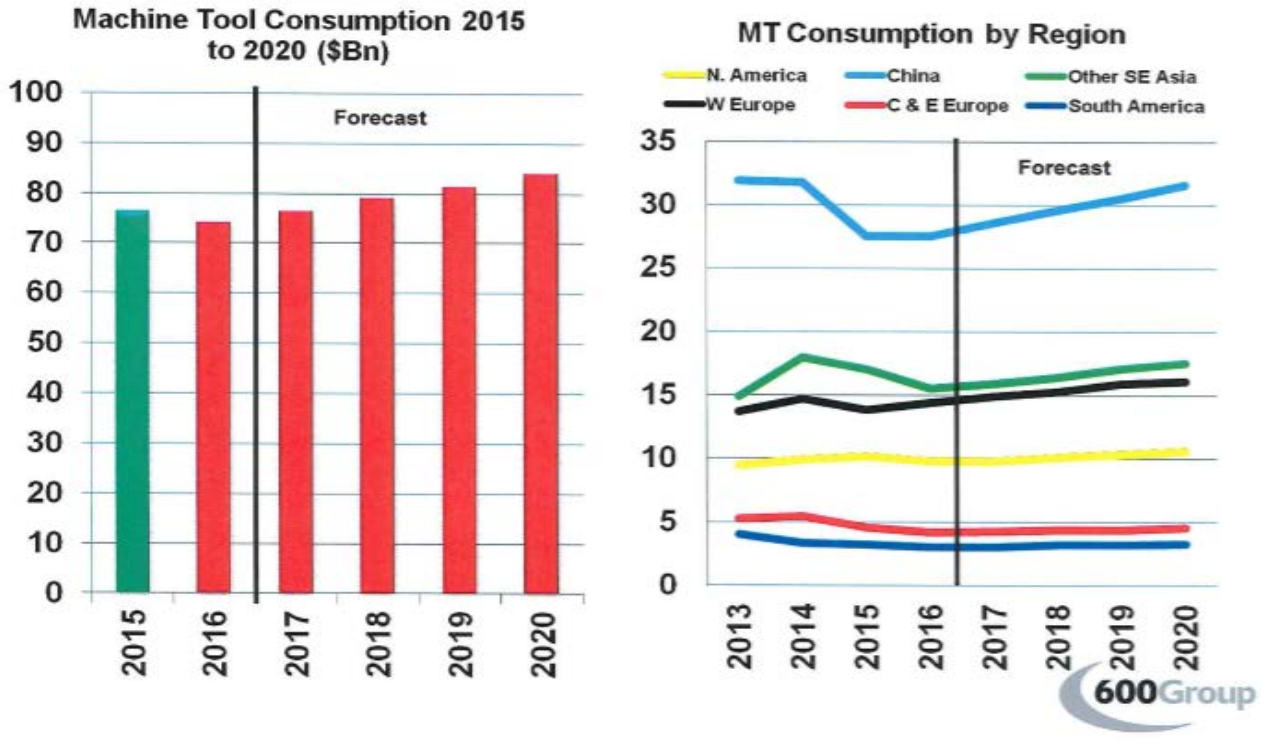
Growth forecasted at around 4% p.a over the medium term

According to leading Consultants, the global market for Machine Tools is projected to grow to over US$110 billion by 2024, driven by the steady recovery in global Purchasing Managers Index; technology advancements and development of Machine Tools with robot-based automation features; and development of flexible Machine Tools that offer unprecedented versatility and productivity. The growth in the market is supported by the fact that manufacturing continues to exert a strong hold on the economic growth of both developed and developing nations alike. The scenario is nurturing the importance of capital good innovation, a fact that bodes well for the market both in terms of product innovation and consumer equipment replacements and upgrades.

Industry diversifying as Asia becomes the leader

Asia-Pacific represents the largest and fastest growing market worldwide led by the rapidly growing manufacturing and industrial activity in China, India, Thailand, Malaysia, Taiwan, and South Korea. Government initiatives such as development of Special Economic Zones, industrial corridors, clusters, fabricated cities and parks and provision of subsidies and tax cuts to manufacturing groups are also fuelling growth in the industrial sector in the region. Improvements in road, rail and marine infrastructure and trade related benefits such as reduction in import duties on raw materials and special export related incentives on finished good, machinery and equipment, represent other factors spurring growth in the region.

World Machine Tool Consumption 2015-20



Source: Oxford Economics, Hardman & Co Research

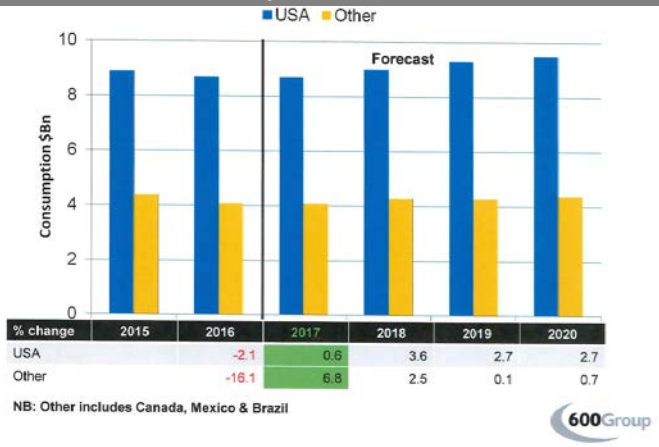
China the leader

China is becoming both a leader in the production of machinery and also its consumption. CNC (computer numerically controlled) lathe manufacturer, Dalian now has 640 different machine tool products on offer. Despite the growth of homegrown machine tool operators, in 2016 the country imported close $20bn worth of Machine Tools. India is now also among the most important machinery producers. India's machine tool manufacturing sector is expected to grow 13% for the 2016-2020 period. Japan has historically held the position of leader in the Asian machine tool market, owing to important manufacturers like Amada, Makino, Okuma, Mazak, and DMG Mori.

Europe still holds leading place but growth in East Europe

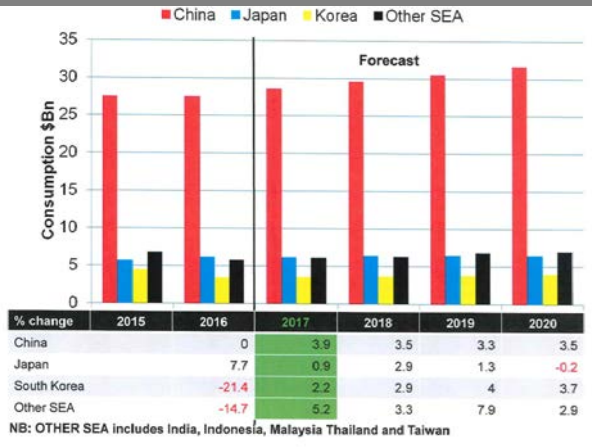
Europe has long held the historical position as leader in the Machine Tools industry, due to Germany, Austria, the UK, France and Italy. But Central and Eastern Europe are now some of the most important growth in the market. Poland has increased its Machine Tools consumption by 13%, Romania by 23.1%, Slovakia by 23% and Hungary by 24% over the last three years.

. Machine Tool Consumption- Americas and Asia



% change	2015	2016	2017	2018	2019	2020
USA		-2.1	0.6	3.6	2.7	2.7
Other		-16.1	6.8	2.5	0.1	0.7

NB: Other includes Canada, Mexico & Brazil



% change	2015	2016	2017	2018	2019	2020
China		0	3.9	3.5	3.3	3.5
Japan		7.7	0.9	2.9	1.3	-0.2
South Korea		-21.4	2.2	2.9	4	3.7
Other SEA		-14.7	5.2	3.3	7.9	2.9

NB: OTHER SEA includes India, Indonesia, Malaysia Thailand and Taiwan

Source: Oxford Economics, Hardman & Co Research

Online market places

Machine tool market growth is also serviced by the increased use of online marketplaces, such as Exapro, that allows buyers to have access to thousands of machines with only a few clicks. Regulations and laws have also become more flexible, especially in Europe, which make deals easier and faster.

Demand driven by advances in industrial technology

Specifically, demand for machine tool products is driven by advances in industrial technology and the related demand for automated process improvements as well as such factors as production capacity utilization and changes in governmental policies regarding tariffs, corporate taxation, fluctuations in foreign currencies, and other investment incentives. Other factors affecting demand include: the need to continuously improve productivity and shorten cycle time; an aging machine tool installed base which will require replacement with more advanced technology; and the declining supply of skilled machinists.

The machine tool industry is subject to technological change, evolving industry standards, changing customer requirements, and improvements in and expansion of product offerings. The ability to anticipate changes in technology, industry standards, customers' requirements and competitors' product offerings and to develop and introduce new and enhanced products on a timely basis that are accepted in the market, are significant factors in maintaining and growth prospects.

Growth forecasted at around 3% p.a over the medium term

The Machine Tool Industry Outlook

	2016 $bn	2017 % chng	2018 % chng	2019 % chng	2020 % chng
China	27.7	5.6	3.5	3.5	3.7
Japan	6.2	5.3	3.4	0.8	-0.3
Taiwan	1.5	5.0	5.7	4.3	3.7
Other	7.1	n.a	n.a	n.a	n.a
Total Asia	**42.5**	**5.7**	**3.5**	**3.4**	**3.4**
US	8.7	3.0	3.1	2.6	2.7
Americas	12.7	1.4	2.9	3.0	3.0
Germany	6.6	-3.1	4.3	3.9	2.8
UK	0.7	6.6	-3.1	1.5	3.7
Other Europe	11.1	n.a	n.a	n.a	n.a
Europe	**18.4**	**2.6**	**4.1**	**3.3**	**2.7**
Total World	**73.6**	**4.5**	**3.6**	**3.3**	**3.2**

Source: Oxford Economics ,Hardman & Co Research

Current trading- US and Australia strong, UK relatively weak

In terms of current trading, revenues in the North American business grew strongly at 6% as did those in Australia up 11%. Quotation activity has remained good and all businesses are reporting stronger order books, with the division as a whole 70% up on the order books at the same time last year.

Order books up 45%

Product development has continued with work on a US built lathe and the recent launch at EMO in Hannover of the Clausing CNC MillPWR. The introduction of the Clausing product range of saws, drills, mills and grinders into the UK, and European markets is proving successful and remains a growing part of the product portfolio.

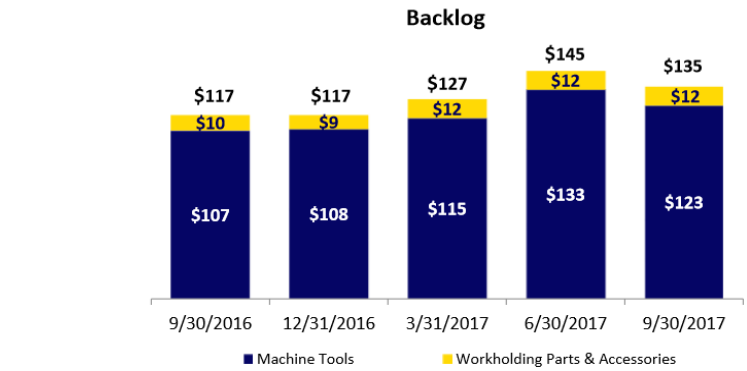
Competitor Hardinge 9M trading update positive for Machine Tools

Machine Tools competitor, Hardinge Inc, based in the US, has similarly released a positive 9 month trading update recently (9/11/17)

.....we continue to expect 2017 will be a solid year, even as orders have varied considerably from quarter to quarter. For the nine-month period, orders were up 9% and we ended September with backlog remaining very strong at $135 million and, similar to the second quarter, at a level we have not seen in five years, supporting our expectation for the year." ……

Machine Tool competitor Hardinge 2017 9m Backlog

($ in millions)



- Strong backlog supports expectations for solid 2017

Source:Hardinge Inc, Hardman & Co Research

Machine Tools- 2018 sales growth forecast to be around 4% per annum, margins at 7% with a medium-term target of 10%

Sales and profitability; Machine Tools division (£m)

Year end March (£m)	2016	2017	2018e	2019E
Sales	32.1	32.4	33.7	35.1
Growth (%)	-7.6	0.9	4.0	4.0
Operating Income	2.1	2.1	2.3	2.5
Margin (%)	6.5	6.4	6.9	7.0

Source: Hardman & Co Research

The laser products industry

Industrial Laser Systems

Market drivers- regulation/traceability, environmental and durability and cost

The laser products industry is highly globalised and fragmented with generally low barriers to entry. The industry has historically tracked that of the machine tool industry until around the end of the 2008/09 recession when hidden demand for high power lasers and high-volume smart phone component manufacturing led to premium growth. Recently Industrial Lasers have outperformed the machine tool sector, with solid single-digit growth driven by regulation/traceability, environmental, durability and factors.

Industry use of Industrial Lasers for material processing has continued to expand worldwide. Laser systems have now become a mainstream manufacturing process covering the areas of laser machining, including cutting and drilling, marking, ablation and a host of other niche applications.

Marking sub sector to grow at 5% per annum

The laser market can be categorised into three segments- marking (16%), micro-processing (40%) and macro-processing (44%). According to Industrial Laser Solutions, leading market consultants, the global Industrial Laser market is reported to be around $2.1bn and growing at around 5% per annum to reach USD 3.38 billion by 2024

Laser marking has always been an important factor in industrial activities, especially in automobiles and Machine Tools as they provide permanent alphanumerical details on the product in terms of brand name, batch number and other details.

Laser marking is a technologically superior alternative to inkjet marking as it requires no consumables and can operate on a continuous high-speed basis when integrated into customers' production lines.

Growth will be driven by increasing adoption of laser systems in various industries such as automobile, packaging and Machine Tools. The absence of substitute technologies is expected to provide an impetus to the growth of the market over the next few years

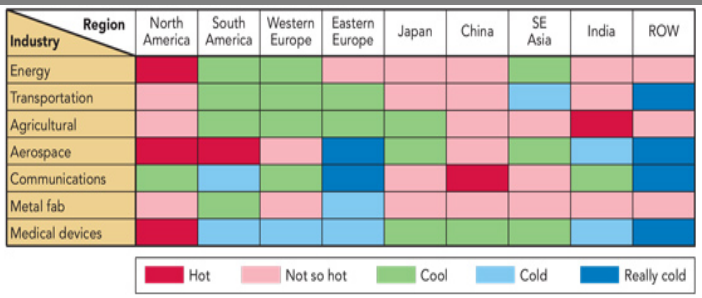
Asia Pacific to lead growth

From a geographic perspective, Asia Pacific dominated the global market accounting for just over 40% of the revenue share in 2016. The presence of a large manufacturing base in countries such as India, China, and Japan has resulted in the growth of the industry in the region over the past few years. Upcoming industries in economies such as Thailand, Indonesia, and Malaysia are expected to provide an impetus to the growth of the market.

Asia Pacific boasts of one of the largest machine tool industry which is expected to drive the market at a CAGR of around 8%p.a. The growth of the automobile, packaging, and electronics manufacturing in emerging economies including China and India is expected to drive the regional market over the projected period.

North America represents around 23% of the global market and is expected to witness above average growth owing to the increasing adaptation of permanent marks instead of barcode stickers. For instance, the U.S. government mandated the use of permanent 2D bar code imprint on all contractor manufactured products.

Laser marking opportunities by geography and industry



Source: Industrial Laser Solutions, Hardman & Co Research

Machine tool market segment to grow at over 7%

In 2016, the machine tool industry the largest application segment of the market representing around 31% of the overall market and is expected to grow at a relatively high rate, registering a CAGR of 7.2% from 2017 to 2024. The presence of regulations for engraving on manufactured products for labelling, identifying and security purposes is expected to drive the growth of the segment over the next few years.

Government regulations for permanent marking as traceability are being implemented. For instance, the U.S. Department of Defense has MIL-STD-130 standard practice for identification marking of U.S. military property. Moreover, the FDA has implemented regulations to establish marking of unique device identification system for medical devices, where labelling is not sufficient.

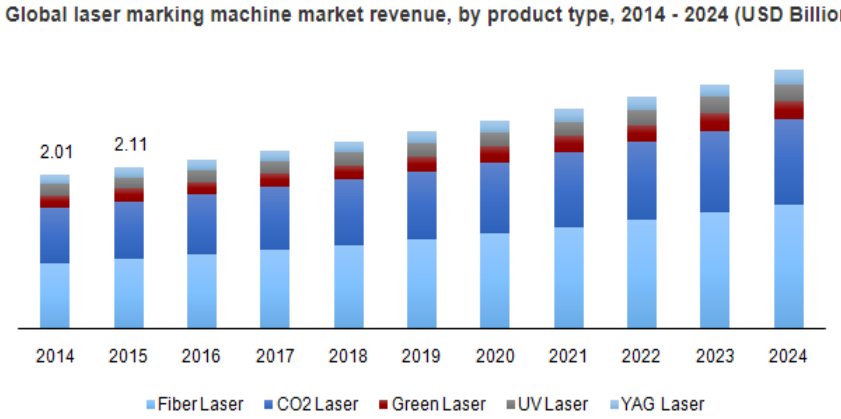
Packaging segment- another growth area

The packaging segment is estimated to generate revenues worth USD 286.0 million by 2024. Laser marking machine is a perfect tool for imprinting products commonly used in packaging industry such as cardboards, paper and polymers. It is a contact free operation and carried out without any mechanical stress. Consumer package made of metals and plastics are marked with identification marking for the recovery of packaging waste.

Fiber lasers latest/best technology

From a product type perspective, the fiber laser marking machine market is expected to witness the fastest growth at between 6-7% per annum owing to its benefits such as high flexibility, easy integration in production lines, and application specific configuration within the plastic and automotive industry. Moreover, it is used for both commercial as well as industrial purposes.

The global laser marking machine market



Source: Industrial Laser Solutions, Hardman & Co Research

In the current laser marking systems, fiber lasers are the latest and best technology- in terms of reliability and marking capability- being implemented. Other positive aspects include: -highest beam quality, air cooled with high ambient air temperature operating capabilities, high efficiency with low power consumption, longest diode life (Up to 100,000 hours), extended warranties over other technologies, high peak power and long pulse durations are good for high speed aggressive marking and deep engraving applications and easy to integrate and service.

TYKMA offers MOPA based fiber lasers in all of their standard products

Fiber lasers are typically available in two different configurations - Q-Switched or MOPA. Q-Switched fiber lasers are reliable and powerful, but have less flexibility compared to MOPA. TYKMA Electrox offers predominantly MOPA based fiber lasers in their standard products but with flexibility depending upon application

Whilst relatively low, laser marking growth is supported by enhanced performance in the speed, cost and quality of the systems being implemented compared to other techniques as well as by legislative changes driving a requirement for greater traceability.

Industrial Lasers systems/Laser marking

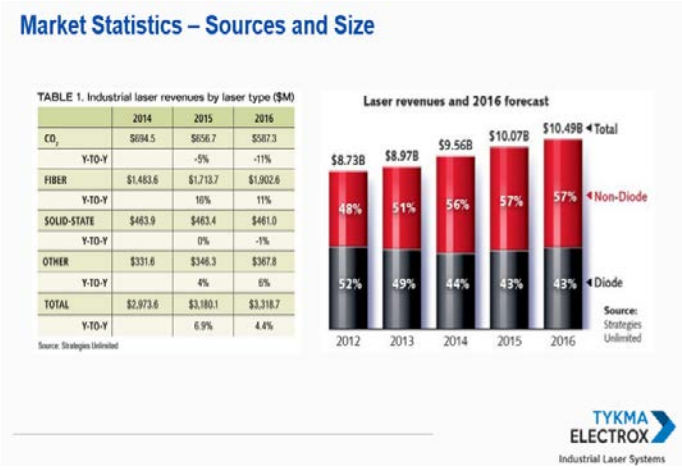


TABLE 3. Lasers for marking/engraving ($M)

	2014	2015	2016
CO_2	$45.9	$42.9	$41.2
Y-TO-Y		-6%	-4%
SOLID-STATE	$50.7	$50.2	$50.6
Y-TO-Y		-1%	1%
FIBER	$392.0	$416.3	$435.0
Y-TO-Y		6%	5%
DIODE	$55.9	$59.2	$64.0
Y-TO-Y		6%	8%
TOTAL	$544.5	$568.6	$590.8
Y-TO-Y		4.4%	3.9%

Source: Strategies Unlimited

Source: Industrial Laser Solutions, Hardman & Co Research

Current trading strong with 20% top line growth

Divisional top line growth has been strong during H1 2017/18, up 17% on the same period last year. The consolidation of manufacturing onto one site and revision of the supply chain during the previous year has ensured margins remain acceptable.

Order books up 18%

Quotation activity remains strong and the order book is up 18% on the same time last year. New products launched last year have become significant contributors to this businesses success and further new product developments are being launched over the coming months. Progress is also being made in export areas in Asia Pacific.

Sales and profitability; Industrial Laser division(£m)

Year end March (£m)	2016	2017	2018E	2019E
Sales	13.1	14.6	16.8	18.5
Growth (%)	42.5	11.2	15.0	10.0
Operating Income	1.2	2.0	2.3	2.6
Margin (%)	9.0	13.6	13.9	14.0

Source: Hardman & Co Research

Industrial Lasers to see top line growth at 10% p.a. with margins at 15%

The group should continue to see double-digit sales increases. TYKMA Electrox should benefit from the ongoing twin drivers of ink replacement and the need to provide parts traceability and a manufacturing audit trail for many products. In addition, TYKMA Electrox continues to develop new products and existing product line extensions.

A diversified industrial engineering company

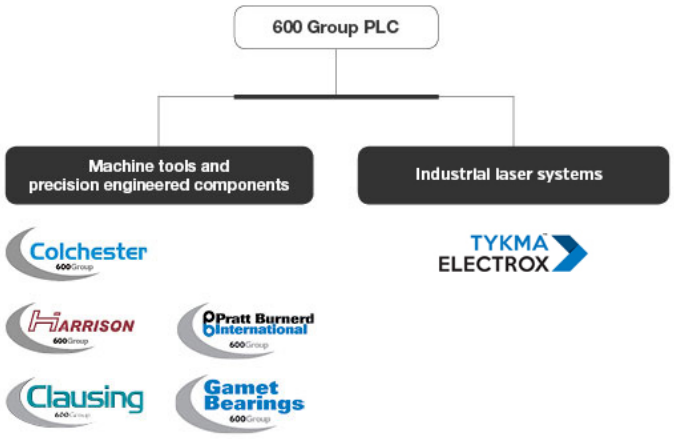
Two Divisions; three areas of activity

600 Group is a diversified industrial engineering company operating in two divisions with three principal areas of activity: Machine Tools currently represents around 69% of turnover and 49% of operating profit with two areas of activity- Machine Tools and Precision engineered components. Industrial Lasers systems represent 31% of turnover and 51% of operating profits. The US currently represents 64% of turnover by destination, the UK 15% and Europe 12%.

Strong brands, reliable distribution, experienced management team

In each of these activities, Group businesses have strong products and brands, significant market share, diverse geographical spread, efficient manufacturing and supply chains, and reliable distribution partner with highly experienced management leadership and teams.

600 Group structure

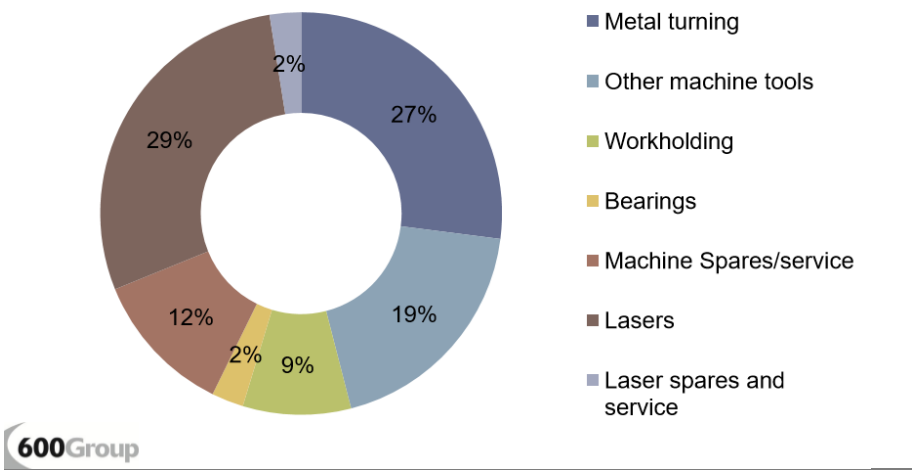


Source: 600 Group, Hardman & Co Research

Serving a wide range of industry sectors with broad product range

Group businesses offer a broad product range and serve customers across a wide range of industry sectors, from niche markets for technical education of young engineering apprentices through to high volume production of automotive, aerospace and defence equipment.

Group revenues by product range

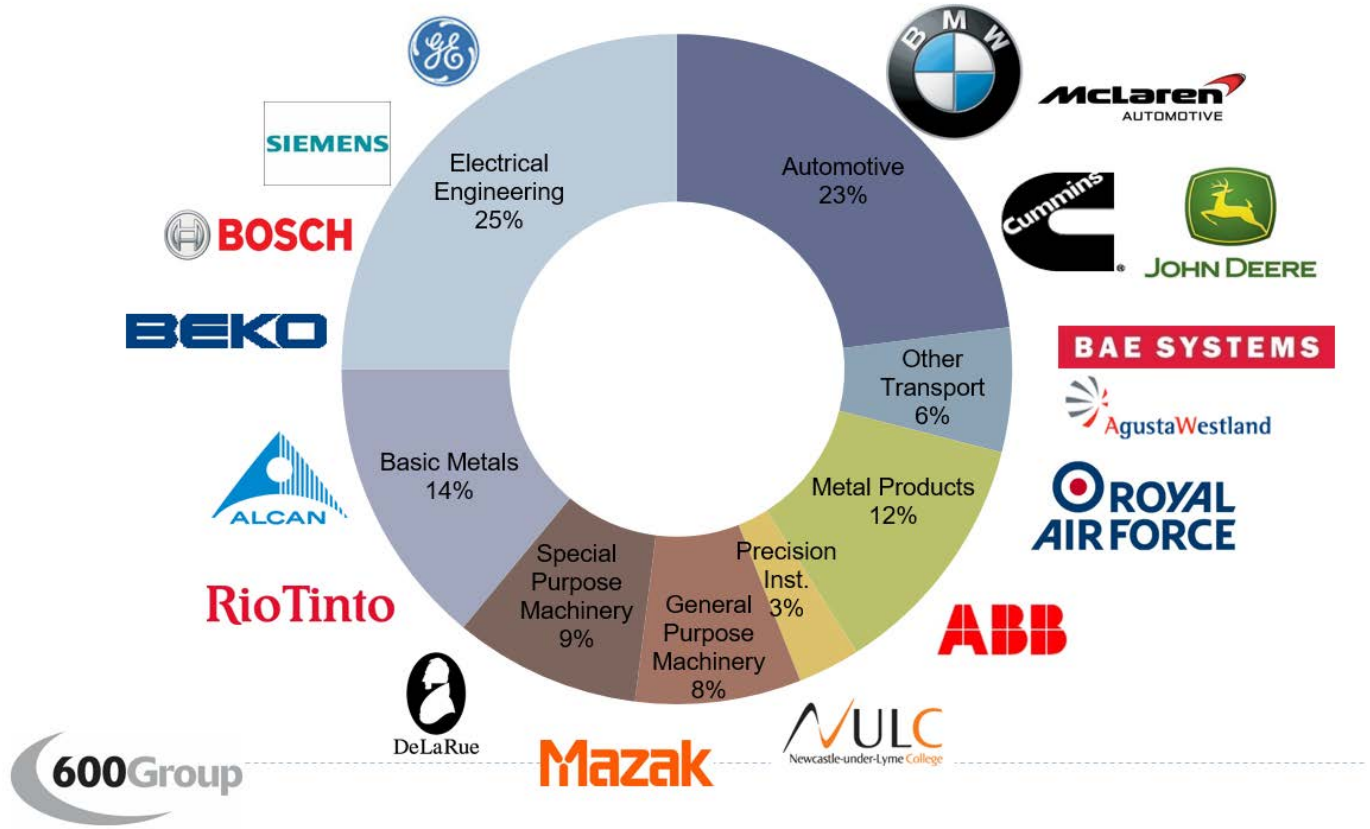


Source: 600 Group, Hardman & Co Research

High recurring revenues business

The Group benefits from a high degree of loyalty and repeat/recurring business via the large number of established distributors in many countries and territories. There is no major concentration and in the year ended 1 April 2017 the top 20 customers, of which 17 were distributors, contributed less than 26% of revenues

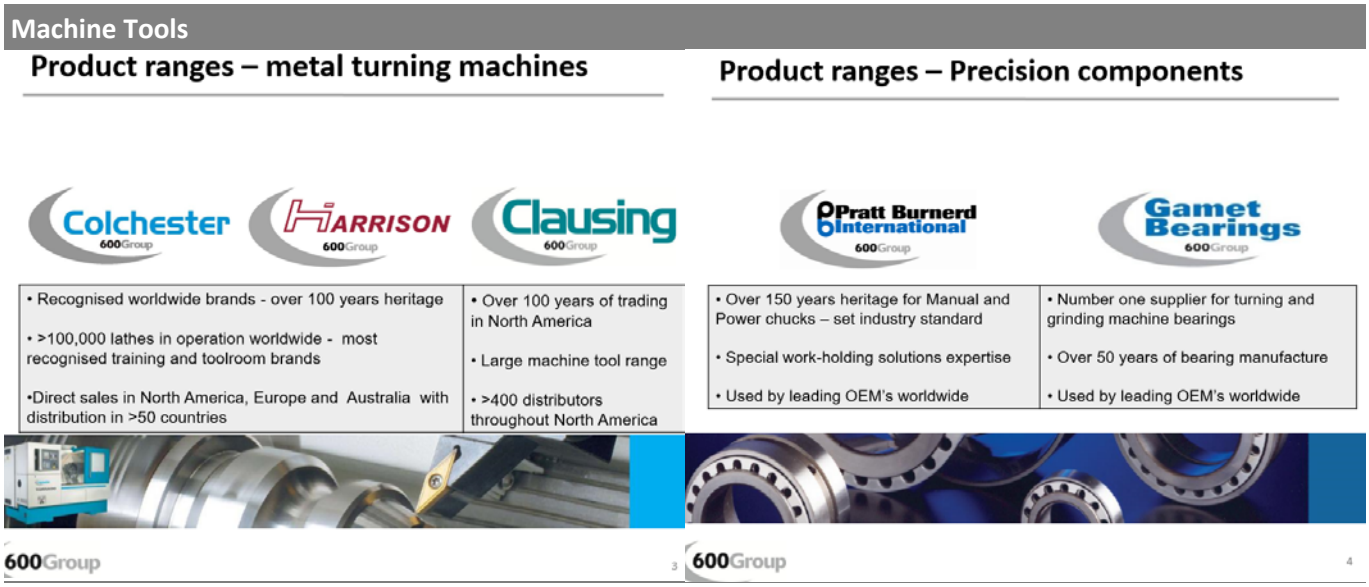
World class end-users



Source: 600 Group, Hardman & Co Research

Machine Tools

The Machine Tools division designs and develops metal processing Machine Tools sold under the brand names Colchester, Harrison and Clausing. The Group also designs and manufactures precision engineering components under the brand names Pratt Burnerd and Gamet. There are also spares, accessories and service operations which support the significant number of machines sold over the Group's long history of supplying quality equipment.



Source: Industry, Hardman & Co Research

Global Operations

The division operates from Heckmondwike and Colchester in the UK, Kalamazoo Michigan in the USA, and Sydney and Brisbane in Australia. Sales are made worldwide, with direct sales operations and distribution in North America, Europe, and Australia together with a network of distributors in other key end-user markets.

Excellent market reputation

The business has a strong reputation in the market for metal turning machines. Products range from small conventional machines for education markets, CNC workshop machines and CNC production machines. The manufacturing footprint is supported by selected outsourcing partners and machines are marketed through the group's wholly owned international sales organisation.

The Clausing product range of drills, mills, saws and grinders, which were introduced into the product portfolio 2015, are now a regular feature of the range of products supplied in the UK and Europe. Additional launches of new products are planned which will further enhance the product range and widen the appeal to customers and distributors. Furthermore, the Clausing range of products has been one of the key reasons behind the growth in the North American operations in recent years and represents around 40% of their product sales compared to a figure of just 5% for the UK and European operation.

Precision Engineered Components - machine spares are distributed to customers globally to help maintain the installed base of group machines which number in excess of 100,000. Additionally, work holding products and taper roller bearings are sold via specialist distributors to OEMs, including other machine builders.

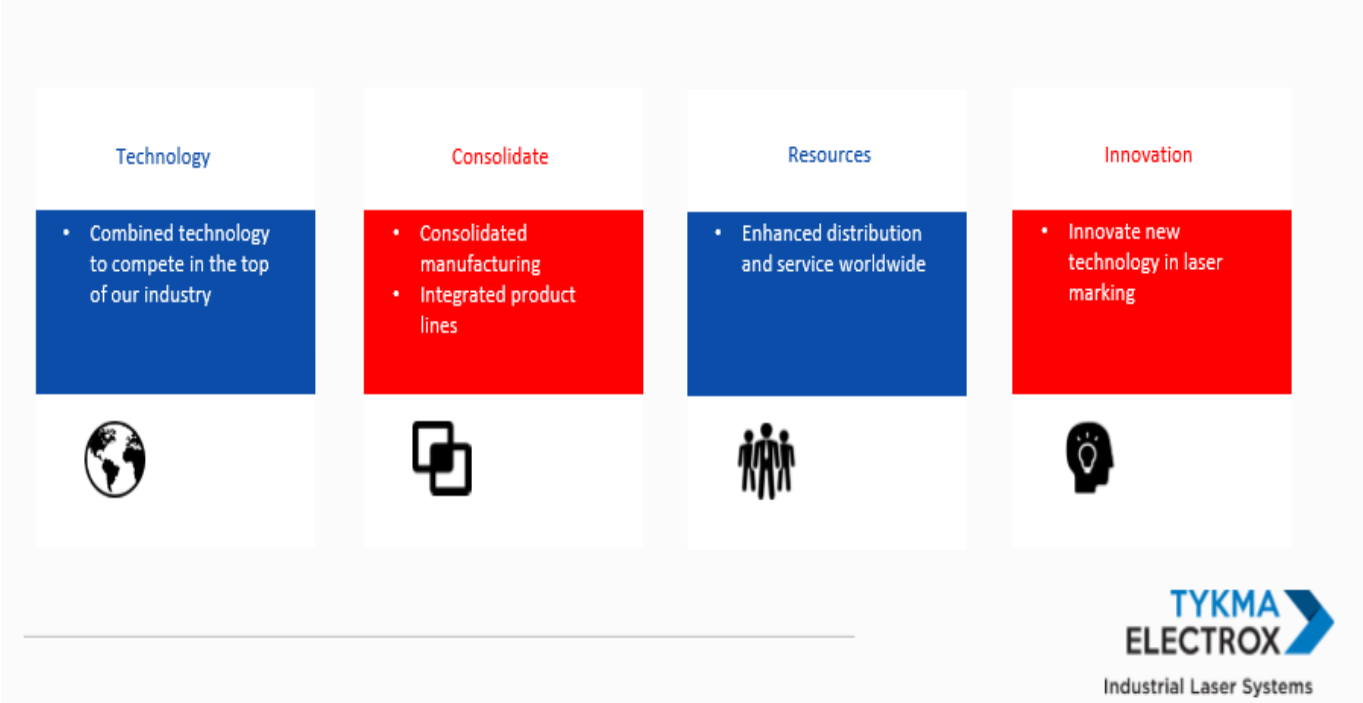
Industrial Laser Systems:

Industrial Laser Systems: The Industrial Laser Systems business operates worldwide under the TYKMA Electrox brand. The integration of the combined US and UK TYKMA Electrox operations was completed in early FY17 and all manufacturing operations are now consolidated in the Chillicothe, Ohio USA facility.

Integration of US and UK operations gives greater marketing presence and economies of scale

This consolidation gives the groups greater markets presence and economies of scale with the business having its own technology and proprietary software. TYKMA Electrox business now has worldwide credibility and has secured repeat orders from several multi-national corporations.

Industrial Lasers systems TYKMA Electrox



Source: 600 Group, Hardman & Co Research

The Industrial Laser Systems division currently accounts for 59% of the Group underlying operating profits (before special items and head office costs).

Proprietary technology and software

Industrial Laser Systems are technologically superior to ink jet marking as they require no consumables and can operate on a continuous high-speed basis when integrated into customers' production lines

The Industrial Laser Systems are sold for a variety of applications to provide solutions which include marking, engraving and micro-material processing. Sales are made to an extensive range of industries and increasingly to large multi-national corporate customers. The requirement for increased product and component traceability is one of the market drivers. Each end user or distributor is free to choose among-brands which combined creates an enhanced product portfolio for solving a larger number of applications.

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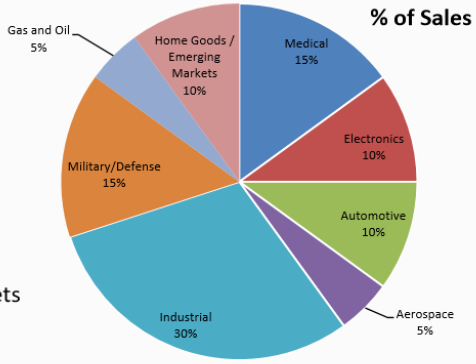
Industrial Lasers systems- markets served

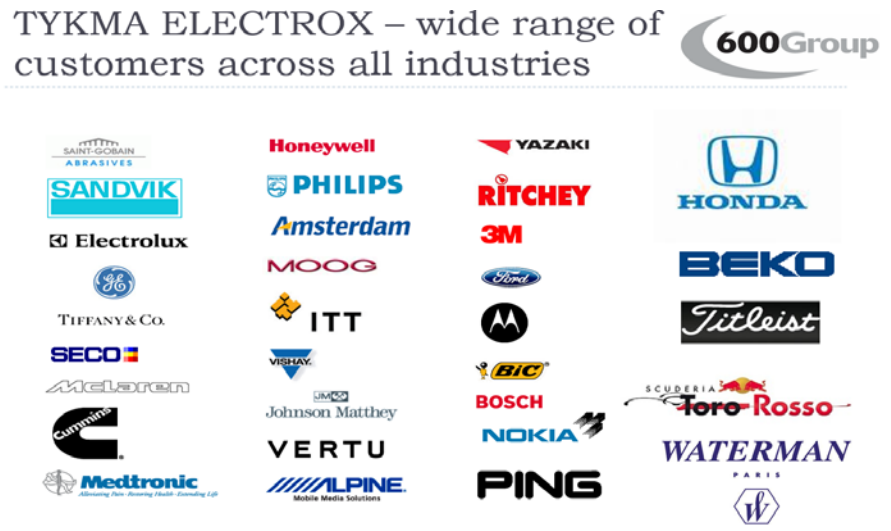
- Medical
- Electronics
- Automotive
- Aerospace
- Industrial
- Military / Defense
- Gas & Oil
- Home Goods/ Emerging Markets

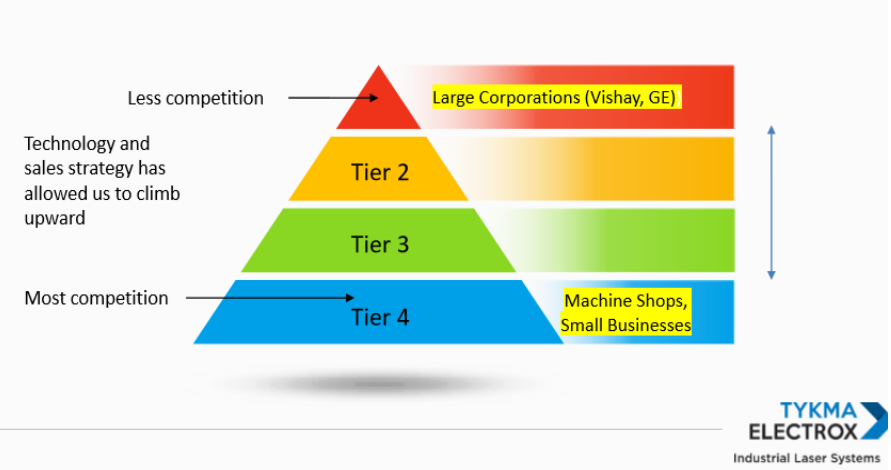


TYKMA ELECTROX Industrial Laser Systems

Source: 600 Group, Hardman & Co Research

Industrial Lasers systems- Customer base





TYKMA ELECTROX Industrial Laser Systems

Source: 600 Group, Hardman & Co Research

Competitive strategy

New product development, new market entry

The Group's strategic objective is to develop its individual businesses through delivering products/service against lead times and quality standards that meet or exceed the requirements of end-user customers.

The Group will continue to pursue an active approach to new product development and foster lasting relationships with chosen supply chain partners. Furthermore, the group will undertake design-led cost reduction activity to maintain or improve its competitiveness,

The Group also intends to further develop its business interests by securing and retaining the right to be the producer of choice for distributors and a programme of carefully targeted strategic acquisitions, joint ventures, license agreements and partnerships especially in the high growth Industrial Laser Systems market

600 Group offer products in a range of prices and capabilities to target a broad potential market. The Group's competitiveness is aided by its reputation for reliability and quality, its strong international sales and distribution organisation, and its extensive customer service organisation

Machine Tools- Strong growth in Europe

For the Machine Tools business, the strategy is to design, manufacture and sell a comprehensive line of Machine Tools that help customers in the worldwide metal cutting market increase productivity and profitability.

The majority of the Group's Machine Tools employ proprietary, interactive, computer control technology that increases productivity through ease of operation via interactive programming software. 600 Group's Machine Tools deliver high levels of machine performance (speed, accuracy and surface finish quality) that increases productivity.

The business routinely expands product offerings to meet customer needs, which has led to design and manufacture more complex machining centres with advanced capabilities. The Group offers a disciplined approach to strategically enter new geographic markets, as appropriate.

The principal strategic medium term objective is to grow UK & European proportion of "other Machine Tools" to the same level as that in the USA.

The Machine Tools Business

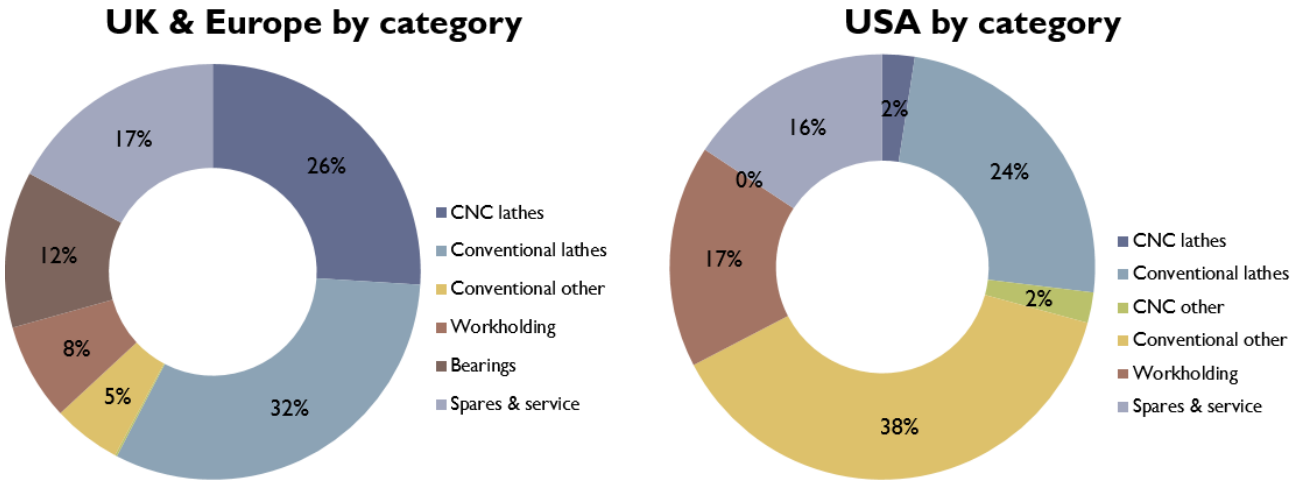
Source: 600 Group, Hardman & Co Research

New product launches are expected to occur in the near term, including more US-produced machines and an increased sales effort in Mexico and Canada. Further product launches are also expected in the UK, building on the addition of the Clausing range introduced in the UK at the end of last year.

Clausing product range expansion in UK and Europe

We see good upside to adding the Clausing range to the UK product range, which contributes 40% of US sales, whereas it currently contributes just 5% of UK and EU sales.

Machine Tools- product lines by geography



Source: 600 Group, Hardman & Co Research

Industrial Lasers- focus on organic growth

For the Industrial Laser business, TYKMA Electrox principal medium term strategic objectives include the focus on organic growth in existing global markets and to continue to develop its customer base with global footprints and from Tier 4 to Tier 1 markets with new technologies. Furthermore the Group is looking to Develop Asia into the second largest contributing market through distributor expansion and market development

Targeted acquisitions

TYKMA Electrox intends to further develop its business interests by a programme of carefully targeted strategic acquisitions particularly in the Industrial Lasers business area.

R&D Program

TYKMA Electrox has an extensive product development program. The group are currently assessing over 25 opportunities for either new products or improvements to existing products. Some key initiatives released recently are in the areas of expanded capability for 3D material processing and large field lasers for diverse applications

Financials

Comparables

600 Group financials compare well

The UK industrial engineering sector is highly heterogenous with little commonality between the various businesses of the corporates. Consequently, financial comparisons between the companies are not directly comparable but 600 Group does standout relatively favourably on many measures compared with some of its sector peers.

Financial comparables

Company name	Gross Profit Margin (%)	EBITDA Margin (%)	Operating Profit Margin (%)	ROE Common Equity (%)	Return On Capital Employed (%)
600 Group PLC	34.9%	7.1%	6.2%	4.5%	4.1%
Avingtrans PLC	17.9%	1.5%	-2.1%	-0.4%	3.9%
Molins PLC	26.5%	4.0%	-1.7%	-3.1%	n.av
Hardringe Inc	33.4%	6.3%	1.2%	3.8%	n.av

Source: Hardman & Co Research

Interims

Recent interims -underlying results much as expected

Recent interims reflected the challenging but improving operating environment. Gross margins were 35% with EBITDA at £1.5m. Underlying operating profit was up to £1.2m with margin at 6% and underlying PBT stood at £0.8m. Reported PBT was £2.1m. Net debt stood at £12.1m on 30/08/2017, compared with £13.9m at 31/03/17.

Reported results were affected by special items including share option costs, amortisation of loan note expenses, and pension credit interest on the pension scheme surplus as well a large credit from the sale of the Group's holding in ProPhotonix (£1.5m in realisation and £1m in profit).

The Group's pension fund, unlike that of other UK corporates, is in surplus, on an accounting basis to the value of £46m and at £12.2m on a technical actuarial basis. There continues to be no requirement for any cash funding from the company and various options for the scheme are being investigated. This includes a buy-out which could result in cash refund to the company.

Forecasts

We forecast sales and margin development for each business segment according to estimated development for sales, cost of sales and SG&A costs. The Machine Tools business is likely to see annual sales' growth of between 3-5% and the Industrial Lasers business to see medium-term top-line growth of close to 10%. with margins in Machine Tools expanding from 6.4% to 7.0% and those in Industrial Lasers attaining close to 15%.

Sales and profitability by division (£m)-Machine Tools

Year end March (£m)	2016	2017	2018E	2019E
Sales	32.1	32.4	33.7	35.1
Growth (%)	-7.6	0.9	4.0	4.0
Operating Income	2.1	2.1	2.3	2.5
Margin (%)	6.5	6.4	6.9	7.0

Source: Hardman & Co Research

Sales and profitability by division (£m)- Industrial Lasers				
Year end March (£m)	**2016**	**2017**	**2018E**	**2019E**
Sales	13.1	14.6	16.8	18.5
Growth (%)	42.5	11.2	15.0	10.0
Operating Income	1.2	2.0	2.3	2.6
Margin (%)	9.0	13.6	13.9	14.0

Source: Hardman & Co Research

2017/18 EBIT at £3.2m

We forecast underlying group EBIT improving from £3.1m in 2016/17 to over £3.2m in 2017/18 and £3.7m in 2018/19 with EBIT margins at around 6.5%.

Profit & Loss

Gross margin maintained, EBITDA margins around 7.5%

- **Forecast sales:** The Machine Tools business is likely to see annual sales' growth of between 3-5% and the Industrial Lasers business to see top-line growth of at least 10% p.a. over the medium term.
- **Gross margin:** Currently 35%- and being maintained, reflecting higher margin product sales, offsetting marginally higher raw material procurement and other production costs.
- **SG&A- SG&A costs:** Currently account for 28% of sales. We forecast a declining trend over the medium term largely reflecting control of G and A as selling costs rise in line with group sales.
- **EBITDA:** Standing at £3.6m in 2016/17 and improving to around £4.0m in the medium term with margins around 7.5%. EBIT margins to improve from current 6.5% to over 7.5% in medium term.
- **Tax:** The group will remain low tax paying reflecting substantial previous tax losses (around £25m) in the UK. A small amount of US tax is payable annually.

Profit & Loss (£m)				
Year end March (£m)	**2016**	**2017**	**2018E**	**2019E**
Sales	**45.27**	**47.03**	**50.52**	**53.55**
COGS	-29.90	-30.60	-32.48	-34.32
Gross profit	**15.37**	**16.43**	**18.03**	**19.22**
Gross margin	**34.0%**	**34.9%**	**35.7%**	**35.9%**
Sales & marketing	-2.58	-2.75	-3.16	-3.69
Admin	-13.06	-10.62	-11.68	-11.91
EBITDA	**2.90**	**3.57**	**3.70**	**4.11**
EBITDA margin	**6.4%**	**7.6%**	**7.3%**	**7.7%**
Depreciation & Amortisation	-0.67	-0.51	-0.50	-0.50
Licensing/Royalties	0.00	0.00	0.00	0.00
Other income	0.00	0.00	0.00	0.00
Underlying EBIT	**-0.27**	**3.06**	**3.20**	**3.62**
Share based costs	0.00	0.00	0.00	0.00
Exceptional items	0.00	0.00	0.00	0.00
Statutory Operating profit	**-0.27**	**3.06**	**3.20**	**3.62**
Net financials	0.00	-0.94	-0.93	-0.78
Pre-tax profit	**-0.27**	**2.12**	**2.27**	**2.84**
Reported pre-tax	-0.27	2.12	3.49	2.84
Tax payable/receivable	0.00	0.12	-0.23	-0.28
Underlying net income	**-0.27**	**2.24**	**2.27**	**2.55**
Statutory net income	-0.27	2.06	3.26	2.55
Underlying Basic EPS (p)	**-0.29**	**2.15**	**2.09**	**2.26**
Statutory Basic EPS (p)	-0.29	1.97	3.00	2.26
U/l Fully-diluted EPS (p)	**-0.29**	**2.15**	**2.09**	**2.26**
Stat. Fully-diluted EPS (p)	-0.29	1.97	3.00	2.26
DPS (p)	0.0	0.0	0.0	0.0

Source: Hardman & Co Research

Balance sheet

- Group has a net debt position at 30th September 2017 of £12.1m- (31st March 2017 of £13.7m). The Group has headroom on its debt facilities of over £3m.
- The Group has a defined pension scheme surplus of around £46m- the decline from £52m at 31/03/17 being due to changes in the value of the schemes assets There continues to be no requirement for any cash funding from the company. Options being considered include reinsuring liabilities with 3rd parties and could potentially see a return of some surplus cash to the company
- The Group's 8% loan notes mature in February 2020. These notes have 43.95m warrants attached , exercisable at 20p, also expiring in February 2020
- The Group has benefitted in H1 2017/18 of a cash injection of £1.12m before expenses from the issue of 8.32m shares. The proceeds have been used to eliminate UK working capital borrowings.
- The balance sheet will remain in debt in the medium term but on a declining trend post 2017/18. We forecast debt at end of 2018/19 of £9.7m.

Balance sheet (£m)

Year end March (£m)	2016	2017	2018E	2019E
Shareholders' funds	40.8	50.2	47.0	49.6
Accumulated goodwill	7.1	7.1	7.1	7.1
Total equity	48.0	57.3	54.2	56.7
Share capital	2.1	2.1	3.2	3.2
Reserves	38.8	48.1	44.6	46.4
Provisions/liabilities	0.0	0.0	0.0	0.0
Deferred tax	14.5	18.2	18.0	17.7
Long-term debt	11.4	9.2	9.2	9.2
Short-term loans	3.7	5.5	2.5	1.6
less: Cash	0.8	1.1	1.1	1.1
less: Deposits	0.0	1.6	1.1	1.1
Invested capital	**67.7**	**80.5**	**75.3**	**76.7**
Fixed assets	3.2	3.7	4.1	4.4
Intangible assets	41.8	51.8	44.9	44.7
Goodwill	7.1	7.1	7.1	7.1
Inventories	11.3	12.7	14.0	15.4
Trade debtors	*6.8*	*7.4*	*8.6*	*9.0*
Other debtors	*0.0*	*0.0*	*0.0*	*-0.3*
Tax credit/liability	*3.8*	*3.5*	*3.5*	*3.5*
Trade creditors	*-6.3*	*-5.4*	*-6.5*	*-6.8*
Other creditors	*0.0*	*-0.4*	*-0.4*	*-0.4*
Debtors less creditors	4.3	5.1	5.1	4.9
Invested capital	**67.7**	**80.5**	**75.3**	**76.7**
Net Debt	**14.3**	**13.6**	**10.6**	**9.7**

Source: Hardman & Co Research

Cashflow

- The Group's cash flow generation is good. The company has low capital requirements with maintenance capex at around £0.5 -£0.8m per annum.
- Working capital management is strict with a target of achieving a level of 25% of revenues down from currently over 30% of sales.
- Acquisitions have been limited in the recent past with the most recent being in the Industrial Laser Systems business. Going forward, the Group intends to further develop its business interests by a programme of carefully targeted strategic acquisitions, joint venture, particularly in the Industrial Lasers business area.
- ProPhotonix proceeds of £1.5m in H1 2017/18 were used to pay down UK debt.
- A dividend has not been paid since the year ending March 2004 and no dividends are forecast to be paid in the medium term as management believes that retention of earnings for deployment in the business is the most appropriate use of financial resources. However, we note that the dividend could be restored if there is a favourable option for the pension fund surplus.

Cashflow (£m)

Year end March (£m)	2016	2017	2018E	2019E
Trading profit	**-0.3**	**3.1**	**3.2**	**3.6**
Depreciation	0.0	0.5	0.4	0.4
Amortisation	0.0	0.1	0.1	0.1
Working capital	-0.4	-3.0	-1.3	-1.5
Other	0.0	0.0	0.0	0.0
Company op cashflow	**-0.7**	**0.5**	**2.4**	**2.6**
Net interest	0.0	0.0	-0.9	-0.8
Tax paid/received	0.0	0.1	-0.2	-0.3
Operational cashflow	**-0.7**	**0.6**	**1.2**	**1.6**
Capital expenditure	-1.5	-0.5	-0.8	-0.7
Sale of fixed assets	0.0	2.1	0.0	0.0
Free cashflow	**-2.2**	**2.2**	**0.4**	**0.9**
Dividends	0.0	0.0	0.0	0.0
Acquisitions	0.0	0.0	0.0	0.0
Disposals	0.0	0.0	1.5	0.0
Other investments	0.0	-1.5	0.0	0.0
Cashflow after invests.	**-2.2**	**0.7**	**1.9**	**0.9**
Share repurchases	0.0	0.0	0.0	0.0
Share issues	0.0	0.0	1.1	0.0
Change in net debt	**-2.8**	**0.7**	**3.0**	**0.9**
Opening net cash	-11.5	-14.3	-13.6	-10.6
Closing net cash	**-14.3**	**-13.6**	**-10.6**	**-9.7**

Source: Hardman & Co Research

Valuation- attractive versus peer group as well as S-o-P and DCF basis

The shares are most attractively valued, trading on calendar 2018 EV/sales, and EV/EBITDA of 0.6 and 7.3 times respectively compared with sector averages of 1.0 and 7.7 times respectively. The shares trade on a perspective PE of around 6 times compared with a sector average multiple of around 16 times. A sum-of-parts methodology suggest significant undervaluation with an inherent business value of around 30p.

Our DCF valuation, using a WACC of 10% suggests that the shares are undervalued with a fair value estimated at around 30p.

Comparative valuation

Shares trading at an attractive discount to peer group on the EV/sales, EV/EBITDA and PE metrics

The UK Engineering Sector is highly diversified and somewhat heterogenous with little company similarity in terms of product mix. There are numerous companies within the sector both private and quoted with market capitalisations ranging from £2m to over £2.0bn.

We believe the best comparators are the engineering companies with market capitalisation in the range £1m to £500m. As can be seen from the table below 600 Group is currently trading at an attractive discount to this peer group across the EV/sales, EV/EBITDA and PE metrics.

Valuation comparables

Company	EV/Sales	EV/EBITDA	PE
	(X)	(X)	(X)
600 Group	**0.6**	**7.4**	**6.3**
UK Industrial Engineering			
Avingtrans	1.4	1.9	24.0
Castings	1.3	6.7	15.4
Chamberlin	0.8	2.7	10.8
Fenner	1.1	8.0	21.5
Goodwin	1.4	9.5	15.2
Molins	0.3	5.6	11.8
Pressure Technologies	0.5	1.2	14.8
Renold	0.7	7.0	8.6
Severfield	0.5	7.7	12.9
Trifast	1.7	19.1	19.4
Vitec Group	1.2	7.5	11.8
Sector average	**1.0**	**7.7**	**15.7**

Source: Hardman & Co Research

Typical Industrial Engineering M&A valuation suggest valuation of over 0.5 times sales and close to 7-10 times EV/EITDA

M&A activity

M&A activity in the sector can also provide assessment of value. There have been numerous transactions within the industrial engineering industry over recent years Transaction values have averaged around 0.5 times EV/sales and 7 times EV/EBITDA.

M & A activity in UK Machinery sector (transaction value <$100m)

Announcement Date	Deal Size (M USD)	Target Name	Acquirer Name	EBITDA Multiple	Sales Multiple
31-Jul-17	37.0	PLF International Ltd	John Bean Technologies Corp	3.29	0.76
31-Jul-17	11.0	La Hacienda Ltd	AMES Co Inc	--	--
31-Mar-17	66.0	Hayward Tyler Group Plc	Avingtrans PLC	1029.14	0.80
08-Jun-17	39.0	Molins PLC-Instrumentation & Tobacco Machinery Division	GD SpA	--	--
04-May-17	72.0	Norbar Torque Tools Holdings Ltd	Snap-On Inc	15.16	2.09
30-Apr-17	28.0	Siemens Gas Turbine Maintenance, Lincoln	Siemens PLC	--	--
22-Nov-16	36.0	Hewden Stuart Ltd-Assets	Ashtead Plant Hire Co Ltd	--	--
18-Jul-16	20.0	Cambridge Medical Robotics Ltd	Investor Group	--	--
17-Jun-16	37.0	Hydro International PLC	Ely Acquisition Ltd	9.08	0.68
01-Apr-16	20.0	Wind Towers Scotland Ltd(WAS 97318R)	CS Wind Corp	-8.04	1.34
02-Feb-16	3.0	Industrial Acoustics Co Ltd-Assets	Beijing Greentec Acoustic Engineering Holdings Co Ltd	--	--
21-Dec-15	7.0	Sherling Steel (UK) Limited- Equipment & Assets	Billington Holdings PLC	--	--
20-Nov-15	4.0	Sherling Steel (UK) Ltd-Assets	Billington Structures Ltd	--	--
11-Nov-15	10.0	Energy Technique PLC	Volution Group PLC	7.77	0.64
02-Nov-15	9.0	First Hose Ltd	GS-Hydro Oy	--	--
12-Oct-15	15.0	Peter Brotherhood Ltd-Trade & Assets Division	Hayward Tyler Group Plc	--	--
03-Aug-15	36.0	BOFA International Ltd	Investor Group	--	--
27-Jul-15	20.0	Davall Gears Ltd	SL Montevideo Technology Inc	--	--
03-Jul-15	9.0	Nelson Fluid Power Ltd	Flowtech Fluidpower PLC	--	--
26-Jun-15	2.0	KSW Engineering Ltd	Undisclosed Acquiror	3.47	0.87
25-Jun-15	22.0	SPTS Technologies UK Ltd-Thermal Products Business	SPT USA Inc	--	--
26-May-15	16.0	HVAC & Refrigeration Engineering Ltd	Oteac Ltd	6.18	0.77
13-May-15	99.0	Severn Trent PLC-Water Purification Business	Industrie De Nora SpA	--	--
29-Apr-15	4.0	Marine Current Turbines Ltd	Atlantis Resources Ltd	--	--
20-Apr-15	21.0	Travis Perkins Distribution Centre	CBRE Global	--	--
15-Apr-15	31.0	JK Lasers	SPI Lasers UK Ltd	-10.54	0.64
07-Mar-15	5.0	Gutters & Ladders (1968) Ltd	SIG PLC	--	--
02-Jul-14	31.0	Xylem Flow Control Ltd	Rotork PLC	--	--
16-Jun-14	5.0	Laboratory Impex Systems Ltd	Ultra Electronics Holdings PLC	--	--
22-May-14	49.0	Nuclear Engineering Services Ltd	Ansaldo Energia SpA	5.77	0.90
09-Apr-14	9.0	Chirton Engineering Ltd	Carr's Milling Industries PLC	--	--
01-Apr-14	36.0	Telestack Ltd	Astec Industries Inc	--	--
20-Feb-14	83.0	Andrew Industries Ltd-Industrial Filtration Business	Lydall Inc	--	--
06-Jan-14	14.0	BioPure Technology Ltd	Spirax-Sarco Engineering PLC	--	--
11-Nov-13	14.0	Travis Perkins Distribution Centre	LondonMetric Property PLC	--	--
02-Jul-13	2.0	Pursuit Marine Drive Ltd	Cellulac Ltd	--	--
10-May-13	7.0	Datong PLC	Seven Technologies Holdings Ltd	2.91	0.46
01-Mar-13	1.0	Base Enamellers Ltd	Manroy PLC	--	--
05-Feb-13	57.0	Pims Group Ltd	Xylem Inc	--	--
06-Dec-12	3.0	Alex Reid Ltd	Christeyns UK Ltd	7.97	0.15
15-Oct-12	10.0	Flowmax Limited	Sabias Securities	3.96	0.55

Source: Thomson Reuters Eikon

Transaction values of deals in industries most similar to 600 Group give valuation of around 35p

Most recently and relevant to the Laser Systems business was Coherent's acquisition of Rofin-Sinar in 2016. At a value of $942m transaction multiples were around 1.8 times sales', over10 times EBITDA and over 15 times EBIT

In the Machine Tools Business area Hurco (US) recently acquired Milltronics for $13m and Takumi Machinery for $7m. We estimate that the transaction multiples were around 1.1 times sales', over 9 times EBITDA and over 10 times EBIT.

Hardinge Inc to be taken private at a value of around 0.8 times sales and 9 times EBITDA

Furthermore, on November 2nd 2017 Privet Fund Management proposed to acquire all the outstanding shares of Hardinge Inc at $17.25 per share. Based upon likely consensus 2018 forecasts for Hardinge this transaction valued the group at over 0.8 times sales and around 9 times EBITDA.

600 Group could be valued at close to 30p per share on a S-o-P basis

Consequently, using similar multiples for valuing the two divisions within the Group suggest an inherent value of around 35p. Allowing for corporate costs and suggests a group valuation of over30p.

S-o-P Valuations

	Sales (£m)	EV/Sales (x)	EV (£m)	Net Debt (£m)	Equity value (£m)	Equity value per share (p)
Machine Tools	34.7	0.8	27.8			
Laser Systems	18.1	1.0	18.1			
600 Group			**45.8**	**-10.6**	**35.2**	**31.5**
	EBITDA (£m)	**EV/EBITDA (x)**	**EV (£m)**	**Net Debt (£m)**	**Equity value (£m)**	**Equity value per share (p)**
Machine Tools	2.7	9.0	24.0			
Laser Systems	2.7	10.0	27.2			
600 Group			**51.2**	**-10.6**	**40.6**	**36.2**

Source: Oxford Economics Hardman & Co Research

DCF valuation – suggests significant upside potential

Discounted cashflow

In our DCF model, all future cash flows are estimated and discounted by using an appropriate cost of capital to give their present value. The discount rate used reflects the risk of the cash flows and incorporates an estimate of the time value of money, and the risk premium. Our base case assumptions are for a 10% WACC and 1% terminal value growth rate both of which are typical values used when valuing other similarly positioned engineering companies.

DCF Valuation- yearly cashflows

	2017E	2018e	2019e	2020e	Terminal
EBITDA	**3.70**	**4.11**	**5.04**	**5.36**	**8.0**
Tax	0.00	-0.28	-0.41	-0.44	-0.7
NOPAT	**3.70**	**3.83**	**4.63**	**4.92**	**7.3**
Change in working capital	-1.30	-1.50	-0.88	-0.92	-1.2
Capex	-0.80	-0.70	-0.50	-0.50	-0.5
Other asset changes	0.00	0.00	0.00	0.00	0.0
Free Cash Flow	**1.59**	**1.63**	**3.25**	**3.50**	**5.6**
Discount rate	10.0%	10.0%	10.0%	10.0%	10.0%
Discount factor	1.00	0.91	0.83	0.75	
Present Value - Free CF	**1.6**	**1.5**	**2.7**	**2.6**	
Cumulative present value	**1.6**	**3.1**	**5.8**	**8.4**	

Source: Hardman & Co Research

DCF Valuation: summary valuation

Valuation- (£M)	
Present value - forecast FCF	23.3
Present value - terminal CF	26.1
Enterprise Value (£m)	**49.4**
Net cash(debt)	**(10.6)**
Market cap equity (£m)	**38.7**
Market cap equity/share (p)	**34.6**

Source: Hardman & Co Research

The sensitivity table below details the sensitivity of the valuation to differing assumptions of cost of capital and terminal growth rates.

DCF sensitivity table

Discount rate	Terminal Growth						
	0%	0.5%	1%	2%	3%	4%	5%
8.0%	44.3	46.3	48.7	54.6	62.9	75.3	96.0
8.5%	40.8	42.5	44.5	49.4	56.0	65.6	80.8
9.0%	37.6	39.1	40.8	44.9	50.3	57.9	69.4
9.5%	34.9	36.1	37.6	41.0	45.5	51.6	60.5
10.0%	**32.4**	**33.5**	**34.7**	**37.6**	**41.4**	**46.4**	**53.4**
10.5%	30.1	31.1	32.1	34.6	37.8	42.0	47.6
11.0%	28.1	28.9	29.9	32.0	34.7	38.2	42.8
12.0%	24.6	25.2	25.9	27.5	29.5	32.0	35.2
13.0%	21.6	22.1	22.6	23.9	25.4	27.2	29.5
14.0%	19.1	19.5	19.9	20.9	22.0	23.4	25.1
15.0%	16.9	17.2	17.6	18.3	19.2	20.3	21.6

Source: Hardman & Co Research

Management - Strong with proven track record

Board of Directors

The Board of Directors has extensive background in commercial and financial sectors at senior level. Strong, credible management team with a proven track record

Position	Name	Remuneration	Audit
Executive Chairman	Paul Dupee	-	-
Chief Financial Officer	Neil Carrick	-	-
Senior Independent non-executive	Derek Zissman	M	C
Non- executive	Stephen Fiamma	C	M
Non-executive	Stephen Rutherford	M	M

Paul Dupee- Chief Executive

Paul Dupee was appointed to the Board as a non-executive Director on 2 February 2011 and appointed Chairman on 14 September 2011. Paul was appointed Executive Chairman on 30 April 2015. He is a private investor and currently Managing Partner of Haddeo Partners LLP.

Neil Carrick- Finance Director

Neil Carrick was appointed to the Board as Group Finance Director on 3rd October 2011. He was previously Group Finance Director and Company Secretary of Cosalt plc.

Non-Executives

*Stephen Rutherford**

A non-executive Director since 1 October 2007. Managing Director of Neofil Limited and Cares UK Limited.

*Derek Zissman**

Appointed to the Board as a non-executive Director on 2 February 2011. Currently a non-executive director of a number of companies including Amiad Water Solutions Ltd (AIM Listed), HelloFresh SE and a previous Vice-Chairman of KPMG LLP.

*Stephen Fiamma**

Appointed to the Board as a non-executive Director on 13 May 2015. Until 2014 a partner in the tax practice of Allen & Overy LLP.

Company matters

Registration

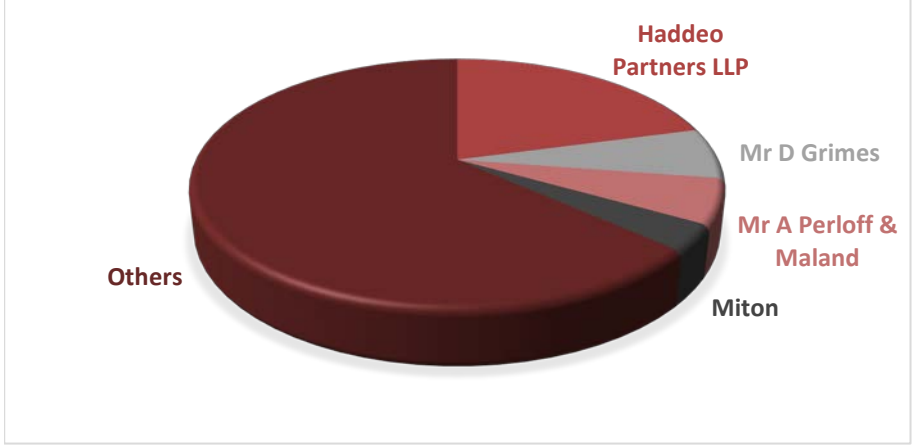
Incorporated in the UK with company registration number: 00196730

UK Headquarters:
Union Street, Heckmondwike, West Yorkshire, WF16 0HL

Shareholder information

At the point of going to press, 600 Group had 112.97m Ordinary shares of 1p nominal value in issue. The Board of Directors holds 30% of the share capital. The NOMAD is SPARK Advisory Partners Ltd and Broker to the company is Finn Cap.

600 Group: Key Shareholders



Source: Industrial Laser Solutions, Hardman & Co Research

600 Group: Share price performance – 5 years

Source: Industrial Laser Solutions, Hardman & Co Research

Competitive positioning

Machine Tools

Key competitive issues- product quality, reliability price

The Machine Tools market in which 600 Group products are sold are extremely competitive and highly fragmented with generally low barriers to entry. 600 Group competes with other manufacturers in terms of quality, reliability, price, value, delivery time, service and technological characteristics.

Many competitors worldwide

600 Group competes with a number of U.S., European and Asian competitors. Many of the companies are larger with substantially greater financial resources and have been supported by governmental or financial institution subsidies and, therefore, may have competitive advantages. Whilst 600 Group's product lines compete effectively, financial resources are limited compared to many of its competitors, making it possibly challenging to remain competitive. Overall, we believe there exists several hundred companies worldwide selling Machine Tools and related products similar to the 600 Group.

These include Chevalier Machinery, Sharp Industries, Lagun, XYZ, Southwestern Industries, Hurco and Hardinge.

Chevalier Machinery

Chevalier Machinery is the US branch company of Falcon Machine Tools, a Taiwanese-based machine tool manufacturer with branches and agents in Europe, the Middle East, Mainland China, South America and the U.S., Falcon, established in 1978, is a publicly traded company listed on the Taiwan Stock Exchange

Chevalier Machinery USA, established more than 30 years ago, is a leading manufacturer of grinding, turning and milling machining centres. Machines provide solutions for the gas & oil, energy, aerospace, medical, automobile, semiconductor, telecommunications industries and job shops. Other products include manual, automatic and CNC profile and surface grinders; vertical grinding centres; cylindrical grinders; double column bridge grinders; vertical lathes, horizontal slant- and flat-bed lathes; multi-axis turning/milling lathes; teach-in type CNC lathes; 5-face CNC bridge mills; horizontal boring machine and vertical machining centres.

Sharp Industries

Sharp Industries, Inc has been supplying high quality Machine Tools to the U S industries for around 40 years. The group started in 1976 supplying high quality manual operated Vertical Milling Machines, and later expanded to precision Toolroom lathes, Surface Grinders, Cylindrical Grinders and Radial Drills. In the early 80"s Sharp started to offer CNC mills and lathes. Currently the product line has now expanded to include 5-axis Vertical Machining Centres, box way VMC's, linear VMC's and small footprint Mini Mills.

Sharp's wide range of manual and CNC products allow the Sharp dealers nationwide to cater to the demands of all industries, research labs, schools, job shops to serve their metal cutting needs.

Lagun

Lagun Machine Tools S.L established in 1954, has developed a wide range of possibilities in milling technology aims to focus on design and manufacture of medium-sized milling machines. at competitive prices and proven reliability.

XYZ

XYZ Industries supply high quality, branded Machine Tools to engineering and manufacturing companies both in the UK and the wider international industrial marketplace.

Southwestern Industries

Southwestern Industries specializes in engineering, manufacturing, and distributing turning and milling equipment for low volume work. Product lines include TRAK bed and knee mills, lathes, retrofit products and the LPM machining centre - all of which feature and use ProtoTRAK CNC. (Controls and machines for low volume work done by skilled machinists)

Hurco

Hurco is an international, industrial technology company which designs, manufactures and sells computerised Machine Tools, consisting primarily of vertical machining centres (mills) and turning centres (lathes), to companies in the metal cutting industry through a worldwide sales, service and distribution network. Hurco. also provide machine tool components, software options, control upgrades, accessories and replacement parts for its products, as well as customer service and training and applications support

Hardinge

Hardinge Inc., founded in 1890 and is headquartered in Elmira, New York. together with its subsidiaries, designs, manufactures, and distributes Machine Tools in North America, Europe, and Asia. Hardinge has manufacturing operations in China, France, Germany, India, Switzerland, Taiwan, the United Kingdom and the United States

The company operates through two segments, Metal-cutting Machine Solutions, and Aftermarket Tooling and Accessories. It offers computer controlled metal-cutting turning machines, grinding machines, machining centres, collets, chucks, index fixtures, repair parts for machines, and other industrial products, as well as engineers and supplies high precision, standard, and specialty workholding devices, and other machine tool accessories. It also provides post-sale support services, such as operation and maintenance training, in-field maintenance, and in-field repair. Hardinge Inc. serves small and medium-sized independent job shops. The company sells its products through distributors, agents, and manufacturers' representatives.

Industrial Lasers Marking Industry

Industrial Laser- globalised and fragmented market place

The Industrial Lasers Marking industry is likewise competitive and fragmented with generally low barriers to entry. Overall, there exists over 250 companies worldwide selling laser products similarto TYKMA Electrox. A majority of these companies are also small regional players selling only on price with limited ability to expand outside of their local market area. Companies are generally focussing on product innovation to expand their share of the global market. Below is a list of the main companies that are seen regularly in the worldwide market.

Coherent/Rofin-Sinar (Germany), Trumph (Germany), TelesisTechnologies (US), Hans Laser (China), Datalogic (Italy), Keyence (Japan), SIC (France), Alltec- FOBA (Germany), Epilog Laser and Gravotech Marking

Coherent/ROFIN-SINAR

Coherent/Rofin-Sinar (acquired by Coherent in 2016) is a leading developer, designer and manufacturer of lasers and laser-based system solutions for industrial material processing applications. The Company focuses on developing technologies and advanced production methods for a wide variety of industrial applications based on a broad scope of technologies.

The product portfolio ranges from single laser-beam sources to highly complex systems, covering all of the key laser technologies such as CO2 lasers, fiber, solid-state, ultrashort pulse and diode lasers, and the entire power spectrum, from single-digit watts up to multi-kilowatts, as well as a comprehensive spectrum of wavelengths or pulse durations and an extensive range of laser components. ROFIN-SINAR Technologies has its operational headquarters in Plymouth, Michigan, and Hamburg, Germany, and maintains production facilities in the US, Germany, UK, Sweden, Finland, Switzerland, Singapore and China. ROFIN currently has more than 52,000 laser units installed worldwide and serves more than 4,000 customers.

TRUMPF

TRUMPF, family owned, is a high-tech company offering manufacturing solutions in the fields of laser technology and electronics. TRUMPF offers a large selection of marking lasers in many different power classes and with all standard wavelengths (infrared, green, ultraviolet). The lasers are ideal for marking processes such as engraving, ablation, annealing, discoloration and foaming. In addition to metals, marking lasers from TRUMPF also process many other materials such as plastics, glass, silicon, ceramics and organic substances.

Telesis

Telesis is the leader in product identification and traceability technology offering a wide range of permanent, programmable laser, Pinstamp®Dot Peen, and Telescribe® Scribe Marking Systems. Principle customers include Ford, Chrysler, General Motors, Volvo, Delco, GE Aerospace, Boeing, Pratt & Whitney, Nordson and AT&T. Telesis offers the broadest standard selection of permanent identification and material processing systems available in the world with its line of Diode-Pumped YAG, Fiber and CO2 laser marking systems offering the ultimate in high-speed, high quality product identification.

Datalogic

Datalogic is a global leader in the automatic data capture and process automation markets, specializing in the design and production of bar code readers, mobile computers, sensors for detection, measurement and safety, RFID, vision and laser marking systems. Datalogic is headquartered in Bologna (Italy), employs approximately 2,700 staff worldwide, distributors in 30 countries, with manufacturing and repair facilities in the USA, Brazil, Italy, Slovakia, Hungary and Vietnam.

SIC Marking

SIC Marking designs, manufactures and distributes dot peen, scribing and laser marking machines. The group is an international leader on the market able to design applications for a wide range of materials, such as steel, alloys, stainless steel, titanium, aluminium, and plastics.

Danaher, Alltec Laser Business Unit (LBU)-, FOBA product range

Danaher, through the Alltec Laser Business Unit (LBU) and FOBA product range is a leading international technology manufacture of solutions for laser marking, laser coding and laser engraving. The group has internationally recognised brand names.

Epilog Laser

Epilog Laser is a leader in the laser engraving, cutting and marking industry based in Golden, Colarado. The group's original concept was based on CO2 laser engraving systems to both commercial customers, small business owners and the home craftsman. More powerful CO2 laser systems have been developed over the years and in 2006, the product line expanded to offer the FiberMark, a system that allows for permanent marking on all types of metals.

In 2008, Epilog launched the industry's a low-cost entry-level CO2 laser engraving system, the Epilog Zing Laser, to bring its technology to an even wider audience.

Gravotech Marking

Gravotech Marking, following the merger of Gravograph, Technifor and Vision id a market leader based in Lyon, France with other operations in the US and China. The Group offer is based on the brands- Type 3, Propen and TEchnifor and Gravograph and has turnover of around Eur125m with, 90% generated outside France.

Risks/Mitigation

There are a number of potential risks and uncertainties which could have a material impact on the group's performance and could cause results to differ materially from current expectations.

Macro-economic

The Group's businesses are active in markets which can be cyclical in nature as the overall level of market demand is dependent upon capital investment intentions. Economic or financial market conditions determine global demand and could adversely affect our customers, distributors, operations, suppliers, and other parties with whom we transact.

The Directors seek to ensure that our overall risk is mitigated by avoiding excessive concentration of exposure to any given geographical or industry segment, or to any individual customer. Market conditions, lead indicators and industry forecasts are monitored for any early warning signs of changes in overall market demand, and measures to exploit opportunities or manage elevated risks are taken as appropriate.

Taiwan

Taiwan is ranked by Gardner Research as the seventh largest producer nation of Machine Tools, with global production valued at almost US$4 billion. Taiwanese suppliers represent approximately one third of the total cost of sales for the Group. Group businesses mitigate against such risk by carefully selecting high quality vendors, and maintaining long term constructive and open relationships. The effectiveness of such mitigation would be limited, however, in certain catastrophic circumstances (for example, extreme weather or seismic activity in the vicinity), against which the Group carries appropriate insurance. Additional supply sources in India have been developed, as a consequence, and an increasing amount of product is now made in the USA as well.

Brexit uncertainty

The UK vote to leave the European Union has created significant uncertainty about the outlook and prospects for the UK economy. We believe that it is still too early to quantify or determine with certainty the impact on the group. We are confident that the Board will continue to monitor developments, consider the impact on the group's businesses and take appropriate action to help mitigate any risks associated with the UK leaving the EU.

Foreign currency fluctuation

Approximately 65% of Group revenue is derived in US$. Significant fluctuations could have a material impact on the financial performance of the Group. The Group mitigates this risk by matching assets and liabilities in $ as well purchasing raw materials in $.

Market deterioration

The Group sells into a wide variety of different markets, selling a diversified product range. Management works with key customers to introduce new products and is constantly seeking to identify new business segments and geographical locations into which to sell products.

Production failures

The continuity of the Group's business activities is dependent upon the cost effective supply of products for sale from our own facilities, and those of our key vendors. Supply can be disrupted by a variety of factors including raw material shortages, labour disputes and unplanned machine down time.

In particular, the Directors are mindful that a small number of key manufacturing outsource partners are located in relatively close proximity to each other in Taiwan. Owing to the complex technical nature and fine production tolerances of the

company's products, an unstable production process can result in significant scrap which could have a significantly adverse impact on results.

The Group seeks to employ a skilled workforce backed by a highly experienced technical and production team in order to provide the relevant experience and skill set to mitigate any production failures.

Fluctuations in the price of raw materials, especially steel and iron, could adversely affect our sales, costs and profitability.

Products are manufactured with a high iron and steel content. The availability and price for these and other raw materials are subject to volatility due to worldwide supply and demand forces, speculative actions, inventory levels, exchange rates, production costs and anticipated or perceived shortages. In some cases, those cost increases can be passed on to customers in the form of price increases; in other cases they cannot. If the prices of raw materials increase and the Group is not able to charge our customers higher prices to compensate, our results of operations would be adversely affected.

Appendices:

600 Group- Machine Tools Product Lines

Machine Tools

Product ranges – Precision components

Pratt Burnerd International 600Group	Gamet Bearings 600Group
• Over 150 years heritage for Manual and Power chucks – set industry standard • Special work-holding solutions expertise • Used by leading OEM's worldwide	• Number one supplier for turning and grinding machine bearings • Over 50 years of bearing manufacture • Used by leading OEM's worldwide

600Group 4

Product ranges – metal turning machines

Colchester 600Group	Harrison 600Group	Clausing 600Group
• Recognised worldwide brands - over 100 years heritage • >100,000 lathes in operation worldwide - most recognised training and toolroom brands •Direct sales in North America, Europe and Australia with distribution in >50 countries		• Over 100 years of trading in North America • Large machine tool range • >400 distributors throughout North America

600Group 3

Source: Industry, Hardman & Co Research

600 Group- Industrial Laser Systems Product Lines

Industrial Lasers Products lines

Product Line – Vereo and Scorpion

Integration Models

- Integration Laser with Rack Mount Controller / Touch Screen Panel
- 10, 20, 30 and 50 Watt Fiber Laser
- 10/20/50W - 2 Selectable Pulse Durations (40ns/260ns) ,1-500 kHz Frequency Range
- 30W – 29 Selectable Pulse Durations from 220- 15ns, 1- 1000 kHz Frequency Range

TYKMA ELECTROX
Industrial Laser Systems

Product Line – Minilase Series

Desktop Models

- 10, 20 and 30 Watt Fiber Laser
- 10/20W - 2 Selectable Pulse Durations (40ns/260ns) ,1-500 kHz Frequency Range
- 30W – 29 Selectable Pulse Durations from 220- 15ns, 1- 1000 kHz Frequency Range
- Micro Rotary

TYKMA ELECTROX
Industrial Laser Systems

Product Line – Zetalase and Minilase XL

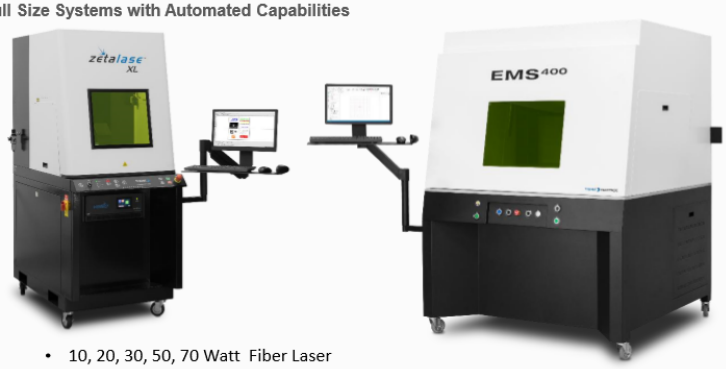
Desktop Models

- 10, 20 and 30 Watt Fiber Laser
- 10/20W - 2 Selectable Pulse Durations (40ns/260ns) ,1-500 kHz Frequency Range
- 30W – 29 Selectable Pulse Durations from 220- 15ns, 1- 1000 kHz Frequency Range
- Rotary

TYKMA ELECTROX
Industrial Laser Systems

Product Line

Mid and Full Size Systems with Automated Capabilities



- 10, 20, 30, 50, 70 Watt Fiber Laser
- 10/20W - 2 Selectable Pulse Durations (40ns/260ns) ,1-500 kHz Frequency Range
- 30W – 29 Selectable Pulse Durations from 220- 15ns, 1- 1000 kHz Frequency Range
- XY Tables, **3D & Large Field!!**

TYKMA ELECTROX
Industrial Laser Systems

Source: 600 Group, Hardman & Co Research

600 Group- Industrial Marking

Industrial Marking

Methods of Industrial Marking and Product Identification

How the markings are created

- Direct Part Marking Systems
- Tags, Nameplates and Labels
- RF Labels and Devices
- Reverse Mold Dies and Offsets
- Inking Applicators
- Sand Blast Techniques
- Engraving Devices
- Stampings and Press Methods
- Milling Tools and Cutters

TYKMA ELECTROX
Industrial Laser Systems

Categories of Industrial Marking and Product Identification

Permanent vs. Non-Permanent

Permanent	Non-Permanent
Laser	Ink- Jet
Dot-Peen	Ink Stamping
Chemical Etching	Tags-Non Welded
Engraving	Ink Markers
Stamps and Dies	RF Tags
In-Mold Process	
Milling Centers	

TYKMA ELECTROX
Industrial Laser Systems

Source: 600 Group, Hardman & Co Research

600 Group: Industrial Marking

Forces and Markets for Industrial Marking and Product Identification

Market Forces

- Marketing Needs
  - Logos and recognition
- Liability and Security
  - Chain of custody
  - Black market and counterfeit protection
- Cost Reduction
  - Limit recalls and exposure
- Quality Control
  - ISO standards adopted worldwide
- Mandated and Legislation
  - VIN numbering
  - FDA
  - DOD
- Industry Competition
  - Leapfrog techniques
- Improved Reading Technologies
  - Data collection driven

Industries

- Medical
- Tooling
- Automotive
- Aerospace
- Military and Defense
- Electronics
- Home Goods
- Oil and Gas
- Heavy Machinery
- General Industrial

Applications

- Implant & Surgical Identification
- Jet Engine Component Marking
- DOD High Value > 5K Components
- FDA Mandated Medical Component
- Chip Marking / Reading
- Engine/Frame VIN Numbering
- Piston/Crank Part Matching
- Gear Marking/Orientation
- Branding Kitchenware
- Nameplate Engraving
- Consumable Tooling
- Clutch Plates
- Valves and Assemblies
- Pipe and Tubing
- And many others!

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Reasons for Industrial Marking and Product Identification

Branding

- Logos
- Trademarks
- Identity Names

Traceability

- Serialization

Lot Control

- Date Codes
- Repeat Numberings

Embedded Symbology

- 1D and 2D Codes
- UID Marking (DOD)
- UDI Marking (FDA)

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Glossary

Machine Tools

A machine tool is usually defined as a power-driven machine, not portable by hand, and powered by an external source of energy. It is designed specifically for metalworking either by cutting, forming, physic-chemical processing, or a combination of these techniques. Machine Tools are traditionally broken down into two categories: metal-cutting and metal forming.

Metal-cutting: Machines that typically cut away chips or swarf and include broaching machines, drilling machines, electrical-discharges machines, lasers, gear cutting machines, grinders, machines centres, milling machines and turning machines such as lathes

Metal forming: Machines typically squeeze metal into shape and include bending machines, cold-heading machines, presses, shears and stamping machines

A lathe is a tool that rotates the workpiece about an axis of rotation to perform various operations such as cutting, sanding, knurling, drilling, or deformation, facing, turning, with tools that are applied to the workpiece to create an object with symmetry about that axis.

Lathes are used in woodturning, metalworking, metal spinning, thermal spraying, parts reclamation, and glass-working. Most suitably equipped metalworking lathes can also be used to produce most solids of revolution, plane surfaces and screw threads or helices. The workpiece is usually held in place by either one or two centers, at least one of which can typically be moved horizontally to accommodate varying workpiece lengths. Other work-holding methods include clamping the work about the axis of rotation using a chuck or collet, or to a faceplate, using clamps or dogs.

CNC- Computer numerically controlled

Industrial Laser Systems

Permanent Marking - "A method used to produce an indelible mark on an object in order to permanently establish a unique brand or traceable identity."

Dot Peen- Dot peen marking machines use a pneumatically driven marking pin to stamp (or peen) a series of very small, closely spaced dots to form straight or curved lines. Independent X and Y marking axes place dots very precisely, resulting in excellent mark quality and legibility. Accurate and powerful five-phase stepper motors enable accurate and consistent mark placement, with 0.025mm resolution on both axes. The dot peen marking method provides fast, accurate marks while exerting minimal force on the part surface. Text, logos, and 2D Data Matrix codes can be marked in any size or orientation. The quality and depth of mark is determined by making adjustments to the mark settings, air pressure, dot spacing, and the clearance between the pin and the part.

Lasers

Laser: L.A.S.E.R is an acronym for "Light Amplification by Stimulated Emission of Radiation". In simple terms, a laser is a focused and controlled beam of light. A laser consists of a gain medium, a mechanism to supply energy to it, and something to provide optical feedback.

The gain medium is a material with properties that allow it to amplify light by stimulated emission. Light of a specific wavelength that passes through the gain medium is amplified (increases in power). For the gain medium to amplify light, it needs to be supplied with energy. This process is called pumping. The energy is typically supplied as an electrical current, or as light at a different wavelength created by a flash lamp or diode.

The most common type of laser uses feedback from an optical cavity—a pair of mirrors on either end of the gain medium. Light bounces back and forth between the mirrors, passing through the gain medium and being amplified each time. Typically one of the two mirrors, the output coupler, is partially transparent. The laser beam escapes through this mirror.

To create a laser, we raise the energy level of atoms to an excited state, thereby enabling them to release light when falling back to their original energy or ground state. In this example we use two main ingredients to accomplish this; a gain medium and a pumping mechanism.

Common Gain Mediums used in Manufacturing Process Lasers include Gas (such as CO2), a Nd:YAGCrystal (Neodymium Doped Yttrium Aluminum Garnet) -a synthetic crystal which serves as the gain medium., Nd:YVO4 Crystal (Neodymium Doped Yttrium Orthovanadate) and Fiber (Ytterbium)- a doped fiber optic cable which serves as the gain medium.

Common Pumping Sources used in Manufacturing Process Lasers: include electricity, arc Lamp / Bulb – A rod shaped lamp or bulb that serves as the pumping mechanism for the laser and semiconductor Diodes.

Fiber lasers are the latest and best technology being implemented into modern day laser marking systems. Fiber lasers have been in production for many years and offer the best combination of reliability and marking capability. The positive aspects include: -highest beam quality, air cooled with high ambient air temperature operating capabilities, high efficiency with low power consumption, longest diode life (Up to 100,000 hours), extended warranties over other technologies, high peak power and long pulse durations are good for high speed aggressive marking and deep engraving applications and easy to integrate and service. Fiber lasers are typically available in two different configurations in the laser marking industry. Q-Switched or MOPA. Q-Switched fiber lasers are reliable and powerful, but have limited flexibility compared to MOPA .

General Marking or Burning – This is typical in metal marking. The desired result is that the characters, logo or pattern is burned sufficiently into the surface of the material. This can be done with varying degrees of aggressiveness. The colour will typically range from gold or light brown to dark brown and the mark can have a rough feel to the touch. On aluminum this could be varying shades of white or grey. This marking is simple to program and is extremely durable.

Annealing / Carbon Migration – The desired result of annealing is a dark contrasted surface mark. This is typically done on stainless steel, steel, cobalt chrome and titanium. The surface of the material is heated by the laser beam to create a dark black mark. The mark is smooth to the touch and there is no visible surface disruption or penetration. This is common for medical marking as to not disrupt the surface of surgical tools or implants. This marking is also common for carbide tool marking, however the end result is typically a white mark. This is necessary to hold tool tolerance

Ablating– The desired result is the removal of some type of coating or treatment process from the underlying material. This is common for anodized aluminum, painted materials, heat treated surfaces and black oxide surfaces. The laser typically removes this surface coating or treatment to reveal the underlying material. This in turn can create varying levels of contract between the mark and the unaffected treat

Deep Engraving – The desired result is the creation of a mark by material removal. On metals, typically a high powered fiber laser is utilized to strip away layers of the material to create a mark with depth. Various degrees of depth can be created depending on the available laser power and the amount of cycle time available. This marking technique can also be used on other substrates, such as rubber, where gaining contrast is not possible.

Plastic Marking / Foaming – The desired result is a contrasted mark on the material without vaporizing and deep engraving the material. The laser creates controlled micro burns on the surface of the material in order to create the mark.

Notes

Notes

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