

by Shabbar Kothari

## Industry landscape

Surgery is a medical specialty that uses operative techniques on a person to investigate or treat a pathological condition such as a disease or injury.<sup>[5]</sup> Treating cancerous bodily parts remains one of the most prominent and complex applications of surgery. Non-cancerous treatments are relatively lower in both complexity and criticality. Traditionally, surgeries have been performed by hand, where surgeons are assisted by a team of nurses and specialists.

According to Data Bridge, the first documented use of **robot-assisted surgery** (henceforth, RAS) occurred in 1985. The turning point for the new age of RAS came in 2000, with da Vinci surgical system (DVS) becoming the first of its kind to be FDA-approved. Ever since, DVS has paved the way for cutting-edge minimally invasive surgery (MIS). The overall RAS market has surged since 2000 and become a staple in the US healthcare system.

The field holds enormous potential for technological advancement, with a high chance of a growing market for RAS over the next 5-10 years and beyond. Medical professionals as well as patients prefer RAS owing to its improved MIS benefits, lessened recovery times and pain, increased accuracy and reduced surgeon fatigue.

On the other hand, research studies on RAS's relative efficacy (over traditional surgery) are yet inconclusive. Still, RAS is undoubtedly experiencing faster growth than the overall surgical device market.

Although a large portion of the RAS market remains fragmented, Intuitive Surgical (ISRG) stands alone both in its colossal market share (40% in the US) and the pivotal role it has played in the history of RAS.

### Additional insights about the industry<sup>[3]</sup>

1. In the US (encompassing 60% of the global RAS market), national health insurance program Medicare plays an important role in the application of **Robotic Surgery Equipment (RSE)**. Critical-access hospitals have been able to secure reimbursements from Medicare, which considers robotic surgery equipment a depreciable capital expense.
2. With the rising popularity of RAS, hospitals have begun employing RSE as a marketing tool to attract surgeons and patients.
3. Academic institutions are adopting robotic equipment to train budding surgeons. This change at a grassroots level is testament to the inevitability and increasing role of RAS in the future of surgery.
4. **Key drivers** for the RSE industry include increased physician visits, larger coverage of private health insurance, aging population and federal funding for Medicare and Medicaid. These drivers apply especially in the U.S., but many would be relevant elsewhere.
5. The industry enjoys small **scaling benefits** as logistic services within RSE can be offered to many hospitals.
6. Many surgeons practice conventional methods of MIS, where relatively small incisions are made during procedures. However, RAS surgeries are an especially effective MIS approach with improved outcomes.
7. Potential industry competition in the RSE business would face high **barriers to entry**.
  - Strict regulations from FDA. New products are put through exhausting testing and legal procedures.
  - Moderate capital investment costs. Surgery equipment is often high-tech, specialized equipment.
  - Incumbent products, such as da Vinci systems, are typically heavily patented.
  - There are significant R&D time and dollar investments to the development of RAS technologies.
  - RAS system manufacturers must take into account the cost of insurance against product liability claims.
  - Unfavorable patient outcomes may lead to significant lawsuit costs for the manufacturer.
  - The industry requires access to a scarce pool of highly skilled labor, particularly for the development, sales and onboarding of high-tech RAS equipment.
8. North American RSE markets are approaching saturation; a large portion of future industry growth is expected from Asia.
9. On an absolute basis, robot-assisted surgeries are typically 1.6 times more expensive than conventional ones. Insurers and hospitals continue to analyze the cost-effectiveness of RAS. The higher surgery cost may be justified if additional benefits are derived from lowering recovery times, hospital costs and complication rates.
10. The RAS market is likely to outpace the growth of the broader surgery market, so that RAS will play a bigger role in 5-10 years.
11. **Key industry players:** Owing to the wide range of clinical treatments, the RAS industry is largely fragmented. Nevertheless, three brands command outsized market share.<sup>[3]</sup>
  - **Intuitive Surgical's da Vinci surgical systems and EndoWrist:** As discussed above, Intuitive's products was a pioneer in RAS equipment and by far has the largest market share (40% U.S., 60% global). It is discussed in more detail later in this report.
  - **Stryker Corp's Mako:** The Mako joint replacement system specializes in Orthopedics among other types of surgeries. It controls 5% of the U.S. RSE market.
  - **Accuray Inc's CyberKnife:** Accuray is a leading radiation oncology company that operates under CyberKnife, a robotic stereotactic radio-surgery system, which automatically tracks, detects and corrects tumors during surgery. Aimed with providing pinpoint treatments, CyberKnife directs high doses of radiation with precision to minimize radiation exposure to surrounding healthy tissue. It controls 3% of the U.S. RSE market.
12. In 2010, according to Lancet Global Health, 321.5 million inpatient surgical procedures were needed to address the global burden of disease. This reflects a global per capita surgical need of 4,664 per 100,000, or 4.7% of the population. As of 2019, the world population is estimated to be 7.8 billion, implying that the surgical need has grown to 363 million, of which surgeries relevant to ISRG were ~200 million. During 2019, just ~1.23 million procedures took place worldwide with the da Vinci system, indicating that robot-assisted surgeries make up only a fraction of total surgeries worldwide. Given its superior MIS and accuracy, there is huge scope for growth. The headwind threatening RAS is the significant up-front cost faced by clients (hospitals), as well as the availability of skilled surgeons.

<i>in \$mm</i>	U.S.	OUS*	Global (U.S. + OUS)
RAS Market 2019 (Base year)	3,400	4,300	7,700
RAS Market 2029 (Target year)	4,937	15,611	20,548
Implied CAGR growth	3.8%	13.8%	10.3%

\*Outside the U.S.

### The Business

- Intuitive Surgical, Inc. (ISRG) develops, manufactures, and markets robotic products designed to improve clinical outcomes of patients through minimally invasive surgery. The brand stands for industry-leading R&D and world-renowned devices in the RAS space.
- Its flagship product, the **da Vinci surgical system**, has led the new wave of robot-assisted surgery since 2000. The system is controlled by a surgeon from a console, and is primarily used in General, Gynecological, Urological and Cardiothoracic and Head-and-Neck surgeries.
- ISRG's second and recently developed product type is the **Ion endoluminal system (IES)** which - cleared by the FDA in 2019 - enables minimally invasive biopsies in the lung. At the time of this writing, the associated impact of revenue from IES is insignificant.
- ISRG's key customers are hospitals; notably those choosing to offer cutting-edge robot-assisted surgery and the most effective forms of MIS procedures.
- ISRG controls 40% of the U.S. market<sup>(3)</sup> and nearly 60% of the global (U.S. included) RAS market as of 2019<sup>(4)</sup>. This is a rare within an industry that is otherwise fraught with a high level of fragmentation, owing to the wide range of clinical treatments. ISRG's long history of such a large market share can be explained by the presence of **economic moats** safeguarding the business from competition. This is discussed further below.
- ISRG's **business model** recognizes revenue with up-front sales or in operating leases and usage-based models where revenue is recognized over time.
  - The key product is the da Vinci surgical system, which generally sells for between \$0.5 mil and \$2 mil. As of 2019, there are 5,582 installed bases of the system worldwide.
  - Additionally there are three other product types that produce Recurring Revenue: Instruments, Accessories and Services. Overall, the Recurring type of revenue grows at a much faster clip than the sale of Base systems. This is presumably as hospitals try to maximize their investment by maximizing use of the systems once installed.
  - Instruments and Accessories, supplementing the main system, have limited lives. ISRG earns between \$700 and \$3,500 for instrument and accessories per surgical procedure.
  - The third recurring revenue is that of Services. ISRG typically enters into service contracts at the time of purchase, the annual fee of which ranges from \$80,000 to \$190,000.
  - The all-new FDA-cleared Ion Endoluminal System (IES) is similarly follows a selling model similar to da Vinci. As of 2019, its impact on the revenue is immaterial. IES is a flexible, robot-assisted, catheter-based platform designed to navigate through very small lung airways to reach peripheral nodules for biopsies.
- Distribution: ISRG provides its products through direct sales organizations in the U.S., some European countries, China, Japan, South Korea, India and Taiwan.
- Acquisitions make up an immaterial part of the ISRG growth strategy. During 2019, ISRG acquired certain assets from Scholly Fiberoptic, a supplier of endoscopes, for \$101.4 mil.

Switching Costs

The purchasing of a da Vinci surgical system is a serious commitment on part of the hospital, as it must agree to accept several large investments in cost, time and training in order for successful integration and execution. It is in the nature of these complex devices for the client (hospital) and ISRG to engage in a sticky long-term business relation. Upon purchase, ISRG deploys an on-site clinical sales team at hospitals, interacting with surgeons or physicians, operating room staff, and hospital administrators to develop and sustain successful robotic surgery. Such commitments erect high Switching Costs for the hospital, and is, in my opinion, ISRG's strongest economic moat.

Switching costs as well as the highly technical and life-critical nature of the product allows **pricing power** to the da Vinci systems. This is reflected in the unwavering gross margins at about 70% since 2010.

Regulatory hurdles and Patents

RAS systems are complex medical devices and are therefore subject to substantial (and growing) regulatory requirements. Governing bodies overseeing safety standards including FDA, International Electrotechnical Commission, Reduction of Hazardous Substances and Waste Electrical & Electronic Equipment Directives. Approvals cycles from such organizations could take weeks or months of rigorous testing for safety and efficacy.

Competing systems would be required to undergo such daunting regulatory hurdles before being commercially available.

R&D learning curve

R&D expenses make up an increasing portion of total revenue for ISRG, and have averaged 10-11% of revenue since 2016. In 2019, ISRG spent \$557 million on R&D. With two decades of experience and a highly skilled personnel on-board, competitors may be deterred by the significant R&D needs of the business. This is a relatively moderate moat as given enough time and financial might, large competitors in relating industries (J&J, Medtronic) with established R&D operations may find this less daunting.

Expertise Network Effect

According to [NFX.com](https://www.nfx.com), the simplified definition of **network effects** is that they occur when a company's product or service becomes more valuable as usage increases. While there are many types, I would like to point out one that relates to ISRG - Expertise network effect.

How does an Expertise network effect transpire? Products that are typically tools used by professionals to do their job — the instruments with which they ply their craft. As professionals become more skilled in their jobs, they also level up their expertise in tools required to do their jobs. If the tools are sophisticated enough, the tools require particular expertise of their own. (Source: [NFX.com](https://www.nfx.com))

ISRG products fits this mold to a moderate extent. Surgeons receive intensive training, both in medical school and at hospitals, not just in robot-assisted surgery, but specifically for da Vinci systems. Investments of time and effort on part of the surgeons ensure that hospitals are more keen to employ the same device in order to attract the best talent in the market. This flywheel effect ensures that still more surgeons will opt training in (what is now) the industry-standard device, and the cycle self-reinforces.

ISRG makes up a large portion of RAS devices in the global market, but especially in the U.S. This network effect is positioned to get stronger as more da Vinci systems are installed.

1.Robots as surgical enablers, MarketWatch, 3 February 2005

2.Prepping Robots to Perform Surgery, The New York Times, 4 May 2008

3JBISWorld Industry Report OD4074

4ISRG 2019 sales of \$4.5bn as a portion of the global RAS market of \$7.7bn.

5.Wikipedia contributors, "Surgery," Wikipedia, The Free Encyclopedia, <https://bit.ly/2VF4fWh>.

## Price Implied Expectations (PIE)

PIE determines how the current price reflects the market's expectations of future value creation. The idea is to start with the current price and use a DCF model to 'read' what the market implies about the company's future performance.

The recent coronavirus-related market slump has impacted ISRG materially. It was trading at ~\$438 or an Enterprise Value of ~\$51.1bn at the time this report was written. I backed out the expected revenues ten years from now, while I varied the sales growth rate until I arrived at the current Enterprise Value.

The last traded price of \$438 implies:

- Sales growth rate will be 14-16% from years 1 to 5, and then decline from 14% to 2% during Years 5-10. With the stronghold of da Vinci systems on the market, it seems unlikely that ISRG will lag the total market growth of the industry. I assumed that other variables such as Operating Margin, Rate of Reinvestment, Cost of Capital and Net Debt remain unchanged.
- ISRG systems today claim \$58 out of every \$100 spent on RAS. The current price implies that this number would decline to \$52 in 10 years. A highly unlikely scenario.

These observations imply that ISRG is undervalued.

## Capital Allocation

Over the past ten years, the following is the 'scorecard' of ISRG's Capital Allocation:

- ISRG has produced a cumulative \$7.7bn of NOPAT, with no bank debt, and reinvestments amounted to ~\$2.5bn. After adjustments, FCFE generated was an estimated \$8.4bn.
- At first glance, Cash appears to have returned to owners through buybacks worth ~\$2.7bn. However, there is an immaterial change in share count since 2010 (117m to 115m). Further investigation may reveal how the \$2.7bn was spent, and whether or not it was to offset dilution effects of employee stock options. It is clear that shareholders were not the beneficiaries of that cash outlay.
- Meanwhile, Book value per share grew 4x, from \$17 to \$71. The business and its management have produced exceptional value for owners.
- While Capital Employed has grown 7x, Earning power (NOPAT/WACC) has grown 5x. This is reflected in ROIC contraction from 72% to 48%. This should not be cause for disquiet, however, as it demonstrates only a changing scale in the business. The company has produced ever growing value for owners (ROIC-WACC/Capital) in dollar terms.

## Valuation and Inputs

### Narrative 1: Riding the Wave

#### The story

In this narrative, I assume that ISRG will maintain its stronghold on the global RAS market over the next five years to 2024. Owing to the Economic Moats (discussed earlier), I assume the da Vinci systems maintain the large market share of the global RAS market.

#### The assumptions

<i>in \$ mil</i>	Base year 2019	Years 1-5	Year 6-10	After year 10	Story link
Total market	7,700	Grow 14% YOY	Steady declining growth rate from 14% to 2%	Grow 2%	Over time, RAS becomes a much larger portion of the general global surgery market owing to favorability to medicals practitioners, hospitals and patients. Industry consensus states that RAS will grow at 14% YOY, and I assume that all-inclusive global surgery market will grow at 2%, slightly above growth in world population.
Market share	58%	58%	58%	58%	Strong switch costs and mild network effects protect the large market share of ISRG, allowing its growth rate to match that of the total market. Target market share remains 58%. I believe this leans toward a conservative view.
Sales growth rate	14%	14%	12% -> 2%	2%	Growth rate levels at 14% until Year 5, thereafter declines to stable growth rate of 2% by Year 10.
Operating margin	29%	29% -----> 27%			Margin contracts mildly over time, reflecting increased R&D and distribution costs. Additionally, slight reductions in selling price to maintain volume growth of units sold and promote sales in hospitals with constrained budgets.
Reinvestment	1.3	1.3 -----> 1.6			This number reflects Sales-to-Cap ratio, which is projected to improve slightly, reflecting optimization of new distribution centers in Europe and Asia. I believe that unit costs would fall slightly as capital base increases.
Cost of Capital	6.5%	6.5%	6.5%	6.5%	Derived using CAPM

#### The cash flows (in \$ millions)

	All-inclusive global surgery market	Global RAS market	Market share	Revenues	NOPAT	Reinvestment	FCFF
2019	70,000	7,700	58%	4,479	1,303	471	832
2020	71,400	8,778	58%	5,091	1,461	548	913
2021	72,828	10,007	58%	5,804	1,643	580	1,062
2022	74,285	11,408	58%	6,617	1,846	662	1,184
2023	75,770	13,005	58%	7,543	2,074	704	1,370
2024	77,286	14,826	58%	8,599	2,330	623	1,707
2025	78,831	16,545	58%	9,596	2,562	552	2,010
2026	80,408	18,068	58%	10,479	2,829	445	2,384

2027	82,016	19,296	58%	11,192	3,022	308	2,714
2028	83,656	20,145	58%	11,684	3,155	146	3,009
2029	85,330	20,548	58%	11,918	3,218	149	3,069
Terminal year	87,036	20,959	58%	12,156	3,246	152	3,094

*The value*

Terminal value	72,127	
PV (terminal value)	38,424	
PV (CF over the next 5 years)	13,811	
Value of operating assets	52,235	
- Debt (including Op Leases)	534	
+ Cash	3,222	
Value of equity	54,923	
Number of shares	115.98	
<b>Value per share</b>	<b>\$474</b>	ISRG was trading at \$438 at the time of the valuation

**Narrative 2: Runaway Horse**

*The story*

In this narrative, I hold true nearly all assumptions of Narrative 1 save one - that of ISRG's sales growth rate and consequent target market share. I assume that as the world's community of surgeons accumulate expertise in da Vinci systems, it plays an ever-increasing role and becomes a larger part of the RAS growth story. In other words, ISRG's growth rate exceeds that of the overall RAS market. This is owing mostly to the deep switch costs and network effect discussed earlier in the report.

*The assumptions*

<i>in \$ mil</i>	Base year 2019	Years 1-5	Year 5-10	After year 10	Story link
Total market	7,700	Grow 14% YOY	Steady declining growth rate from 14% to 2%	Grow 2.5%	Same as Narrative 1
Market share	58%	61% -> 67%	67% -> 69%	66%	This is the only difference between the two narratives. Target market share is 69% - implying that 7 out of every 10 dollars on RAS are claimed by da Vinci machines.
Sales growth rate	20%	19% -> 16%	16% -> 2%	2%	The current growth rate of 20% declines to 16% by Year 5, thereafter falls to stable growth of 2% by Year 10.
Operating margin	29%		29% ----->	27%	Same as Narrative 1
Reinvestment	1.3		1.3 ----->	1.6	Same as Narrative 1
Cost of Capital	6.5%	6.5%	6.5%	6.5%	Derived using CAPM

*The cash flows (in \$ millions)*

	All-inclusive global surgery market	Global RAS market	Market share	Revenues	NOPAT	Reinvestment	FCFF
2019	70,000	7,700	58%	4,479	1,303	655	649
2020	71,400	8,778	61%	5,330	1,530	738	792
2021	72,828	10,007	63%	6,289	1,780	764	1,016
2022	74,285	11,408	65%	7,359	2,053	841	1,212
2023	75,770	13,005	66%	8,536	2,347	911	1,437
2024	77,286	14,826	67%	9,902	2,683	817	1,866
2025	78,831	16,545	68%	11,209	2,993	729	2,264
2026	80,408	18,068	68%	12,374	3,341	588	2,753
2027	82,016	19,296	69%	13,315	3,595	399	3,196
2028	83,656	20,145	69%	13,954	3,768	174	3,593
2029	85,330	20,548	69%	14,233	3,843	178	3,665
Terminal year	87,036	20,959	69%	14,518	3,876	181	3,695

*The value*

Terminal value	86,139	
PV (terminal value)	45,889	
PV (CF over the next 5 years)	15,016	
Value of operating assets	60,905	
- Debt (including Op Leases)	534	
+ Cash	3,222	
Value of equity	63,593	
Number of shares	115.98	
<b>Value per share</b>	<b>\$548</b>	ISRG was trading at \$438 at the time of the valuation

## Recommendation

Surgery as a means to investigate and treat pathology dates back many millennia and continues to be an essential branch of medicine. There is widespread agreement on the benefits of robot-assisted surgery (RAS), driving a growing demand from hospitals worldwide. RAS's complex and life-critical nature yields a winner-take-most landscape. The clear leader in this space is Intuitive Surgical - and has been over the past two decades.

The two narratives presented in this report yield an intrinsic value range of \$474 to \$548. At \$438, the stock offers an 8-20% margin of safety. I recommend a **Buy**.

TSR: With a 7-year hold period, and a EV/NOPAT multiple contraction from 47 (2019) to 42 (2026), yields a TSR of 13% CAGR and a 240% total gain.

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