



HARDMAN & CO.



# Artificial Solutions

Enterprise-grade artificial intelligence

*By Milan Radia, Hardman & Co Analyst*

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## Technology



Source: Refinitiv Eikon

## Market data

EPIC/TKR	ASAI.SE
Price (SEK)	25.9
12m High (SEK)	44.1
12m Low (SEK)	0.5
Shares (m)	22.0
Mkt Cap (SEKm)	570
EV (SEKm)	747m
Free Float*	20%
	Nasdaq First
Market	North

\*As defined by AIM Rule 26

## Description

Artificial Solutions is a leading global vendor of artificial intelligence (AI) software to large enterprises. Headquartered in Sweden, the company comprises around 104 people.

## Company information

CEO	Lawrence Flynn
CFO	Chris Bushnell
Chairman	Åsa Hedin
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	<a href="http://www.artificial-solutions.com">www.artificial-solutions.com</a>

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# ARTIFICIAL SOLUTIONS

## Enterprise-grade artificial intelligence

Artificial Solutions is a vendor of highly advanced artificial intelligence (AI)-based conversational solutions. Its Teneo technology platform is used by major global enterprises to automate their interactions with their own customers; these include Shell, AT&T, Vodafone, Volvo and Telenor – an enviable list and testimony to the proven technology leadership of the Teneo platform and its scalability. Strong growth rates are driven by expansion of existing customer deployments and new wins. The AI market overall is growing at ca.40% p.a., and Artificial Solutions' management expects to substantially outperform this metric over the next few years, based on contracted order backlog and the pipeline of new opportunities. AI-centric listed businesses successfully monetising the revenue opportunity are rare, and this company is one of them.

- **Leading vendor of AI solutions:** Amid surging global interest in all things related to AI, Artificial Solutions has emerged as a leading vendor of conversational AI solutions to the world's largest enterprises, particularly B2C businesses, across a range of sectors. Its Teneo platform is highly scalable, functions in 35 languages and is designed for a range of applications, of which conversational AI is the first example.
- **Firmly positioned as leading vendor in this marketplace:** A survey of 700 CIOs of large enterprises in 2018 saw Artificial Solutions being ranked third in a list of emerging technology companies to watch and being classed as leader in its segment. The major systems integrators are also seeing this, and are actively selling the Teneo platform and bringing deals to the company.
- **AI market growth is rapid:** Industry forecasts are anticipating in excess of a 40% CAGR for global industry revenue over the next five years. Against this backdrop, Artificial Solutions expects to exceed this growth rate, based on usage-based revenue growth from existing customer deployments and new customer additions, the latter partly from proof-of-concepts converting into live deployments.
- **Valuation:** Artificial Solutions commenced trading on the Nasdaq First North exchange in Stockholm in March 2019. A DCF analysis produces a mid-point implied fair equity value of €97m, while a detailed valuation of the company's intellectual property (IP) assets, comprising patents and software licences, undertaken in 2016 came in at \$96m. While these valuations are at a premium to the current valuation, we believe the company will need to deliver on revenue growth expectations.
- **Risks:** Competing with some of the world's largest technology companies brings challenges, such as keeping pace with developments, retaining talented people and creating enterprise mindshare vs. strong brands. Systems integrators are an excellent route to market but may reduce the company's visibility into potentially lengthy sales cycles, but, to date, Artificial Solutions has proven adept on these factors.

## Financial summary and valuation

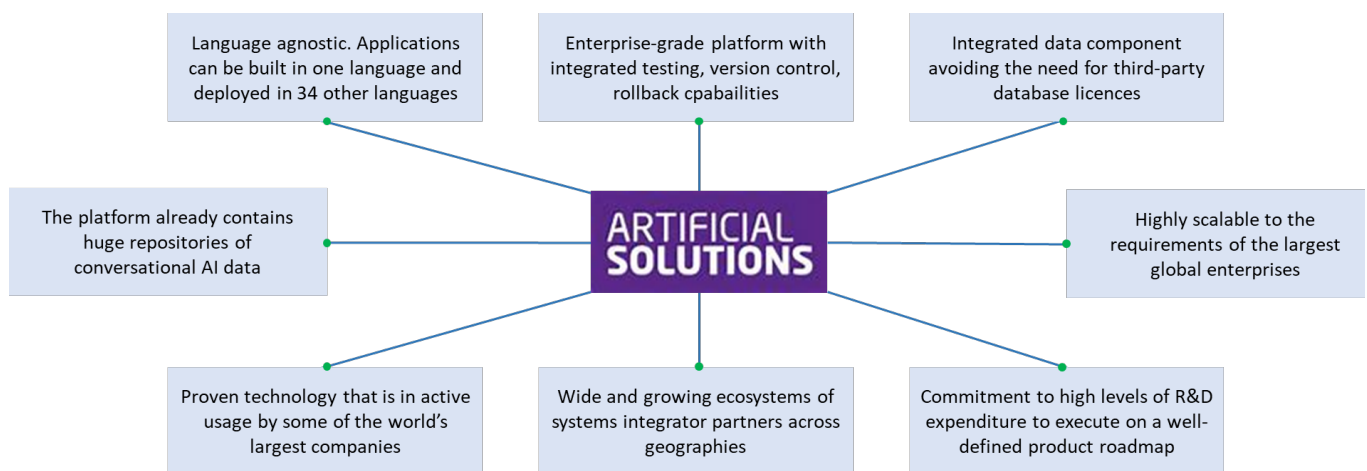
Year-end Dec (€m)	2017	2018	2019E	2020E	2021E
Revenue	7.06	6.09	8.39	11.47	17.96
EBITDA	-6.79	-9.26	-6.86	-2.70	3.44
EBITDA margin	-96%	-152%	-82%	-24%	19%
EBIT	-9.44	-11.58	-9.41	-5.51	0.35
Pre-tax profit	-10.93	-14.24	-8.81	-4.75	1.45
Net income	-10.93	-14.24	-8.81	-4.75	1.45
EPS (€)	-0.50	-0.65	-0.40	-0.22	0.07
EV/revenue (x)	10.2	11.8	8.6	6.3	4.0
EV/EBITDA (x)	-10.6	-7.8	-10.5	-26.6	20.9

Source: Hardman & Co Research

## Investment highlights

- ▶ Amid growing global interest in all things related to artificial intelligence (AI), it is the case that certain companies have created technology platforms that are not only suitable for live deployment for important applications but are also scalable to the requirements of the largest global enterprises. Artificial Solutions is one of these companies and a rare example of a relatively small, independent company that has carved out a significant customer base populated by marquee names. Examples include Shell, AT&T, Vodafone and Volkswagen. Not only have early deployments with a number of key customers been successful, in many cases Artificial Solutions has already moved on to additional deployments in other areas of their businesses.
- ▶ The company is a leading vendor of conversational AI solutions, or smart chatbots as these technologies are sometimes called. These are virtual assistants that can respond accurately and appropriately to customer queries based on a deep understanding of what the customer is seeking to do. Machine learning from millions of pieces of data is the method by which the chatbots gain the “intelligence” to engage in a conversation with the end-user. The more human-like the interaction, the more successful the chatbot is likely to be in delivering an acceptable level of satisfaction.

### Artificial Solutions – key attributes



Source: Hardman & Co Research

- ▶ Teneo is an enterprise-centric, industrial ground AI platform, designed to scale to the requirements of companies with the largest customer bases in the world. Its conversational AI solutions are seeing strong adoption rates by major enterprises seeking to drive efficiencies in their client interaction. Teneo's core data repository is built in an Apache Cassandra database, which is a highly-scalable and resilient platform for mission-critical deployments. The returns on investment for customers are readily appreciable, while the list of reference deployments for the company and its systems integrator partners continues to expand.
- ▶ Artificial Solutions has consistently achieved strong rankings within the AI industry and more widely in the technology sector. In 2018, ETR Research published the results of its survey of around 700 enterprise CIOs from companies that it calculated represented some \$300bn in annual IT spend. Of these participating companies, 229 were in the top Global 2000 IT decision makers (ITDMs), and 66 were in the Fortune 100. The overlap between these

## Artificial Solutions - Enterprise-grade artificial intelligence

enterprises and Artificial Solutions' target market is, therefore, significant. The results from an Artificial Solutions perspective are impressive, with the company ranking third among all "emerging technology companies to keep an eye on" and, perhaps even more significantly, was considered to be the best-positioned company in its sector.

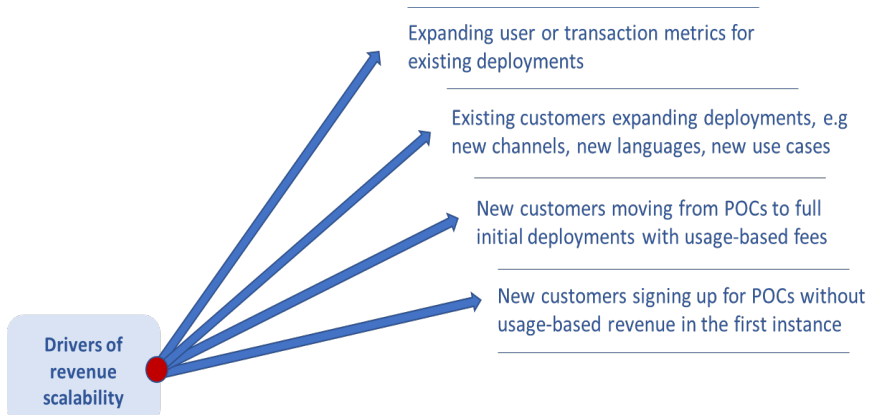
### ETR Research: Emerging technology companies to keep an eye on



Source: ETR Research

- Inherent revenue scalability. Artificial Solutions sells term licences that grant an enterprise the right to use the Teneo platform for a specified period – usually two or three years. Alongside the term licences, and associated support and maintenance contracts, each customer contract incorporates a usage-based revenue element. The enterprise-grade nature of the company's conversational AI capabilities allows the company to focus its attention on the largest enterprises with the highest numbers of users. The other side of the coin is that sales cycles are typically fairly extended and usually require pilot deployments in some form. However, once these enterprises have accepted that Artificial Solutions delivers on their requirements, the opportunity to scale revenue is substantial. The diagram below sets out the ways in which these deployments have, to date, tended to evolve.

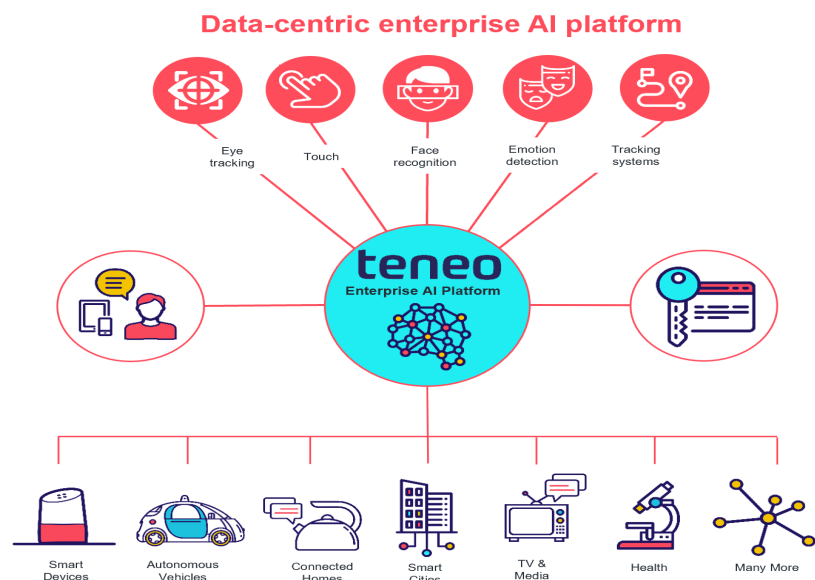
### Artificial Solutions – drivers of revenue scalability



Source: Hardman & Co Research

- Teneo is a broad AI platform. While the initial core focus has been on conversational AI systems and applications, from day one, the company's ambitions for the platform were far greater. The next strategic step for Teneo is to extend its capabilities to make it a full-stack AI enterprise platform. The schematic below sets out some of the vision, with a range of data inputs across biometrics and other highly advanced recognition systems, and the application spanning a full spectrum of Internet of Things (IOT) connected environments, including smart cities, connect homes, autonomous vehicles and healthcare systems. The scalability of the platform has been designed to meet the requirements of these megadata-centric applications. The systems integrator partnerships that Artificial Solutions has cultivated will be critical in addressing these opportunities, and it is likely that targeted acquisitions will, over time, be made to augment the existing development capabilities and resources.

### Artificial Solutions' Teneo platform summarised



Source: Company data

- Transition from consultancy to platform licence sales. The revenue mix continues to trend towards licences. Since completing the initial development of the core software platform, called Teneo, in 2013, the company has focused on reducing its proportion of services revenue through engaging with partners to sell and implement its Teneo platform. The benefits to Artificial Solutions include significantly enhanced margins and improved revenue scalability. The impact of the strategic decision to shift the revenue mix away from Professional Services should not be understated. The relatively complex nature of AI-based conversational solutions lends itself to input from the systems integrators for large enterprises seeking an integrated customer-facing infrastructure. The need to integrate the Teneo platform with other elements of the IT infrastructure drive relatively sizeable services engagements. Three primary drivers of this shift were i) the higher margins associated with software revenue, ii) the greater predictability of term licence and usage-based revenue streams, and iii) the scope to scale the customer base at a faster rate, with the benefit of systems integrator (SI) partners actively selling the platform through dedicated AI practices worldwide. The inevitable shorter-term impact pending an uplift in usage revenue has been a flatter revenue profile, as the services revenue continues to play a diminishing profile in the revenue mix. Going forward, this is expected to be far more than offset by the revenue backlog converting into revenue.



## Artificial Solutions - Enterprise-grade artificial intelligence

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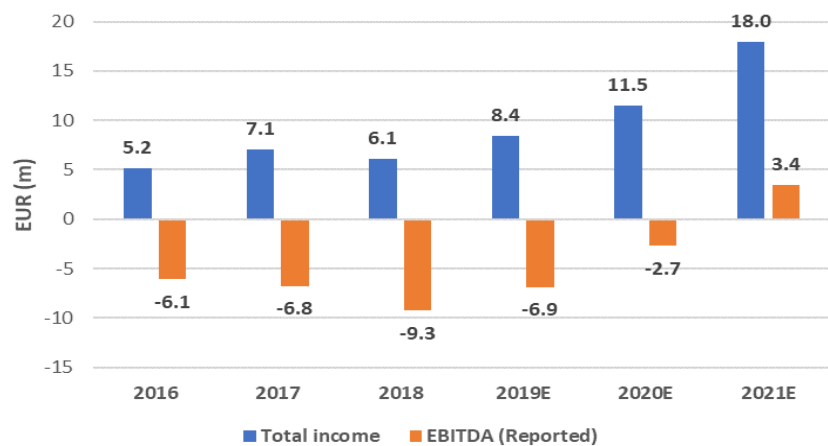
- ▶ SI interest in the Teneo platform remains high. This is because there is acknowledgement that Teneo offers one of the leading conversational AI solutions globally. SIs actively engaged with Artificial Solutions today include Accenture, KPMG, Sapient, Deloitte, Teleperformance and Cognizant – a very healthy list for a company of this size. These relationships are evolving quickly from an implementation-led set of relationships with the SIs to growing evidence that the latter are able to sell the Teneo platform without significant, or, in some cases, any input from Artificial Solutions. During 2018, the company received its first two deals in which it had no involvement during the sales cycle, one with a payments service provider with KPMG and the other with a large Asian enterprise with Teleperformance. Beyond the large SIs, smaller, more specialist partners are also seen as potentially important over the medium term.
- ▶ Competitive landscape is populated by heavyweights. Unsurprisingly, the SIs are also working with AI solutions being developed by the likes of IBM, Google and Microsoft. Artificial Solutions is focused on more complex deployments and believes that it is seen as the preferred vendor by many of the SIs when the use case is mission-critical and sophisticated – for example featuring multiple languages and multi-channel interaction with end-users.
- ▶ AI platforms are, by their nature, data-intensive. However, Artificial Solutions does not compete with its customers for data. For on-premise deployments of the Teneo platforms, the data specific to a customer reside with that customer and remain in its ownership. In 2018, the majority of Teneo deployments were on-premise. Of course, it is important that any machine-learning platform has access to the relevant data to improve algorithms to learn and improve. Where customers have to protect data, Artificial Solutions is able to enter into data agreements that allow anonymised sharing of data to drive improvements in the Teneo platform.

## Financial summary

### At a pivotal juncture in its development

Artificial Solutions is at a pivotal juncture in its development. Having created a proven, industrial-grade, AI platform designed for the requirements of the largest global enterprises, the company's focus has shifted to executing on a growing pipeline of proof-of-concept deployments. Systems integrators are actively selling the company's Teneo AI platform, and this is reflected in the rising share of order intake from partners, which, in 2018, stood at 50%, and is set to increase further.

### Artificial Solutions – revenue and EBITDA progression, 2016-21E



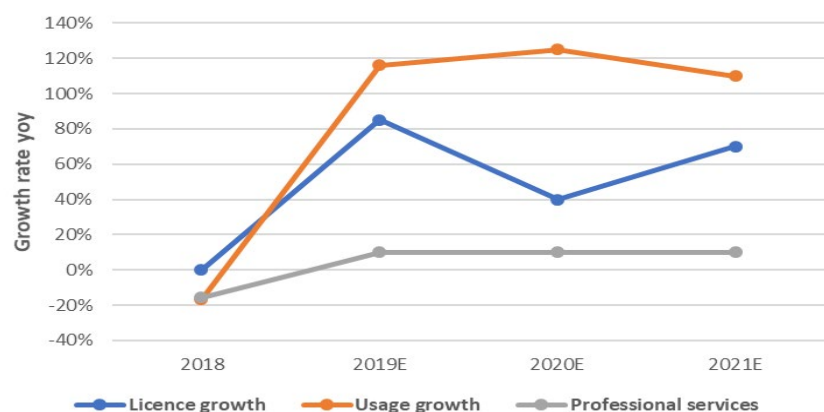
Source: Company data, Hardman & Co Research

## Revenue

### Inherently scalable revenue model

The revenue model is inherently scalable, with multi-year term licences and compulsory support agreements creating revenue visibility, augmented by a growing base of usage revenue generated by user growth and transactions through the enterprise applications built on the Teneo platform. Artificial Solutions' revenue growth over the next few years is expected to materially exceed the growth rates of the Natural Language Processing (NLP) end-market, which is expected to grow at ca.40% p.a. over the next five years.

### Artificial Solutions – revenue growth rates by segment

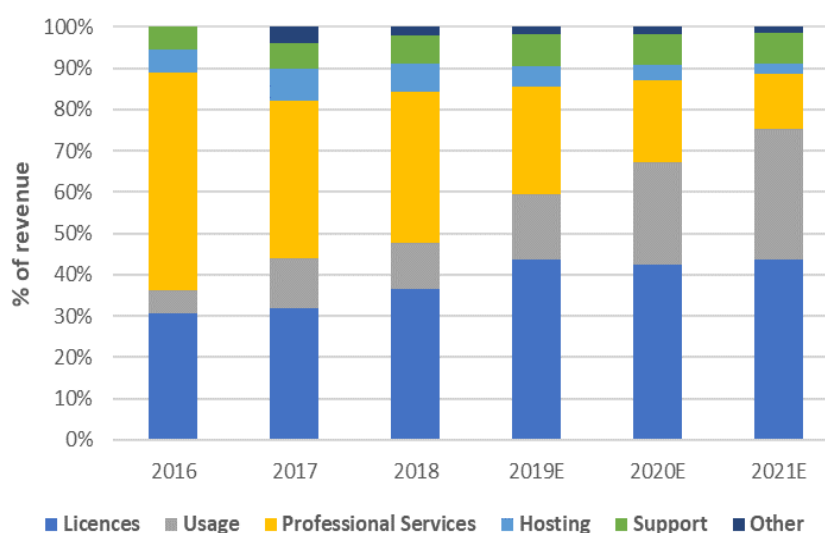


Source: Company data, Hardman & Co Research



At the same time, the shift away from Professional Services will be pronounced – in 2016, this segment represented 52% of revenue; by 2021, we expect that proportion to have come down to 13%.

### Artificial Solutions – revenue mix, 2016-21E



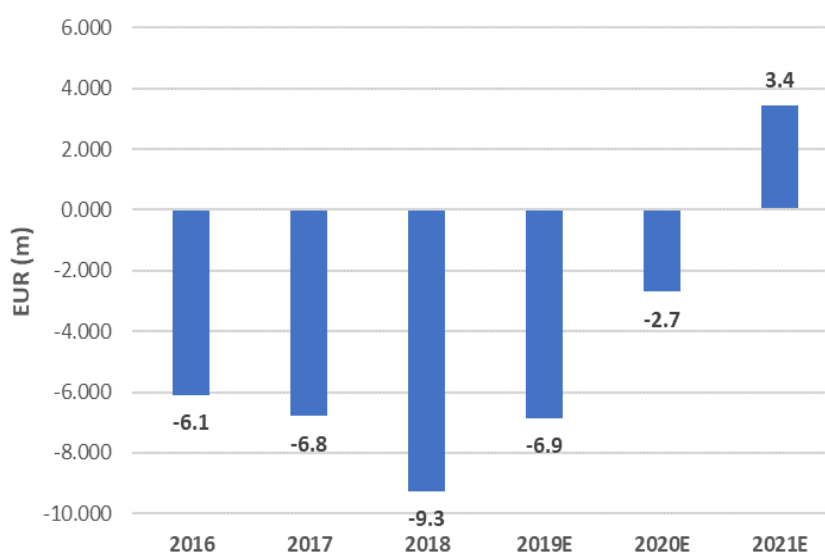
Source: Company data, Hardman & Co Research

## Margins

EBITDA breakeven by 2021

We expect the company to achieve EBITDA breakeven in 2021, driven by a growing proportion of higher licence and usage-based revenue within the overall revenue mix, together with operational gearing driven by a relatively flat anticipated profile of operating expenses. Our forecast summary is set out in the chart below.

### Artificial Solutions – EBITDA evolution, 2016-21E



Source: Company data, Hardman & Co Research

## Valuation

Implied fair value of firm of €114m...

Our approach to understanding the potential valuation of Artificial Solutions centres on a discounted cash flow (DCF) analysis. At the same time, we take account of a detailed valuation undertaken in 2016 of the company's intellectual property (IP) assets in the form of patents and software licences.

In summary, the DCF analysis produces a mid-point implied fair enterprise value of €114m and an equity fair value of €97m, while the IP valuation in 2016 was \$96m. Since then, a further patent has been added by Artificial Solutions. Therefore, in broad terms, the two approaches produce similar outcomes in a narrow range of €95m to €100m as an implied enterprise value for the business. This compares with the current enterprise value of ca.€56m (SEK585m).

### DCF valuation

...which equates to equity value of €97m

Based on relatively conservative assumptions, which are set out in their entirety in the table below, we derive an implied fair value for the company of €114m, which, after the current net debt position of ca.€17m, equates to an equity value of €97m. Sensitivity tables are set out on the next page. In Swedish Krona, this is SEK915m, which compares with the company's current market capitalisation on the NASDAQ First North Exchange in Stockholm of ca.SEK560m.

#### Artificial Solutions – Hardman & Co discounted cashflow analysis

##### Key inputs

Terminal FCF growth rate	3.0%
Long-term sustainable EBIT margin	30.0%
Long-term tax rate on EBIT	20.0%
<b>WACC</b>	<b>10.0%</b>

Y/end December, €m	2019E	2020E	2021E	2022E	2023E	2024E	2025E	2026E	2027E	Terminal value
<b>Revenues</b>	<b>8.4</b>	<b>11.5</b>	<b>18.0</b>	<b>26.5</b>	<b>37.0</b>	<b>48.8</b>	<b>60.4</b>	<b>70.0</b>	<b>72.1</b>	
yoy growth	37.8%	36.7%	56.6%	47.6%	39.7%	31.8%	23.8%	15.9%	3.0%	
EBIT margin	-112.2%	-48.0%	1.9%	6.6%	11.3%	16.0%	20.6%	25.3%	30.0%	
<b>EBIT</b>	<b>-9.4</b>	<b>-5.5</b>	<b>0.3</b>	<b>1.8</b>	<b>4.2</b>	<b>7.8</b>	<b>12.5</b>	<b>17.7</b>	<b>21.6</b>	
Depreciation & amortisation	2.6	2.8	3.1	3.1	3.1	3.0	3.0	3.0	3.0	
Capitalised costs	-1.2	-1.4	-1.6	-1.6	-1.7	-1.7	-1.8	-1.8	-1.9	
<b>Adj. EBITDA</b>	<b>-8.1</b>	<b>-4.1</b>	<b>1.8</b>	<b>3.2</b>	<b>5.6</b>	<b>9.1</b>	<b>13.7</b>	<b>18.9</b>	<b>22.7</b>	
Tax rate	0.0%	0.0%	0.0%	10.0%	15.0%	20.0%	20.0%	20.0%	20.0%	
Tax on EBIT	0.0	0.0	0.0	-0.2	-0.6	-1.6	-2.5	-3.5	-4.3	
Change in net working capital	0.6	1.8	1.1	0.9	0.7	0.6	0.4	0.4	0.3	
<b>Cashflow from operations</b>	<b>-7.4</b>	<b>-2.3</b>	<b>2.9</b>	<b>3.9</b>	<b>5.6</b>	<b>8.1</b>	<b>11.7</b>	<b>15.7</b>	<b>18.7</b>	
Capex	-0.7	-0.4	-0.2	-0.7	-1.1	-1.6	-2.1	-2.5	-3.0	
<b>Unlevered free cash flow</b>	<b>-8.1</b>	<b>-2.7</b>	<b>2.7</b>	<b>3.2</b>	<b>4.5</b>	<b>6.5</b>	<b>9.6</b>	<b>13.2</b>	<b>15.7</b>	<b>224.1</b>
Year	1	2	3	4	5	6	7	8	9	10
Discount factor	1.10	1.21	1.33	1.46	1.61	1.77	1.95	2.14	2.36	2.36
<b>Present value</b>	<b>-7.3</b>	<b>-2.2</b>	<b>2.0</b>	<b>2.2</b>	<b>2.8</b>	<b>3.7</b>	<b>4.9</b>	<b>6.1</b>	<b>6.7</b>	<b>95.1</b>

Note: based on medium-term assumptions from 2022E

##### Implied valuation metrics

Implied valuation metrics	EURm
Sum of 9-year cash flow	18.9
Terminal value	95.1
Value of the firm	113.9
Net funds	-17.0
<b>Total equity value</b>	<b>96.9</b>
No. of shares in issue (m)	22.0
<b>Fair value share price (EUR)</b>	<b>4.4</b>
€:SEK exchange rate	10.4
<b>Fair value share price (EUR)</b>	<b>45.9</b>

Source: Hardman & Co Research

## DCF sensitivity varying WACC and terminal FCF growth rate

€m	8%	9%	10%	11%	12%
1.5%	126	100	80	65	53
2.0%	136	107	85	68	55
2.5%	148	115	91	72	58
3.0%	162	124	97	77	62
3.5%	180	135	104	82	65
4.0%	202	148	113	88	70
4.5%	230	164	123	95	74

Source: Hardman &amp; Co Research

## DCF sensitivity varying terminal EBIT margin and terminal FCF growth rate

€m	20%	25%	30%	35%	40%
1.5%	43	62	80	99	117
2.0%	46	66	85	104	124
2.5%	50	70	91	111	131
3.0%	54	75	97	119	140
3.5%	58	81	104	127	150
4.0%	64	88	113	137	162
4.5%	70	96	123	149	176

Source: Hardman &amp; Co Research

## IP assets

IP assets valued at \$96m

Artificial Solutions' patents describe the systems and methods used to develop and deliver the Teneo platform. An in-depth analysis of its patent portfolio was undertaken in 2Q 2016 by Oxfirst, a leading IP consultancy. At that stage, the company was deemed to have a patent portfolio representing 0.97% of the relevant US patent landscape and 0.63% of the relevant European patent landscape. This led Oxfirst to estimate that the commercial value of Artificial Solutions' IP assets was \$96m, comprising \$56m for the patent portfolio and \$40m for the software licences.

## Artificial Solutions – key patents

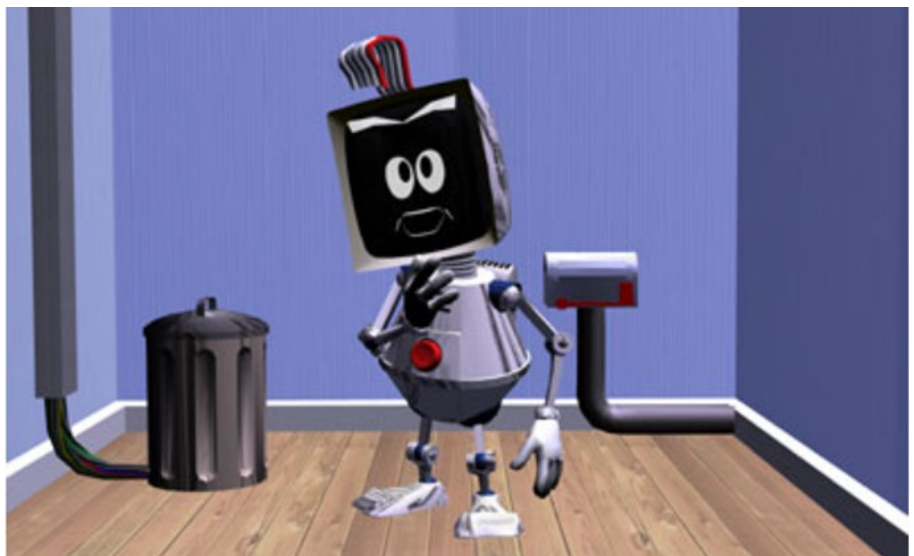
Network of Virtual Assistants	A system for the operation of a virtual assistant (VA) network, comprising a plurality of VAs and related brokers operating on network-connected devices, wherein the VAs receive user requests and send these to VA brokers which delegate these to other VAs for fulfilment. (Patent nos 9172747; filing 12/11/2014; US)
Teneo: Core	The system comprises a dialogue interface module, a natural language engine, a solution data repository per domain and language, and a plurality of flow elements and rules for managing interactions with users, and an interface software model. (Patent nos 8346563; filing 30/12/2012; US)
Teneo: Development data, training, automation	Conversational AI applications enable users to interact with technology in a humanlike manner. This patent covers the system, methods and tools to build, test and optimise such applications in a semiautomatic manner utilising usage data in the form of transaction log files. (Patent nos 8892419 & 8903711; filing 04/12/2012; US)
Teneo Data (Patent pending)	A system for natural language (NL) analytics, comprising a NL application data importer, a NL application data augmentor that enriches the data, and an analytics component which provides a means of querying and analysing structured and unstructured data. (Patent pending; filing 13/05/2015; US)
Teneo Hybrid Methodology	A system for combining both linguistic and machine learning approaches for developing, optimizing and executing conversational interaction applications. (Patent nos 10068174; filing 04/09/2018; US)

Source: Company data

## Company background

- ▶ Artificial Solutions' origins lie in a consultancy for enterprises with a focus on artificial intelligence (AI). The offerings were centred on integration of various snippets of code around a core processing engine. While these technology components were being integrated to deliver comprehensive client solutions, the services-centric model inherently lacked scalability. However, there were a meaningful number of customers using the application, which was already deployed in 21 languages. These deployments provided the company with invaluable insights into how people really interacted with technology in their customers' domains.
- ▶ In 2008, the company hit the headlines when its chatbot, named Elbot, claimed the Loebner Prize. Elbot, pictured below, is a humorous "chatterbot" that does not pretend to be human. Rather, it (or perhaps he) is designed to come across as a robot that is powered by a human. The Loebner prize is based on the Turing Test (discussed later in this report) – Elbot persuaded three of 12 judges that they were conversing with a human, which we understand is the best result so far in the almost 30 years that the Loebner Prize has been on offer.

### Artificial Solutions' Elbot chatterbot



*Source: Company data*

- ▶ Elbot remains in active service in app and website form, and is a nice showcase for some of the company's conversational AI capabilities, displaying an ability to memorise and recall earlier parts of conversations, and recognise user sentiment, while also proactively taking conversations into different directions. However, Elbot as a character is not a central feature of the company's Teneo enterprise software platform. There are many chatterbots in existence today, and their collective progression in becoming more humanlike is strong.
- ▶ In September 2010, fairly soon after the arrival of the current CEO, a decision was made to transition Artificial Solutions towards a software-based business model. To achieve this, a new software platform was built from the ground up using the accumulated know-how and the capabilities of the existing components and modules. A key benefit of the prior consulting experience was that Artificial Solutions' substantial knowledge of implementation complexities and customer requirements could essentially be productised and embedded in

## Artificial Solutions - Enterprise-grade artificial intelligence

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the new platform. The platform development process commenced in earnest in 2011, and the first release of the new software platform did not happen until around two and a half years later, in 2013.

- ▶ Around this time, Artificial Solutions started to sell direct to enterprises to gain references for its second-generation solutions. Since this time, consultancy activities and services revenue have become progressively less important for the business.
- ▶ This first release of Teneo was sufficiently evolved to allow some customers to be migrated. It was also around this time that Apple first launched Siri, which cast a spotlight on digital assistants and AI in a conversational context. On the one hand, management notes that it had to help potential customers understand the difference between a basic proposition such as Siri and highly advanced technologies such as those of Artificial Solutions; on the other hand, it did facilitate broader activity in this segment.

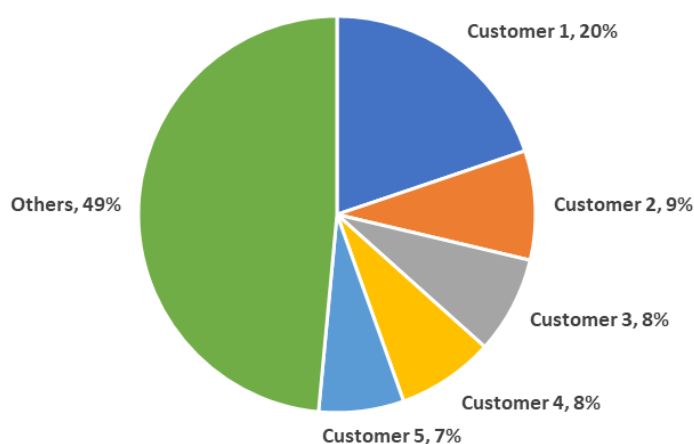
## Customer base

### A well-diversified customer base

Artificial Solutions has managed to create a well-diversified customer base comprising large enterprises across a range of industry sectors. Its top customers represent a total of 51% of total revenue, a metric that will reduce over time, as additional customer deployments start to generate material usage-based revenue streams. The “Other” category in the pie chart below comprises a combination of proof-of-concepts, as well as early-stage full deployments.

In light of Gartner’s observation that only 4% of CIOs have actually implemented AI systems so far, Artificial Solutions’ customer roster represents strong progress, particularly for an independent company such as Artificial Solutions. With the benefit of a proven technology platform and intensifying activity by SI partners, the company appears to be well placed to hold its own in terms of market share over the next few years.

### Artificial Solutions – customer concentration



Source: Company data, Hardman & Co Research, Company data

### Global oil company

A major oil company commissioned a specialist solution from Artificial Solutions, resulting in an extranet-based chatbot to provide assistance with technical queries relating to the company’s industrial oils and lubricants. The customer operates a 24x7 technical support centre based in Europe; the chatbot deployment has facilitated a reduction in technical staff headcount at this support centre of 40%. Currently, the chatbot is available in seven languages – English, German, French, Chinese, Japanese Russian and Spanish.

### Major auto manufacturer

In 2018, Artificial Solutions won a contract with a major auto manufacturer, which has decided to standardise on the Teneo platform for all of its conversational AI applications. A key driver for this decision has been the company’s growing understanding that there is a significant correlation between customer test drives and sales of new cars. A robot called Lucy has been deployed in the company’s Spanish business, using the Teneo platform. Lucy engages with customers visiting the website, offering and booking test drives. The end-result to date has been a 400% improvement in the dropout rate of customers visiting the website, but not taking matters further.

## Artificial Solutions - Enterprise-grade artificial intelligence

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### Top 20 US fast food chain

One of the larger fast food chains in the US has deployed chatbot agents to take customer orders that will take many millions of orders p.a. Working with a major SI, Artificial Solutions has developed a talking chatbot agent to take these customer orders, which is currently in the proof-of-concept phase, with the intention of rolling out the capability across a substantial number of outlets across the country.

### Emerging opportunities in video gaming and autonomous vehicles

## Additional sector opportunities

Artificial Solutions is already exploring a series of additional market opportunities with meaningful players in these respective segments. These initiatives are generally still at the R&D stage, but with their prospects bolstered by the involvement of partners. Two examples are as follows:

- (i) In the video gaming segment, Artificial Solutions is working with a major games console manufacturer. The focus is on the development of virtual reality gaming offerings, with synchronised voice control of characters and other aspects of the gaming experience. This initiative is still at the R&D stage; however, work has also recently commenced with a games development studio, creating a second partnership in this segment.
- (ii) Autonomous vehicles are widely seen as a potentially transformational technology. AI will play a critical role in autonomous vehicles – of that there can be little doubt. The level of investment going into this segment is enormous but, at this juncture, it remains tricky to select the winners. Artificial Solutions has opted to work with infrastructure providers to develop voice-driven AI solutions to control and operate these vehicles and the various systems that they will contain. Notably, Artificial Solutions has some exposure to the automotive sector today, as it has developed a speaking user manual for a large automotive manufacturer specific to particular models of its cars.



## Strong ROI proposition

### Transparent and quantifiable ROI proposition

The enterprise market is an obvious opportunity for conversational AI technologies, particularly where companies are interacting with their end-customers for product information, post-sale customer service or handling of complaints. Enterprise CIOs already understand that AI will be beneficial for their businesses; however, they are still working out how to get there. SIs will have a major role to play in influencing enterprise decision-making on the right platforms and applications.

Cost reduction is undoubtedly one of the primary drivers of enterprise adoption of the Teneo platform. One of the relative advantages of selling a conversational AI solution compared with other less-well-defined AI solutions is that the potential return on investment (ROI) is relatively transparent. These solutions are providing end-users with an alternative way of communicating with the enterprise to human interaction. In the absence of an automated customer services offering, end-users will engage with customer services employees at a cost per transaction that is readily quantifiable.

### Enterprise drivers of AI adoption

#### 1. Cost reduction / efficiencies

Substitution of enterprise human interaction with customers with multi-lingual conversational AI / chatbots offers scope to reduce customer service costs, call centre headcount and centralise operations in particular geographies.

#### 2. Revenue expansion

Chatbots, when properly configured and implemented, should have a clear purpose, whether to drive revenue conversion rates or enhance customer service satisfaction ratios. The end-user is guided towards the preferred outcome.

#### 3. Competitive differentiation

Amidst fairly dramatic shifts in how customers are seeking to interact with enterprises (retail banking is a stark example), chatbots and automated services that are available 24x7 signify innovation, convenience and a focus on customer care.

*Source: Company data, Hardman & Co Research*

## Substantial cost savings versus human customer interaction

### Teneo platform has highly favourable ROI characteristics

For example, in the section on usage fees with Artificial Solutions' revenue model that we discussed in the previous section, a major enterprise user of Teneo estimates its cost per call centre interaction at a few dollars. This is far higher than the usage fees that this customer pays to Artificial Solutions per active user. So, if a customer were to call multiple times, for example, to resolve various points relating to a new account or a particular product, the saving for that customer example would be very significant if Artificial Solutions were deployed and able to assist with the various queries. It is certainly clear why enterprises would consider deploying the Teneo platform and investing in ensuring that it is as effective as possible, given its highly-favourable ROI characteristics.

### Financial alignment between company and customers

#### Pricing is typically ROI-based

Artificial Solutions agrees rate cards with each of its customers that are linked directly to the expected ROI. The alignment between the company and its customers is an attractive feature of the business model. Growing usage fees are directly correlated with cost savings being generated by end-user adoption of the automated customer interaction option. Volume discounts are also a characteristic of agreements, but, given the scale of the enterprises concerned, the absolute numbers are typically quite large for these discounts to become activated.

### Inherent scalability of revenue once initial deployments have taken place

#### Success-based revenue streams

In a number of use cases, Artificial Solutions' usage or transaction-based revenue is dependent on the number of correctly interpreted data points. Customers' interests, therefore, become aligned with those of Artificial Solutions in terms of delivering lower error rates and faster throughput.

The agreed transaction fee structure is based on a volume-driven sliding scale, with a minimum of a few cents per order placed through an automated order bot. By way of a simple example, if millions of orders p.a. were automated, at a transaction fee of a couple of cents, this would equate to several millions of annualised revenue to Artificial Solutions from just one customer. This example is illustrative of the inherent scalability of revenue once initial deployments have taken place. The roadmap with this customer includes the addition of speech-enabled ordering in the company's mobile app.

# Conversational AI

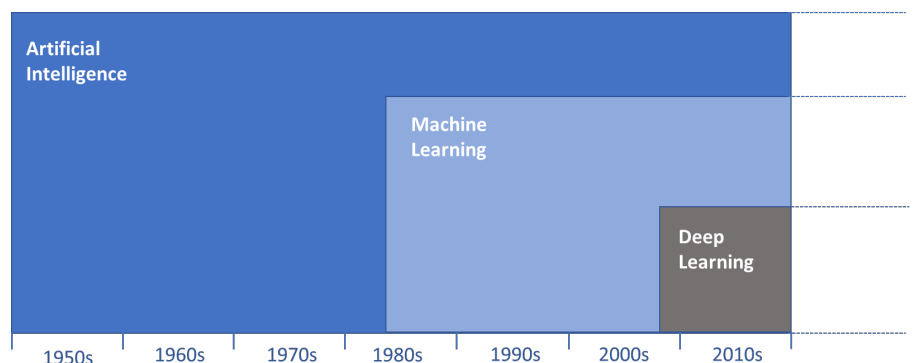
## The history of AI

Enormous implications of AI for the world as we know it

Artificial Intelligence (AI) essentially started off as a psychology-based attempt to replicate on a computer how people think and process. The term “artificial intelligence” is widely acknowledged to have first been formally coined in 1956 at a research project conference held at Dartmouth College, in the US. Interestingly, these scientists concluded that machines that could reason as effectively as humans would be developed within a generation, which proved to be a rather optimistic conclusion. However, they were right to identify this as a future trend with enormous implications for the world as we know it. Intelligence implies that a computer or machine can make decisions based on an appreciation of the circumstances or context in which these are being taken. This is a central tenet of what we know as human intelligence. We are still some way away from developing machines that have true humanlike intelligence, but progression towards this goal of general AI will continue to be made over the coming decades.

AI is already being used widely by enterprises, but users may not immediately recognise this in their interactions with technology or business applications. This might take the form of an instruction to Amazon Alexa or a fraud alert from a credit card company while attempting an online payment transaction or, increasingly, an online chat or telephone interaction with an intelligent chatbot.

### The evolution of AI



Source: Microsoft, Hardman & Co Research

## Machine learning

Machine learning has splintered into multiple strands of development

AI is evolving rapidly and, over the past three decades, has encompassed machine learning and deep learning. Machine learning was developed in the 1980s, and has become a mainstay of AI as it is understood today. Machine learning is centred on data science techniques, i.e. it is based on algorithms that process data in particular ways to produce helpful outputs. To some extent, machine learning could be characterised as the difference between rules-based computing and data being used to create the rules. The next step in this process is, of course, to evaluate whether the inference or prediction that is the output is correct.

The evolution of machine learning has become splintered into multiple schools of thought, each pursuing different routes to developing the ideal algorithms. Symbolic Reasoning (complex systems of rules derived from data), neural networks (machine learning based on neuroscience), decision trees (iteration through elimination of solutions that do not match the desired output) and Bayesian inference (statistical methods based on probability theory) are all examples of these schools of thought.

It may be many years before anyone can identify which is the correct path to follow, and many believe that a combination of these efforts will eventually be the right way forward, which is an intuitively attractive conclusion.

### Deep learning

Deep learning is based on neural networks

Deep learning is based on neural networks, which were first invented many years ago as mathematical models of the brain. The deep learning approach is inspired by the neurons and connections that are present in the human brain. The acceleration over the last decade in the pace of development of these “networks” has been extraordinary, resulting in AI being considered in applications across most industrial and service sectors.

Deep-learning networks are data-intensive, and can be thousands of layers deep and have billions of parameters in extreme scenarios. However, the debate continues as to whether deep learning will ever produce truly humanlike intelligence, because pattern recognition capabilities are not equivalent to human common sense or human “smarts”. By changing a few inputs, deep learning systems are often shown to be unable to adapt to the new circumstances in the absence of being fed appropriate learning data on the new scenario. None of this changes the huge potential benefits of AI-based automation, but it does mean that there needs to be recognition of the limitations. There are well documented examples of AI facial recognition producing biased conclusions in a criminal identification context, as they were fed data heavily weighted towards certain ethnicities. This is part of the learning curve for the organisations developing these types of systems. Perhaps unsurprisingly, the ethics of AI have become a hot topic.

### Chatbots

Within two to three years, IBM predicts  
85% of customer service interactions  
could be handled by automated customer  
service agents

Amid the recognition that AI will have a very important role to play in the business world, call centres have been fairly early-adopters of AI in the form of conversational AI solutions. IBM has published estimates suggesting that within two to three years, 85% of customer service interactions will be handled by automated customer service agents, i.e. chatbots. Telecoms network operators, financial services companies and fast-food chains are all already examples of sectors where chatbots are in extensive use.

#### *Eliza, the world's first chatbot*

The first chatbot is accredited to a US scientist at MIT by the name of Joseph Weizenbaum, who developed a psychotherapist chatbot called Eliza. The project was deemed to be a success, as users were impressed the chatbot's ability to pluck out certain words and phrases from the user's statements and insert them into pre-programmed sentences that Eliza used in response.

#### *Consumers are embracing virtual assistants*

Perhaps the most familiar aspects of AI today are the virtual digital assistants contained within smart home devices such as Amazon Echo and Google Home Hub devices. Aimed at the consumer market, these devices are easy to configure and use, and bring AI-based intelligent conversational abilities to domestic environments. The ability to control smart home devices, access digital content and leverage a range of convenience and information features is driving exceptionally strong growth in adoption of these technologies in the consumer market. These offerings are grounded in conversational AI, i.e. intelligent digital assistants that are able to offer human-like interaction abilities.

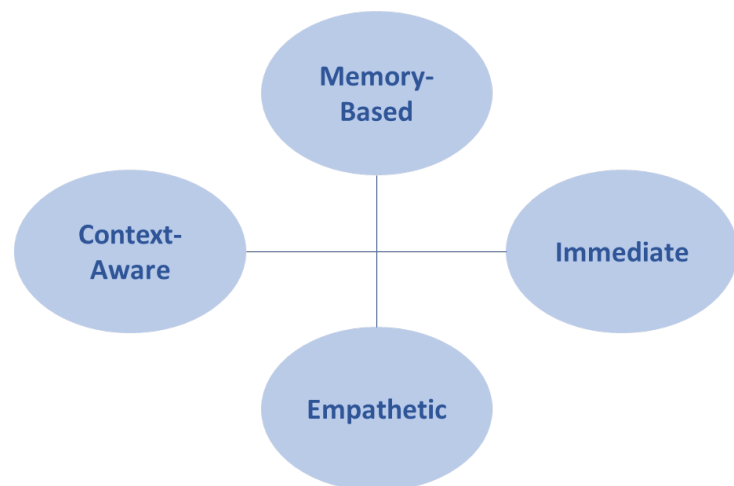
### Chatbot needs to understand context and user's intent

#### *Conversations are contextual*

For a chatbot to be conversational, it needs to be aware of the context in which the human participating in the conversation is making the request or statement. In order to keep the flow of the conversation going, it is key that the chatbot responds in the current context. So, for example, if a user asks a question about the weather and follows up with a second question that does not mention the weather, the chatbot should ideally be able to recognise whether the follow-up question is still on the same topic or has strayed onto a different subject, i.e. it needs to understand the context and the user's intent and answers accordingly. This is the essence of a conversation.

We identify the following key ingredients of a chatbot, which are key to creating a conversational capability that resembles a human. Beyond context, an ability to recognise an emotion and respond with empathy is key, and a memory for what has been said and immediacy of responses are all part of the requisite toolkit.

#### Key ingredients of a conversational AI chatbot



Source: Hardman & Co Research

### Human conversations are not linear

#### *The importance of nuances*

However, human conversation is not linear, by which we mean that humans will often tend to meander through a conversation via various adjuncts and distractions. It is far from straightforward for a computer platform to recognise and respond to these deviations when the context changes. Similarly, when creating a machine learning platform, nuances are important:

1. "You cancelled my order, I would like a refund"
2. "I cancelled my order and I would like a refund"

These are similar statements, but each implies something very different in terms of the cause of the issue and the conclusion that the AI platform should reach to address the end-user's issue in this scenario. Particularly in scenario (1), the end-user will likely have a reduced tolerance level for an ineffective first response. Properly configured, the chatbot will recognise this and activate the appropriate next steps. In order to achieve this, the platform needs to recognise meaning.

### Understanding nuances is critical for user satisfaction

#### *Training is key to capturing meaning*

So, how are all of these engineered into a chatbot? There is a lot of verbal complexity in a conversation. Understanding these nuances is a critical driver of user satisfaction when it comes to resolving matters such as the example above.

Teneo implementations have, to date, been successful in 80% of total deployments, which is a compelling success rate. Teneo achieves these success rates by having trained its machine learning platform rigorously from millions of examples of word usage in order to capture meaning. This is done by capturing relationships between words. These word embeddings are mathematical representations of words derived from the training process. Customers are ultimately seeking a combination of positive customer experience, productivity/throughput enhancements and cost savings that the platform delivers in terms of operational expense reductions. One metric that measures this rate of success is the proportion of customer service queries that are resolved during the first interaction with the robot.

#### *The data belongs to the customer*

Customer services, by its nature, is an area of activity where enterprises may possess substantial repositories of information about their customers. It is this data, together with data collected from ongoing customer interactions, that feeds into the optimisation of chatbots through machine learning. However, Artificial Solutions remains clear in its position that this data belongs to the customer. It does not demand that the data is uploaded to the Cloud or create any level of opacity with respect to where the data is stored and how it is replicated. For many large enterprises, these are important factors from a regulatory and risk management perspective, as we discuss in more detail in a separate section of this report.

#### *The Turing Test*

In a conversational AI context, the Turing Test is a benchmark developed by Alan Turing in 1950, which was based on the notion that computers able to converse with humans were thinking like humans. The test was called "the imitation game" and comprised a human communicating with a machine and a human without knowing which was which, and having to identify the machine based on the nature of the conversation.

#### *Machines are approaching parity with human accuracy in some tests*

AI is now approaching the accuracy levels of humans in many core disciplines and tasks. A number of tests undertaken in the last two to three years have seen computers achieving parity, on a standardised basis, with humans. These include object recognition tests (RESNET vision test), switchboard speech recognition and reading comprehension (SQuAD test). This does not mean that perfect results were achieved; rather that the results were in line with average score ranges for humans. Nonetheless, this represents remarkable progress in the AI journey. Despite all of the progress, there can be no doubt that we are in the very early days of what AI will ultimately become and the role it will play.

#### *Artificial general intelligence (AGI)*

### AGI the 'holy grail' of AI

AGI is, in some sense, the holy grail of AI, and refers to a scenario in which a machine can be built that is as smart as a human. While AI efforts today are focused on specific tasks and workloads, achieving parity with general brain power is a long way away. A book entitled *Architects of Intelligence*, authored by Martin Ford, contains interviews with some of the leading authorities in AI globally, whose collective average estimate of when AGI will be achieved was in 80 years' time. Equally significant is the relative lack of consensus with respect to the path to AGI, whether deep learning/neural networks, symbolic logic or some other type of breakthrough. Certainly, the pace of development in the industry is extraordinary, leading to many debates on whether human existence as we know it will ultimately be threatened by

## Artificial Solutions - Enterprise-grade artificial intelligence

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machines. These are better left for another day, but questions and concerns will continue to arise with respect to data bias and alignment of values, i.e. the ethics of AI, which is of critical importance.

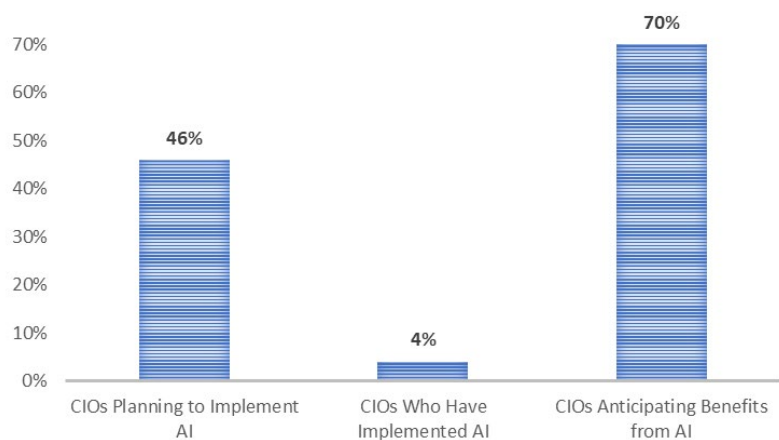


## AI market growth forecasts

### Enterprises have barely scratched the surface with AI

Despite all of the hype around AI and the growing acknowledgment that it will play a growing role in the consumer and enterprise arenas, the extent to which AI solutions have actually been implemented is rather limited. Gartner's 2018 CIO survey revealed that, while 70% of CIOs anticipate benefits from AI, only 4% have actually implemented AI in any guise, but 46% plan to do so, suggesting a buoyant addressable market for vendors with proven and enterprise-grade AI offerings.

#### Artificial Solutions - AI findings from 2018 Gartner CIO survey



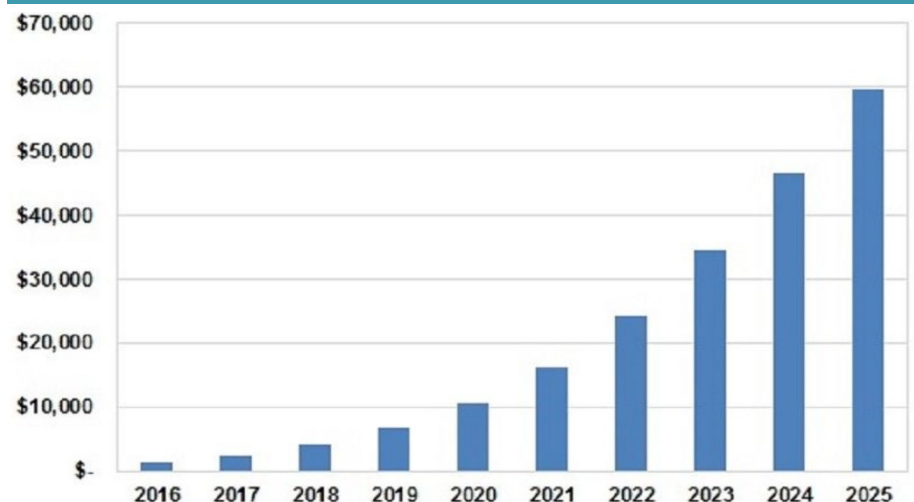
Source: Gartner CIO Survey 2018, Hardman & Co Research

### Substantial growth ahead in AI

It is perhaps unsurprising that the forecast growth rate is very high, with global AI revenue expected to increase over 10-fold between 2018 and 2025 across all market segments. This is consistent with our view that AI penetration remains in its infancy. Tractica estimates the AI market will be worth ca.\$60bn by 2025.

Global AI revenue expected to increase more than 10-fold between 2018 and 2025

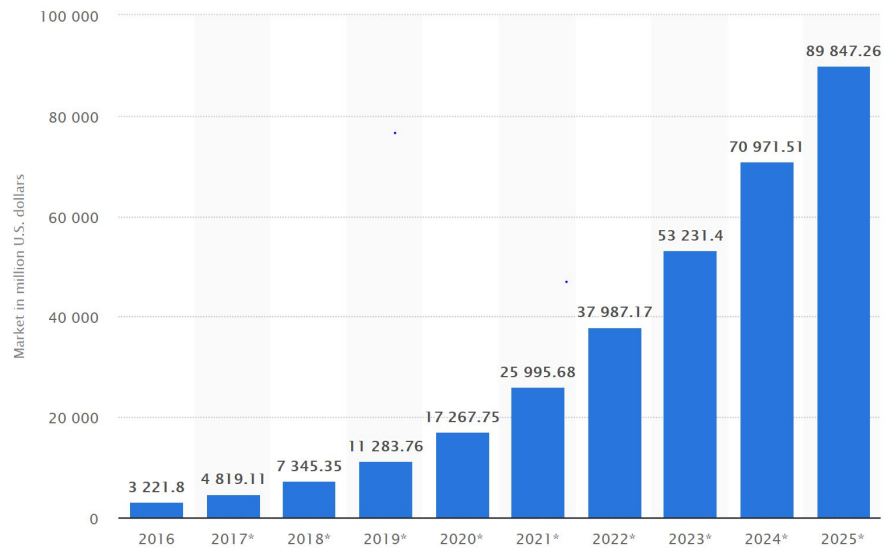
#### Tractica Artificial Intelligence worldwide revenue forecasts, 2016-25 (\$m)



Source: Tractica

Notably, Statista has come to even more positive conclusions regarding the growth rate of the market. It estimates that the market will be worth \$90bn worldwide by 2025. It expects enterprise applications to represent the largest subset of this market.

**Statista Artificial Intelligence worldwide revenue forecasts, 2016-25 (\$m)**



Source: Statista

Against this highly favourable anticipated demand backdrop for AI vendors, it is important to note that enterprises will continue to address this opportunity gradually and with a degree of caution, given the complexity and early-stage nature of many of the solutions that are available. Our view is that enterprise sales cycles will, in many cases, be relatively lengthy and require vendors to demonstrate that the AI platforms deliver the ROI promised on the tin. We bear this in mind when considering our forecasts for Artificial Solutions later in this report.

# Regulation and AI

## Data is critical

Data is critical for AI but regulations are creating constraints

As we have already discussed, data lies at the heart of AI, machine learning and related algorithms. These technologies can get more accurate and better only if they are fuelled with incremental data that allows the platforms to learn. To some extent, these are black boxes that have relatively limited transparency on how data on individuals is being used.

However, the regulatory landscape is getting tougher on data transfer between entities for any reason and accountability of data processors. The General Data Protection Regulation (GDPR), for example, came into force in May 2018.

### GDPR in Europe

The GDPR applies not only to organisations located within the EU but also to organisations located outside of the EU if they offer goods or services to, or monitor the behaviour of, EU data subjects. It applies to all companies processing and holding the personal data of data subjects residing in the European Union, regardless of the company's location.

The GDPR defines profiling as any form of automated processing of personal data consisting of the use of personal data to evaluate certain personal aspects relating to individual, in particular to analyse or predict aspects concerning that specific person's characteristics.

The GDPR applies to 'personal data', meaning any information relating to an identifiable person who can be directly or indirectly identified in particular by reference to an identifier. This definition provides for a wide range of personal identifiers to constitute personal data, including name, identification number, location data, or online identifier, reflecting changes in technology and the way organisations collect information about people.

### Pseudonymisation and anonymisation

Data-handling techniques gaining considerable attention

These techniques for handling data have gained considerable attention since the GDPR came into force. In summary, pseudonymisation entails the replacement of parts of a data record by which an individual may be identifiable with alternative identifiers – also called pseudonyms. An important aspect here is that, with the benefit of additional information, the original data subjects could be identified, which is potentially problematic from a regulatory perspective.

Article 4(5) of the GDPR states the following:

*"Pseudonymisation means the processing of personal data in such a manner that the personal data can no longer be attributed to a specific data subject without the use of additional information, provided that such additional information is kept separately and is subject to technical and organisational measures to ensure that the personal data are not attributed to an identified or identifiable natural person."*

Recital 26 of the GDPR goes on to state the following:

*“Personal data which have undergone pseudonymisation, which could be attributed to a natural person by the use of additional information should be considered to be information on an identifiable natural person...”*

So, while techniques akin to pseudonymisation, such as tokenisation, have long been used in segments such as payments, it is not considered a complete or sufficient solution in the context of the GDPR for many data-centric applications. That said, for a subset of applications, pseudonymisation may be enough and, at the same time, offer a degree of “statistical utility”, i.e. it can be usefully deployed to analyse trends, etc.

Anonymisation takes things further, such that individuals within anonymous data sets cannot be re-identified. Anonymisation is a more involved process, which is more complex and potentially more costly.

### *Artificial Solutions’ approach to data regulations*

Enterprises can align security and compliance with their own policies

Teneo was designed with an open architecture in order to allow enterprises to align the platform’s security and compliance criteria with enterprises’ own legal, risk and compliance policies. This can be done across multiple geographies and differing legal requirements.

In April 2018, in preparation for the GDPR, Artificial Solutions announced enhancements to the Teneo platform designed to allow its enterprise customers to pseudonymise personal data to enable conversations to continue to be used for statistical analysis and data insight, even when the personal data has been removed in accordance with the GDPR policy of the enterprise concerned. Some data can be anonymised at source, which is still useful for Artificial Solutions’ machine learning process. However, for obvious reasons, this data is less useful for aspects such as service personalisation.

The platform can be deployed on-premise or within the client’s own externally-located IT infrastructure. In addition, to facilitate data management, all customer queries, information and responses gathered by Teneo are in a single location. This not only helps from the perspective of interpreting data, but also managing the data and complying with all applicable legislation.

In countries where data cannot be taken offshore in any form (Japan, for example), Artificial Solutions has entered into partnerships with local data processors to generate inputs into the conversational AI and machine learning platforms. This model is likely to be replicated in other markets going forward to overcome data residency obstacles.

The Teneo data component gives total control of the data to the customer, which can decide at source how to handle the data. At one extreme, the customer could decide not to store any names, addresses or credit card details, all of which would appear as a hash in the log file. The default position tends to be that, where there is an authenticated user that undertakes repeated transactions, an enterprise will typically seek to retain a greater amount of information. If a user is engaged in a one-off interaction or transaction, the enterprise is likely to retain far less personal data.

# The Teneo platform

## A highly-advanced AI platform

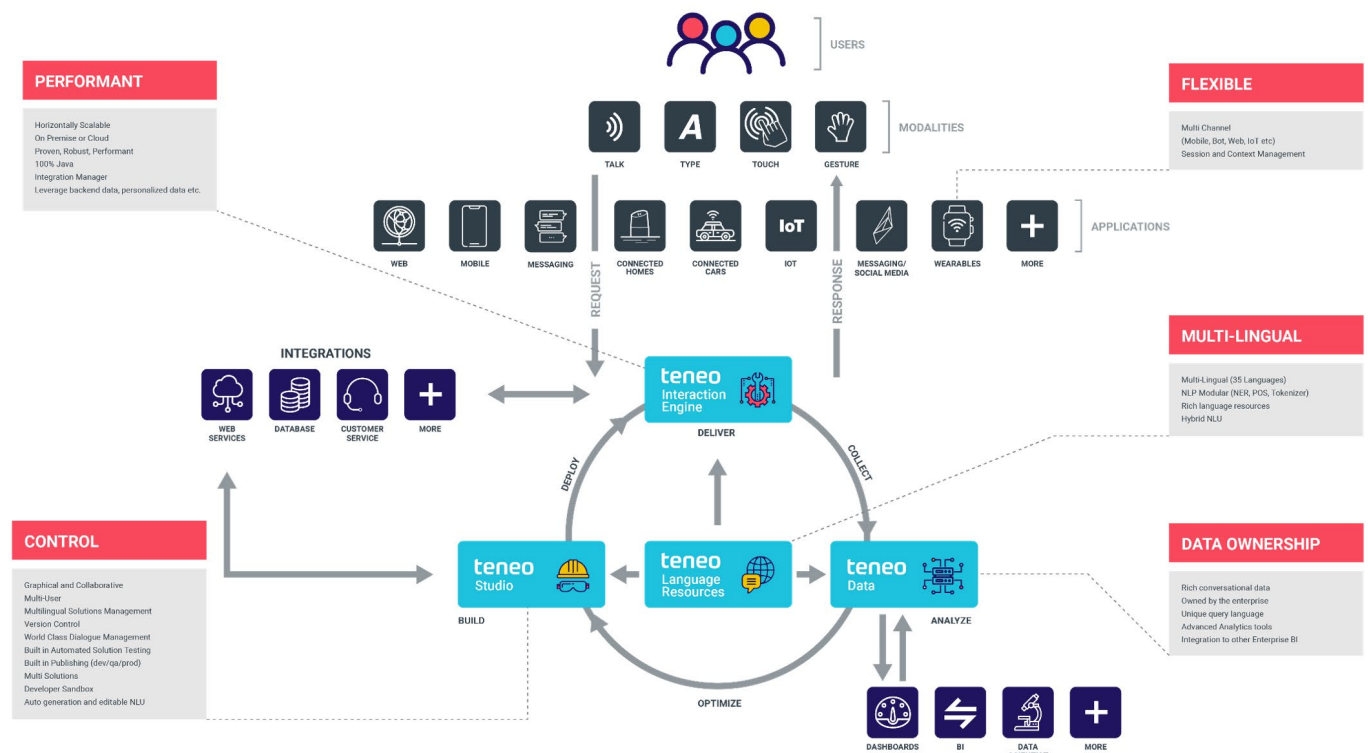
Teneo's data set comprises tens of millions of data points

Teneo is a highly advanced AI platform that offers enterprises a highly scalable, industrial-grade platform on which to build AI applications. It is designed to allow non-AI specialists to develop and implement conversational applications across their organisations, regardless of the industry in which they operate. The platform has been built and refined over a period of a decade by leading computational linguistic programmers and incorporates a data set comprising tens of millions of data points.

Every customer uses the same Teneo platform with no code changes across different customers. This unified platform supports all use cases across verticals. The "package" that each customer purchases contains all of the functionality required to build different applications.

Teneo is a closed loop platform that incorporates all of the key tools that are required. It is capable of closed loop learning and closed loop predictions based on the data of the enterprise in which it is deployed. It absorbs data from a wide range of sources, which can include advanced systems for face recognition, retinal scanning, touch-based sensors and asset tracking.

### Artificial Solutions – Teneo architecture



Source: Hardman & Co Research, Company data

## A wide range of Teneo case studies

As discussed earlier in this report, conversational applications built on the Teneo platform already span a wide range of use cases – for example, intelligent customer service chatbots to handle queries, virtual sales assistants to provide information, and voice-enabled digital assistants to take orders. The potential applications are wide-ranging in nature, as set out in the schematic above, spanning smart cities, autonomous vehicles, health monitoring, and much more. Additionally, Teneo is increasingly being involved in R&D programmes for virtual reality and augmented reality scenarios where an AI conversational component delivers a more immersive experience.

## Integration with other enterprise systems

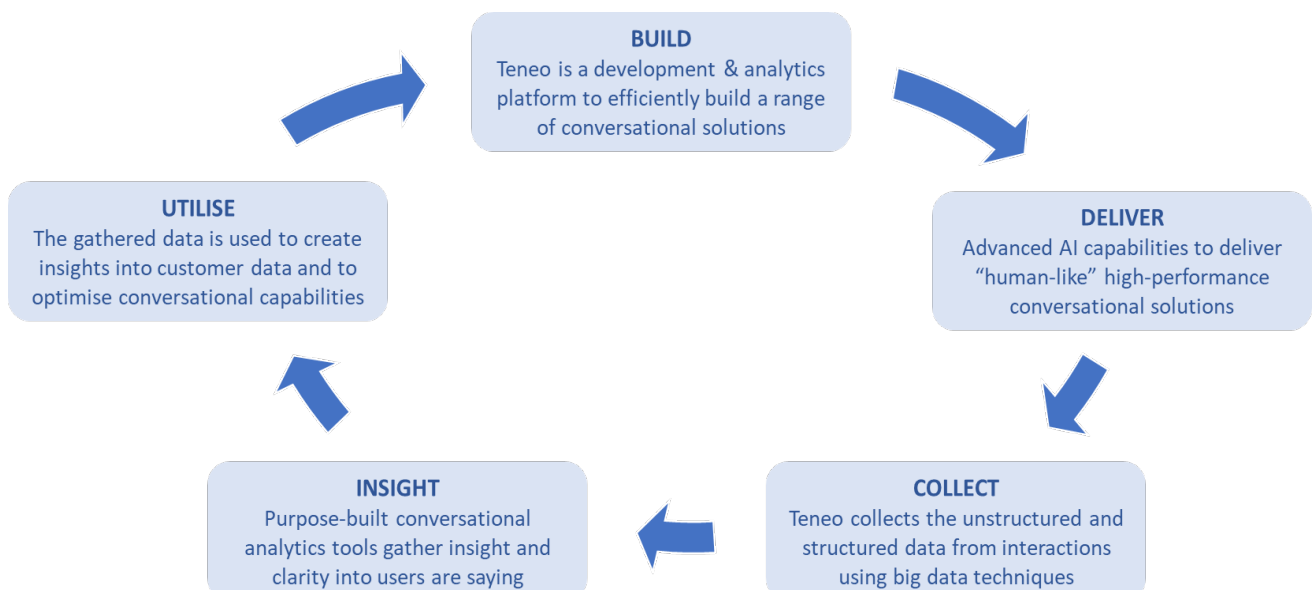
### Integration with other enterprise systems

The Teneo platform allows delivery of multi-channel, self-service solutions and multi-channel, contact-centre solutions. Inevitably, this breadth of coverage requires integration with a range of other enterprise systems. For example, when interacting with an internal chatbot, an employee might ask how many days of holiday he/she has remaining for the year. This request will be received by the interaction engine, which will trigger an API call to the HR system in order to interrogate the user's HR file to obtain the answer. The end-user does not interact with the Teneo platform itself, but rather with applications built on the platform. However, it is the platform that is integrated with the various other IT applications and systems within the enterprise.

## Constantly learning and optimising

The platform is constantly collecting data to generate insights, which are analysed using the purpose-built tools embedded in the platform, in order to optimise its capabilities. It is not only structured data that is collected by Teneo, but also unstructured – for example, the transcript text of an online chat between a customer services representative and a consumer. The resulting data sets are huge, a topic that we come on to later in this section. It is this data that Teneo uses to learn and optimise its algorithms so that the quality of conversations are consistently improved. The diagram below summarises the process flows within the Teneo platform.

### Teneo platform workflows



Source: Company data, Hardman & Co Research

### This is Big Data

## Apache Cassandra data repository

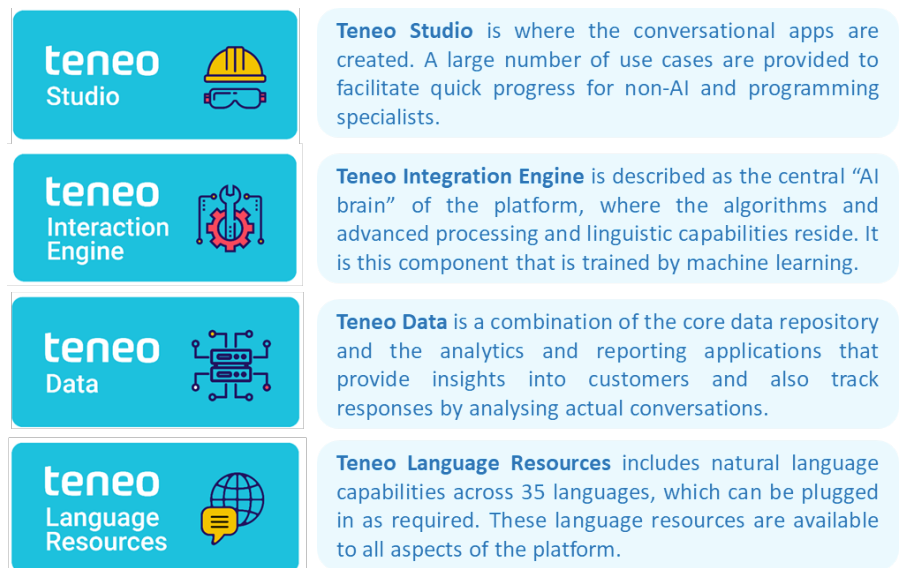
We have already touched on the massive data sets that Teneo has aggregated and that continue to grow with every transaction on the platform. In this context, the scalability and performance of the database become important factors from an architecture perspective. Teneo's core data repository is built in an Apache Cassandra database, which is a highly scalable and resilient platform for mission-critical deployments. It is also used by some of the largest B2C and B2B companies in the world. Examples include Netflix, eBay, Instagram, Apple and over 1,500 other companies with large, active data sets. While these are open source technologies, Artificial Solutions opts to use them under licence, ensuring appropriate code consistency and support.

## Key Teneo components

The graphic below sets out the major components of the Teneo platform and their respective functions. At the heart of the platform sits the Teneo interaction engine, which is highly scalable and can handle millions of transactions per minute.

Teneo Query Language (TQL) is an additional standard component within the Teneo data module. At the point of implementation, decisions will be made on how various subsets of data will be treated, and the TQL is adapted accordingly so that the file transfer protocol obscures any confidential aspects of the data.

### Key components of the Teneo platform



Source: Hardman & Co Research, Company data

## Lyra

### A cloud-based personal assistant app

Lyra was launched by Artificial Solutions in 2013, and is a cloud-based virtual personal assistant app. It works across mobile, desktop and tablet platforms with continuity across a user's devices. The voice-enabled assistant is able to conversationally answer questions using a range of search engines, find locations on maps, and play digital content; it also operates in over 70 languages. Some examples of its functionality are set out in the screenshots below.

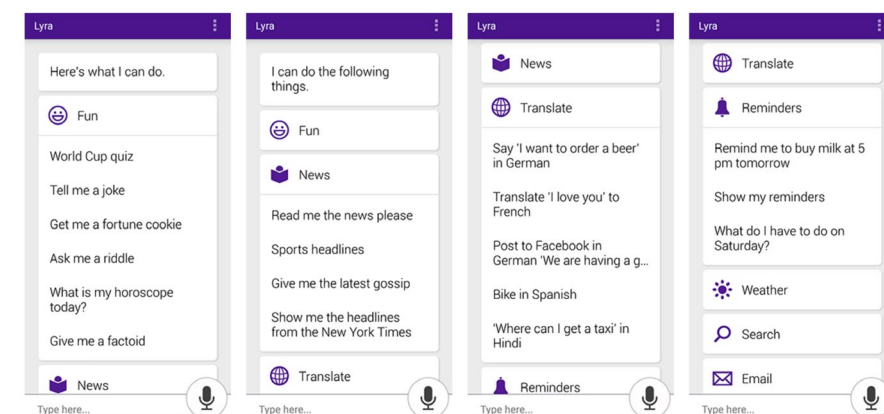
Along with Elbot (see earlier), Lyra exemplifies some of the underlying technology attributes of the Teneo platform, but is today not a central feature of enterprise deployments. As the company evolves its business model to become a broader AI



## Artificial Solutions - Enterprise-grade artificial intelligence

platform, these capabilities are likely to become more relevant as front-end for a wide range of end-user-facing applications.

### Artificial Solutions' Lyra screenshots



Source: Company data

## Designed for enterprises

Artificial Solutions' products, Teneo in particular, have been created from the ground up to address the enterprise market. The company has a client roster that comprises some of the leading global enterprises across a range of industry sectors.

A key question might be what the differences are between Teneo's capabilities and those of consumer-facing platforms or less advanced platforms. Examples of enterprise-centric functionality include:

- (i) **Integrated debugging of the solution** – for example, in some rival environments, if the platform is not performing as expected, the enterprise team has to look elsewhere to understand why. In contrast, this capability is integrated within the Teneo environment, which provides an accelerating boost to development cycles.
- (ii) **Version rollback** – in many rival platforms, there is no integrated rollback – so once a version of an application is published, it is not possible to revert to the previous version in the event of issues being discovered. However much testing is carried out, discovery of bugs and issues at some point will be inevitable. Teneo offers the enterprise the ability to effectively reverse the publication process, revert to the previous version, complete the necessary changes, and then re-publish as required. This is standard functionality in advanced platforms in other segments of the software industry.
- (iii) **Integrated testing suite or integrated data component** – releases of new versions of an application should take place after the code has been put through a testing suite, even in a highly agile environment. The ability to complete this testing process within the Teneo platform, rather than having to export the code to a third-party environment and then come back to Teneo to make requisite changes and ultimately publish, represents a major productivity advantage for an enterprise development team.
- (iv) **Data retention and security** – the Teneo data component gives total control of the data to the enterprises, which can decide at source how to handle the data, based on their own compliance and risk policies. From a compliance and risks management perspective, this is an important consideration, and is linked to the next point.
- (v) **Hosting is optional rather than compulsory** – one of the common strands running through many competing solutions, particularly those from the major Cloud platform providers, is that the compute and learning elements of the platform reside in the Cloud. The customers are, therefore, typically compelled to upload their data into the Cloud, where it is fed into the machine learning platform. For many large enterprises, this is an inherently unappealing approach. Artificial Solutions can provide a hosted solution, but most of its deployments are on-premise, primarily in the enterprise's own/colocated data centre facilities or, on occasion, delivered by a systems integrator on a hosted basis.
- (vi) **High accuracy rates** – High levels of precision are important to enterprises, especially those working in regulated industries such as financial services. Teneo has demonstrable accuracy rates, which among the highest in the industry for an automated platform.

## Competitive landscape

Artificial Solutions offers a complete solution for enterprises

There are a host of companies that address some aspect of the conversational AI marketplace. In this section, we focus on the names that have the most credible propositions for the enterprise segment on which Artificial Solutions is squarely focused. Artificial Solutions is clear in its competitive positioning, which is offering a more advanced and complete solution for enterprises than AWS, Google, IBM, Microsoft and Oracle. Indeed, the company notes that enterprises that have looked at or trialled some of these solutions are well placed to have an educated discussion on the advanced capabilities and advantages of Teneo.

One particular point of differentiation is the delivery of the platform. While Artificial Solutions is perfectly capable of hosting the Teneo platform for customer deployments, this is not obligatory. Indeed, the majority of recent deployments have been either on-premise (typically at enterprise-owned data centres) or hosted by SI partners for the enterprise. In either scenario, Artificial Solutions allows the deployment to mirror the data control policies of the broader enterprise, rather than seeking to impose a data retention model on the customer. This contrasts with the requirements of the large platforms, which offer these capabilities as part of their Cloud platforms. As discussed in detail in this report, this can be a major obstacle from a regulatory and compliance perspective.

### *Amazon Web Services (AWS)*

AWS Artificial Intelligence is a family of AWS services that provide cloud-native machine learning and deep learning technologies addressing different use cases and needs. AWS AI services bring natural language understanding (NLU), automatic speech recognition (ASR), visual search and image recognition, text-to-speech (TTS), and machine learning (ML) technologies within the reach of every developer.

AWS Lex builds conversational interfaces into any application using voice and text. Lex provides the advanced deep learning functionalities of ASR for converting speech to text, and NLU to recognise the intent of the text. This enables the building of applications with highly engaging user experiences and lifelike conversational interactions.

### *Google*

Google's Dialogflow is a service that runs exclusively on the Google Cloud Platform. The platform leverages Google's extensive machine learning and speech-to-text conversion capabilities. It is optimised to work with Google Assistant devices. Some interesting enterprise deployment case studies are set on the product website, including a booking bot on Facebook Messenger for KLM, the Dutch airline, and an AI-based intelligent voice-ordering assistant for the Domino's pizza native app. These users cite the ease of use of the platform to create the bot and the quality of the natural language processing algorithms.

### *Microsoft*

For the last few years, Microsoft has made no secret of its ambitions to be a major player in the social AI market, albeit with some well-documented initial stumbles. In 2016, the company launched its Tay AI chatbot on Twitter in the US, targeting users between the ages of 18 and 24. However, matters soon went awry, and its learning mechanisms were manipulated into a series of inappropriate comments. A Tay relaunch later in the year fared little better. Another attempt in the US called Zo followed in 2017.

Meanwhile, Xiaolce, a female chatbot focused on Chinese end-users, had been launched on the Weibo micro-blogging site, and it has become a great success. Using sentiment analysis to create empathy and “full duplex” to allow the chatbot to predict what the user will say next, Xiaolce is proving highly popular with over 300 million users today. Microsoft intends to roll out some of the elements of this success to its chatbots in other countries, including Rinna in Japan and Ruuh in India.

In the last couple of years, Microsoft has made a series of AI-centric acquisitions, including XOXCO (US conversational AI developer), Semantic Machines (conversational AI), Bonsai (machine learning and reinforcement learning) and Lobe (deep learning development). It remains to be seen whether Microsoft can generate traction at the more complex end of the enterprise segment, building on its social AI initiatives. The Azure Bot Service has approaching 400,000 users, some of whom will be enterprise-focused. Microsoft has disclosed that there are in excess of 30,000 active bots per month that use Microsoft's conversational AI tools, used by over a thousand companies, including many larger enterprises. Microsoft's Conversational AI tools let you deploy bots on a website, Slack, Facebook Messenger, Kik, SMS using Twilio, Telegram, Cortana, Skype for Business, email and others.

### *IBM*

IBM's Watson AI platform is essentially a supercomputer that is based on machine learning. It is designed as an open, multi-cloud platform designed to facilitate automation of AI lifecycles. Watson is a question-answering computer system capable of answering questions posed in natural language. The core of Watson is a natural language processing (NLP) implementation. Watson has been deployed to date across a range of applications in industrial, utilities, healthcare and business analytics contexts.

IBM Watson does offer virtual assistant capabilities that may overlap with some of the functionality of Artificial Solutions, but the costs of deployment are typically substantially higher for the IBM offerings, especially once high integration, implementation and hardware costs are taken into consideration.

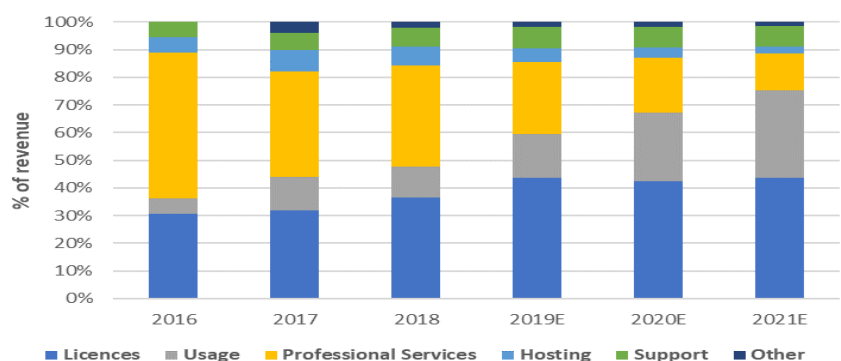
# Financials

## Revenue

There are five primary elements to the Artificial Solutions revenue model:

- (i) **Licence fees:** Artificial Solutions charges enterprises a licence fee to use its platform. These platform licence fees are term licences, typically spanning two to three years. The customer must have an active licence in order to continue using the Teneo platform. It is feasible that these contract periods will be extended as the applications built on Teneo become more entrenched into their customers' IT environments and deliver significant returns on investment.
- (ii) **Support fees:** In addition, there is an annual support and maintenance fee of 17% of the upfront licence fee. This is in line with standard software industry practice, and covers minor platform updates, bug fixes and the provision of technical support, although much of the latter will be delivered by systems integrator partners. The annual support and maintenance is compulsory, alongside the annual term licence fee, in order for the customer to continue to use the product.
- (iii) **Usage fees:** Today, usage fees represent a modest part of the revenue base, reflecting the relatively early-stage of many of the customer deployments. But, usage revenue is expected to grow substantially as end-user interactions on the applications that have been built on Teneo scale in number. For example, one of Artificial Solutions' major telecom customers pays a usage fee of per active user per month.
- (iv) **Professional Services:** Artificial Solutions continues to maintain a professional services capability, but management has consistently sought to reduce services revenues in recent years, in favour of leaving implementation and integration services to systems integrator partners.
- (v) **Hosting services:** The company does have the capability to host deployments in a dedicated data centre capacity, but this is a diminishing part of the revenue line. Most new customer deployments tend to be on-premise, or the hosting services are provided by systems integrator partners.

Artificial Solutions – evolving revenue mix, 2016-21E



Source: Company data, Hardman & Co Research

## Broadening scope of deployments over time

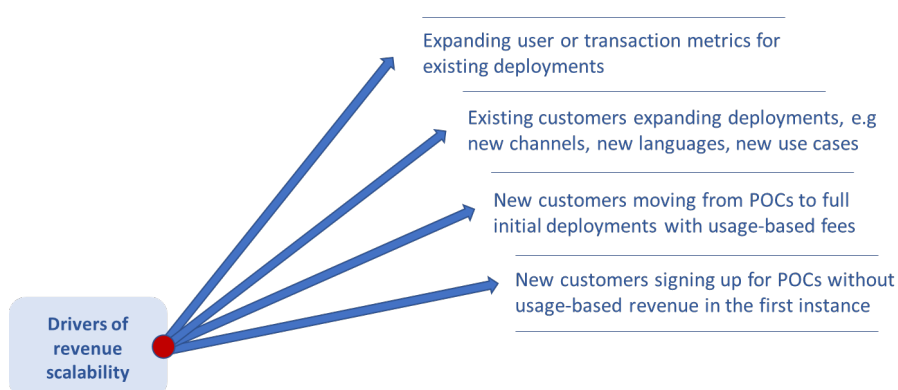
### Inherent revenue scalability

We expect the revenue growth of the business to be driven by a combination of expansion of revenue from existing customers and new customer additions. Today, the revenue base comprises primarily initial deployments by customers in a particular slice of their business in the form of proof-of-concept engagements. At most, these are currently across one division of their customers' operations.

Over time, the existing customers will drive revenue in two major ways: through greater usage metrics within the existing deployment, or through a decision, typically after witnessing positive outturns, to broaden the deployment into other divisions, geographies, languages, etc. At the current time, the company expects a consistent flow of new proof-of-concepts to be added, while existing proof-of-concepts will continue to convert into live deployments, representing new customer growth.

Alongside these trends, usage-based revenue should, over time, become the largest part of Artificial Solutions' revenue, as major enterprises deploy conversational AI solutions built on Teneo on a wider basis and experience growth in transactional volumes.

### Artificial Solutions – drivers of revenue scalability



Source: Hardman & Co Research

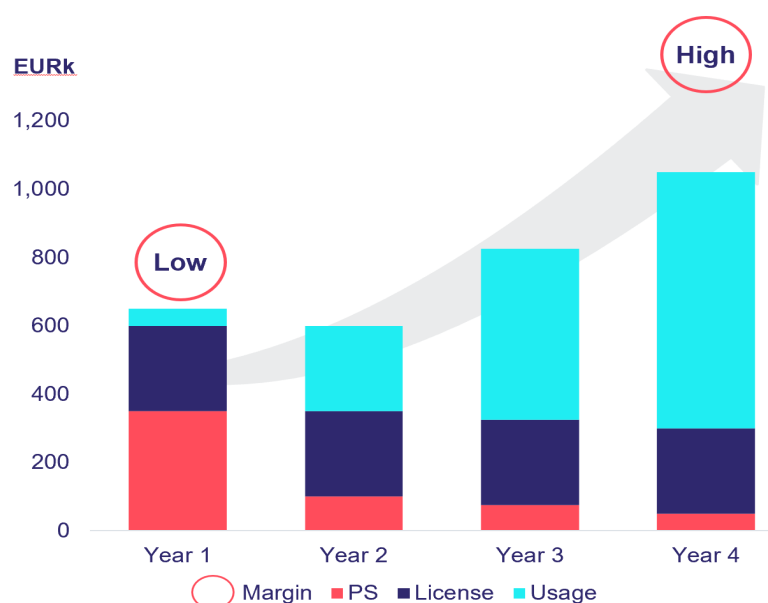
## Stylised customer progression

### Customer progression

The company's experience of how deployments evolve in terms of revenue composition is summarised in the chart below. Post the initial implementation phase, the professional services element is much reduced, as the Teneo platform is designed to allow non-AI specialist personnel at customers to build conversational AI applications. The term licence fee remains unchanged for the duration of the contract for a specific deployment, while usage fees scale in line with the growth of usage/greater number of transactions processed through the platform.

The margin progression is correspondingly upwards, as the revenue mix swings in favour of higher-margin usage-based revenue. The high-volume nature of many of Artificial Solutions' contracts could lend themselves to accelerated transaction-based revenue.

## Artificial Solutions – stylised customer revenue and margin progression



Source: Company data, Hardman & Co Research

## Customer retention

High levels of customer retention

The customer retention rate for the purposes of the company's planning assumptions is expected to be at least 80% – the current run rate is ahead of this target. The outturn will ultimately reflect the extent of the crystallisation of the returns on investment that should be associated with the efficiency, productivity and sales conversion benefits of the Teneo platform, if the applications are properly configured and marketed.

There have been occasional instances of customers discontinuing projects with Artificial Solutions, primarily after running proof-of-concept exercises. These instances are included in the customer retention targets. However, far more rare are decisions to discontinue a deployment once the chatbot has gone live. One notable example that explains the dip in usage revenue seen in 2018 is a major customer that opted to discontinue its activities at one of the business lines where Teneo had been deployed. In this case, Teneo remains in active usage in other divisions at this same customer, confirming that the performance of Teneo was not a factor.

## Order intake and order backlog

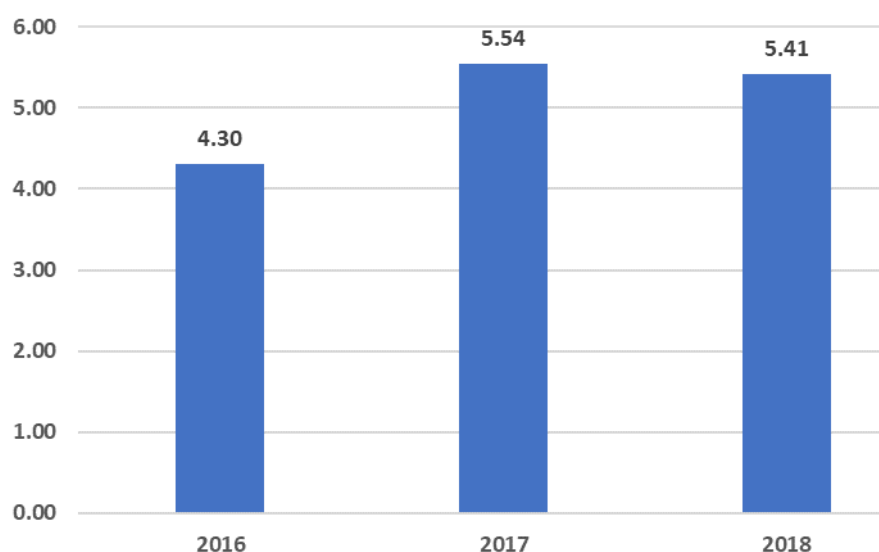
Target to grow order intake in excess of NLP market

The company's stated target is to grow its order intake in excess of the growth rate of the NLP market over the medium to longer term. Systems integrator (SI) partners will account for a growing proportion of order intake, continuing the trend seen over the past three years.

Artificial Solutions' order intake metric is confined to the value of orders that are contractually committed during the period, with no inclusion of extrapolated transaction-based revenue.



Artificial Solutions – order intake, 2016-18 (€m)

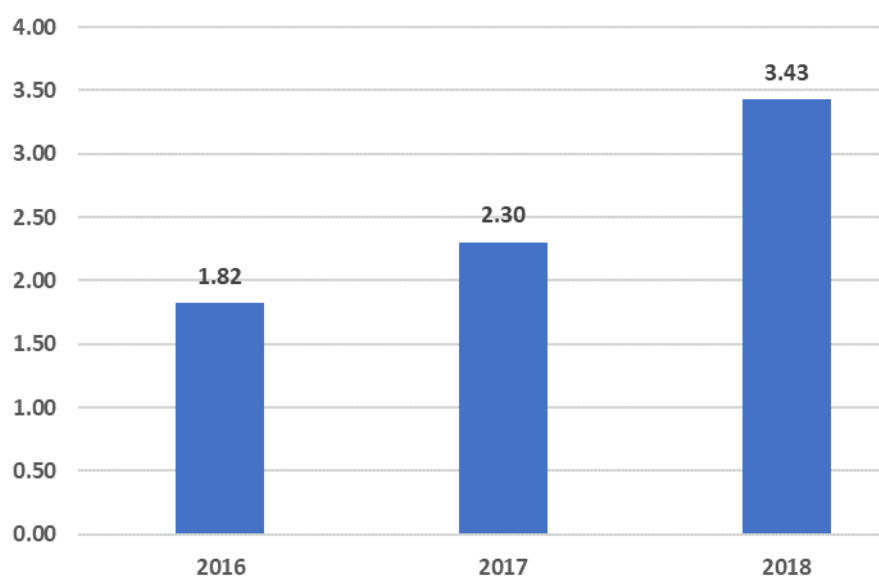


Source: Company data, Hardman & Co Research

### Significant growth in order backlog

Order backlog comprises the value of contractually committed orders received from contractors that have not yet been recognised as revenue. This is a key metric upon which management places emphasis as a barometer of the future health of the business, while providing an indication of future revenue growth. The closing 2018 order backlog was €3.4m, of which we expect ca.70% to convert into revenue in 2019, particularly licence revenue. Compared with the reported net sales outturn of €1.6m, this represents significant growth, without taking account of any additional conversions of proof-of-concepts into live deployments.

Artificial Solutions – order backlog, 2016-18 (€m)



Source: Company data, Hardman & Co Research

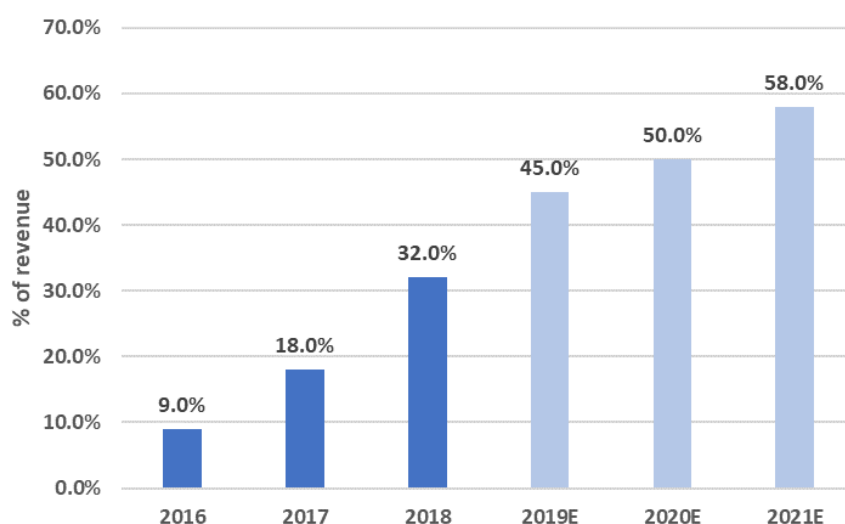
We estimate directly sourced sales will represent ca.40% of revenue by 2021

## Direct sales versus indirect revenue

In recent years, the company's routes to markets have evolved significantly towards systems integrators, which, in 2018, delivered ca.30% of Artificial Solutions' total revenue. As a consequence, the proportion of licence and support/maintenance revenue within contract values has increased, with much of the services workload pre- and post-sale being delivered by partners. These trends are expected to continue in the same direction over the next few years.

We estimate that directly-sourced sales will represent around 40% of the company's revenue by 2021, compared with over 90% in 2016. While this requires a share of revenue to be paid to partners, the global reach of these organisations into the enterprise segment is far greater than any smaller individual software or technology vendor might ever hope to achieve in isolation.

Artificial Solutions – % of revenue from SI partners, 2016-21E



Source: Company data, Hardman & Co Research

Key attribute of revenue model is growing degree of predictability over time

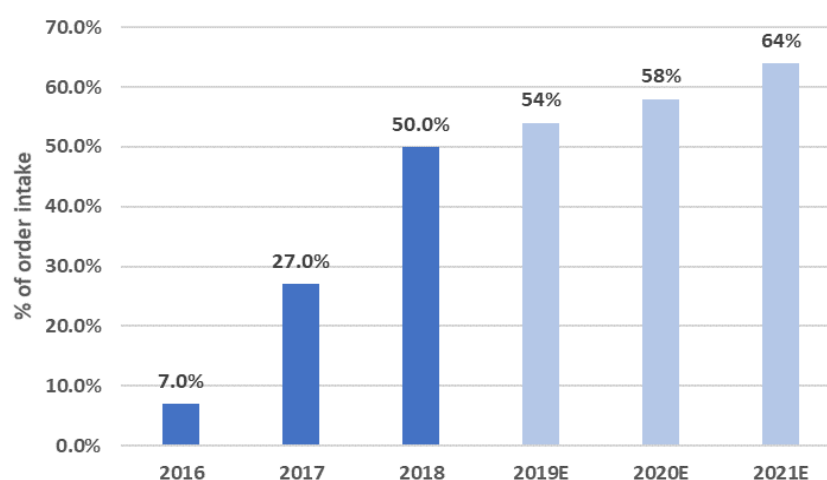
The relatively complex nature of AI-based conversational solutions lends itself to input from the systems integrators for large enterprises seeking an integrated customer-facing infrastructure. The need to integrate the Teneo platform with other elements of the IT infrastructure drives relatively sizeable services engagements. The inevitable shorter-term impact, pending an uplift in usage revenue, is a flatter revenue profile, as the services revenue continues to play a diminishing profile in the revenue mix.

We will return to the margin benefits of this shift in a later section which stems from reduced revenue within the mix from lower-margin Professional Services. A key attribute of Artificial Solutions' revenue model is a growing degree of predictability over time, resulting from multi-year term licences and usage-based revenue streams.

Uptrend in order intake contribution from SI partners

In 2018, compared with 32% of revenue from SI partners, the proportion of order intake from them was considerably higher, at 50%, as set out in the chart below. This lends support to the view that there are multiple projects under way that will translate into reported revenue in coming fiscal periods, and hence a marked acceleration in revenue growth over 2019-21. Our expectation is that this percentage of order intake will expand further to nearer 64% by 2021.

## Artificial Solutions - % of order intake from SI partners, 2016-21E



Source: Company data, Hardman &amp; Co Research

## Revenue model

The table below sets out the historical revenue of Artificial Solutions, together with our estimates for 2019-21. Many of the key trends have already been covered. We expect usage revenue to catch up with licence revenue in 2020, with usage revenue expected to more than double in each of 2019, 2020 and 2021.

## Artificial Solutions – revenue model, 2016-21E

Year-end Dec., (€m)	2016	2017	2018	2019E	2020E	2021E
<b>Licences</b>	<b>1.10</b>	<b>1.60</b>	<b>1.60</b>	<b>2.96</b>	<b>4.14</b>	<b>7.04</b>
% growth YoY	-	45%	0%	85%	40%	70%
% of total revenue	31%	32%	36%	44%	42%	44%
<b>Usage</b>	<b>0.20</b>	<b>0.60</b>	<b>0.50</b>	<b>1.08</b>	<b>2.43</b>	<b>5.10</b>
% growth YoY	-	200%	-17%	116%	125%	110%
% of total revenue	6%	12%	11%	16%	25%	32%
<b>Professional Services</b>	<b>1.90</b>	<b>1.90</b>	<b>1.60</b>	<b>1.76</b>	<b>1.94</b>	<b>2.13</b>
% growth YoY	-	0%	-16%	10%	10%	10%
% of total revenue	53%	38%	36%	26%	20%	13%
<b>Hosting</b>	<b>0.20</b>	<b>0.40</b>	<b>0.30</b>	<b>0.32</b>	<b>0.35</b>	<b>0.38</b>
% growth YoY	-	100%	-25%	8%	8%	8%
% of total revenue	6%	8%	7%	5%	4%	2%
<b>Support</b>	<b>0.20</b>	<b>0.30</b>	<b>0.30</b>	<b>0.53</b>	<b>0.73</b>	<b>1.23</b>
% growth YoY	-	50%	0%	77%	38%	67%
% of total revenue	6%	6%	7%	8%	8%	8%
<b>Other</b>	<b>0.00</b>	<b>0.20</b>	<b>0.09</b>	<b>0.12</b>	<b>0.16</b>	<b>0.22</b>
% growth YoY	-	100%	-55%	35%	35%	35%
% of total revenue	0%	4%	2%	2%	2%	1%
<b>Sales</b>	<b>3.60</b>	<b>5.00</b>	<b>4.39</b>	<b>6.78</b>	<b>9.76</b>	<b>16.10</b>
% growth YoY	-	39%	-12%	54%	44%	65%
<b>Capitalised costs</b>	<b>0.64</b>	<b>0.87</b>	<b>1.19</b>	<b>1.20</b>	<b>1.38</b>	<b>1.59</b>
% growth YoY	-	37%	36%	1%	15%	15%
<b>Other operating income</b>	<b>0.90</b>	<b>1.23</b>	<b>0.52</b>	<b>0.41</b>	<b>0.33</b>	<b>0.26</b>
% growth YoY	-	37%	-58%	-20%	-20%	-20%
<b>Total income</b>	<b>5.14</b>	<b>7.11</b>	<b>6.09</b>	<b>8.39</b>	<b>11.47</b>	<b>17.96</b>
% growth YoY	-	38%	-14%	38%	37%	57%

Source: Company data, Hardman &amp; Co Research

Revenue recognition is in accordance with IFRS. Term licences and maintenance revenue are recognised pro-rata over contract periods, while services and

## Artificial Solutions - Enterprise-grade artificial intelligence

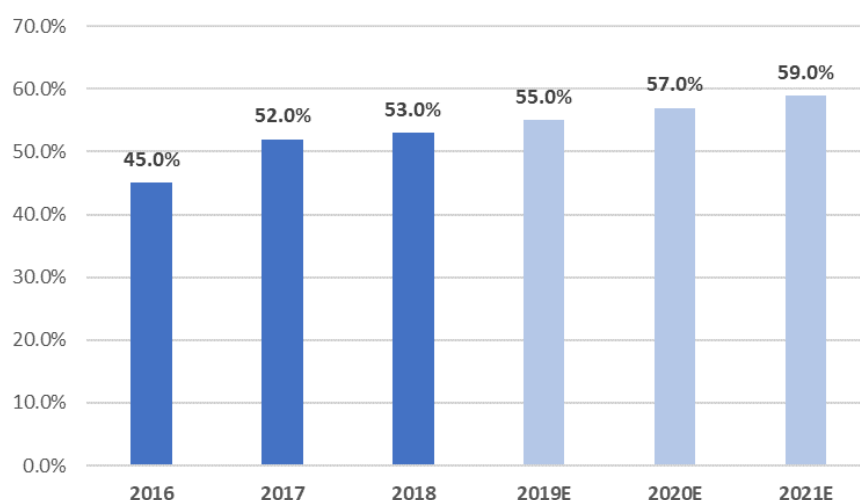
implementation revenues are recognised as delivered. Usage and transaction-based revenues are invoiced and recognised at the end of agreed monthly or quarterly billing periods.

### Gross margin

We expect the margin trend to remain upwards

The typical gross margin on software sales is around 90%, which is in-line with industry norms for software businesses. On consultancy activities, the gross margin is nearer 40%, again consistent with typical service margins. Accordingly, in light of the ongoing revenue mix shift, the margin trend is expected to remain upwards. As the usage-based revenue stream grows within the overall revenue mix, margins will improve. This is due to the diminishing proportion of professional services and the operating leverage that is inherent in the business model, in turn due to the modest opex expansion that is anticipated over the next few years, alongside strong revenue growth.

Artificial Solutions – gross margin evolution, 2016-21E



Source: Company data, Hardman & Co Research

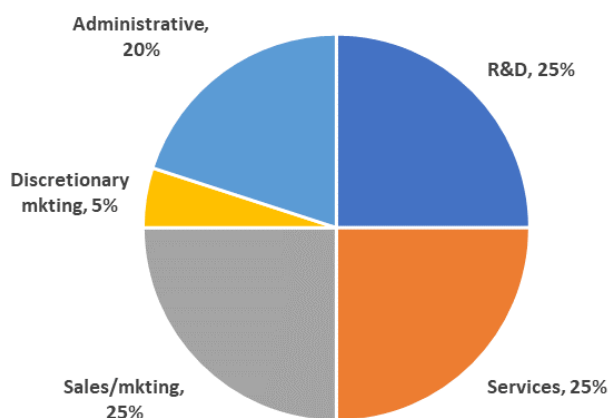
### Operating expenses

Operating cost base not expected to see significant increases...

Overall headcount stood at 104 employees at the end of 2018, essentially flat versus the prior year. The average headcount during 2018 was 111 employees, indicating proactive management of headcount and reflecting a shift away from Professional Services. Over the same period, staff costs increased by 7% YoY, reflecting a change in mix within headcount, particularly numbers of employees in professional services functions.

Looking forward, it is not expected that the operating cost base will see significant increases. Within the company's headcount, there are likely to be further adjustments – away from professional service capability towards product development heads and additional AI specialists.

### Artificial Solutions – operating expenses split, 2018



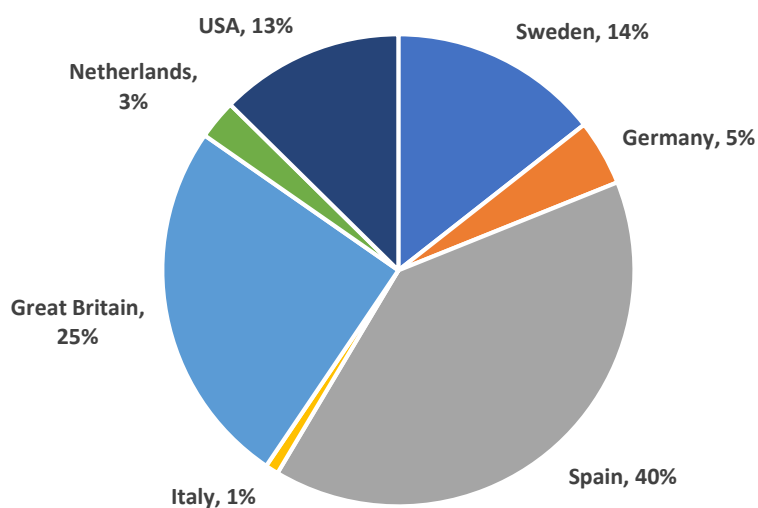
Source: Company data, Hardman & Co Research

...and so potential for meaningful operating leverage

Accordingly, beyond the margin benefits of the revenue mix shift, it is also likely that there will be potentially meaningful operating leverage, as revenue growth accelerates alongside relatively flat operating expenses.

The broad geographical presence of the company is exemplified by the location of its employees, as set out in the chart below. This distribution partly reflects customer activity but is also, we believe, a function of the requirement to be able to attract talent from a range of countries.

### Artificial Solutions – operating expenses split, 2018



Source: Company data, Hardman & Co Research

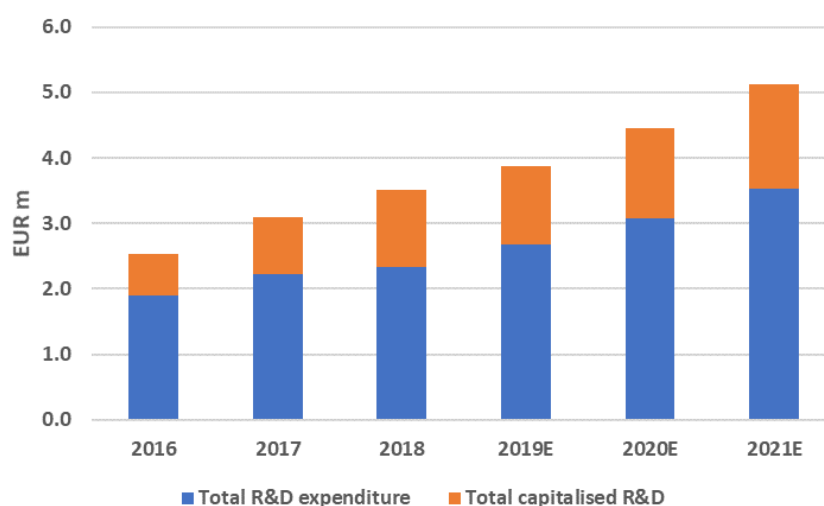
## R&D expenditure

### Majority of R&D costs now complete

Management notes that the majority of R&D costs are now complete. That said, we assume that R&D expenditure will continue to scale modestly to reflect ongoing improvements to the Teneo platform, combined with investment in some of the new areas of opportunity for Teneo. Indeed, the company's 2018 annual report notes that the main focus of R&D in 2018 was building a new "data" foundation and using this to build the new "Teneo learn" and "Teneo predict" machine learning modules, which will be fully integrated, core elements of Teneo.

We also assume that capitalisation of R&D will continue at a similar proportion of capitalised R&D as in 2018. The new K3 accounting requirements are consistent with the company's approach to capitalisation.

### Artificial Solutions – capitalised and total R&D, 2016-21E



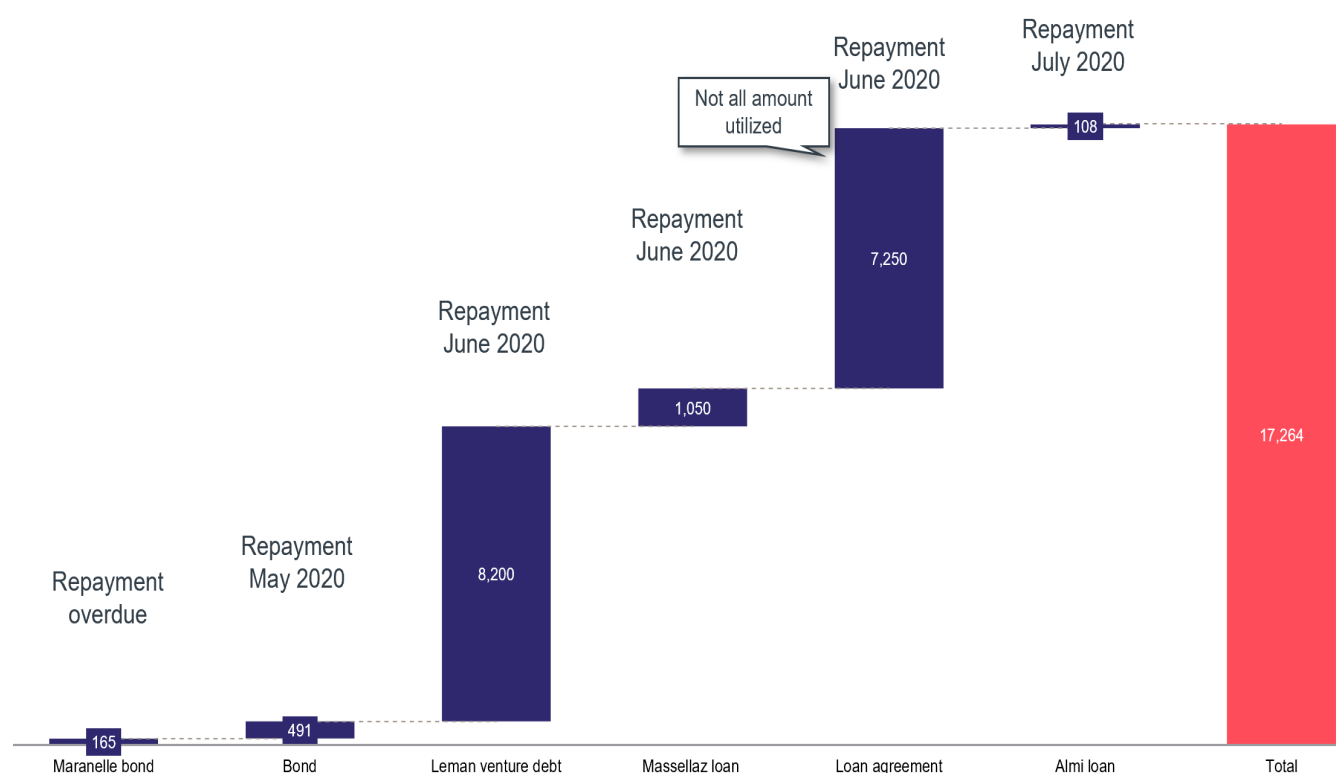
Source: Company data, Hardman & Co Research

## Debt

We expect improved debt terms in 2019 and 2020

Post completion of the reverse takeover transaction that completed in March 2019, Artificial Solutions had €17.3m of interest-bearing liabilities, the majority comprising debt that is due for repayment during 2020. Our expectation is that these debt arrangements and facilities will be refinanced during the course of 2019 and 2020 on improved terms, reflecting the financial performance of the business.

### Artificial Solutions – debt structure post reverse takeover transaction (€m)



Source: Company data

## Profit and loss

### Artificial Solutions – profit and loss

Year-end Dec., (€m)	2016	2017	2018	2019E	2020E	2021E
<b>Income</b>						
Net sales	3.620	4.951	4.389	6.777	9.756	16.102
Capitalised costs	0.636	0.872	1.187	1.203	1.384	1.591
Other operating income	0.901	1.234	0.517	0.413	0.331	0.264
<b>Total income</b>	<b>5.158</b>	<b>7.057</b>	<b>6.093</b>	<b>8.393</b>	<b>11.471</b>	<b>17.958</b>
<b>Operating expenses</b>						
Other external costs	-3.379	-4.278	-5.022	-4.616	-3.212	-3.232
Personnel costs	-7.873	-9.572	-10.326	-10.636	-10.955	-11.284
Other operating expenses	-0.002	0.000	-0.003	-0.004	-0.004	-0.005
<b>Total operating expenses</b>	<b>-11.254</b>	<b>-13.851</b>	<b>-15.352</b>	<b>-15.256</b>	<b>-14.171</b>	<b>-14.522</b>
<b>EBITDA (Reported)</b>	<b>-6.096</b>	<b>-6.794</b>	<b>-9.259</b>	<b>-6.863</b>	<b>-2.701</b>	<b>3.436</b>
Adj. EBITDA excl. capitalised costs	-6.732	-7.666	-10.446	-8.066	-4.084	1.845
Depreciation & amortisation	-2.293	-2.641	-2.320	-2.552	-2.807	-3.088
<b>EBIT (Reported)</b>	<b>-8.389</b>	<b>-9.435</b>	<b>-11.579</b>	<b>-9.415</b>	<b>-5.508</b>	<b>0.348</b>
Adj. EBIT excl. capitalised costs	-9.025	-10.307	-12.766	-10.618	-6.892	-1.243
Interest income	0.278	0.449	0.366	0.120	0.150	0.165
Interest expenses	-2.059	-1.941	-3.023	-2.072	-2.201	-2.155
Net financial income	-1.781	-1.492	-2.657	-1.952	-2.051	-1.990
<b>Pre-tax profit</b>	<b>-20.978</b>	<b>-10.927</b>	<b>-14.236</b>	<b>-8.815</b>	<b>-4.752</b>	<b>1.446</b>
Adj. PTP excl. capitalised costs	-21.613	-11.799	-15.423	-10.018	-6.135	-0.145
Taxation	-0.003	0.000	-0.002	0.000	0.000	0.000
<b>Net income</b>	<b>-10.174</b>	<b>-10.927</b>	<b>-14.238</b>	<b>-8.815</b>	<b>-4.752</b>	<b>1.446</b>

Source: Company data, Hardman & Co Research



## Balance sheet

### Artificial Solutions – balance sheet

Year-end Dec., (€m)	2016	2017	2018	2019E	2020E	2021E
<b>ASSETS</b>						
<b>Fixed intangible assets</b>						
Capitalised expenditure for licences & software	3.480	3.107	2.870	1.203	1.384	1.591
Goodwill	2.081	0.767	0.000	0.000	0.000	0.000
<b>Total intangible assets</b>	<b>5.561</b>	<b>3.873</b>	<b>2.870</b>	<b>1.203</b>	<b>1.384</b>	<b>1.591</b>
<b>Fixed tangible assets</b>						
Equipment, furniture & fittings	0.240	0.227	0.174	0.207	0.250	0.305
<b>Total tangible fixed assets</b>	<b>0.240</b>	<b>0.227</b>	<b>0.174</b>	<b>0.207</b>	<b>0.250</b>	<b>0.305</b>
<b>Total fixed assets</b>	<b>5.801</b>	<b>4.100</b>	<b>3.044</b>	<b>1.410</b>	<b>1.633</b>	<b>1.897</b>
Other non-current receivables	0.380	0.517	0.538	0.591	0.651	0.716
<b>Total non-current assets</b>	<b>6.181</b>	<b>4.618</b>	<b>3.581</b>	<b>2.001</b>	<b>2.284</b>	<b>2.612</b>
<b>Current assets</b>						
Accounts receivable - trade	0.734	0.399	0.560	0.755	1.020	1.377
Tax receivable	0.515	0.369	0.883	0.000	0.000	0.000
Other receivables	0.109	0.088	0.329	0.361	0.398	0.437
Prepaid expenses & accrued income	0.609	0.583	0.470	0.517	0.568	0.625
<b>Total current receivables</b>	<b>1.967</b>	<b>1.439</b>	<b>2.241</b>	<b>1.634</b>	<b>1.986</b>	<b>2.439</b>
Cash & bank balances	0.810	0.491	4.564	1.010	-0.317	2.003
<b>Total current assets</b>	<b>2.777</b>	<b>1.930</b>	<b>6.804</b>	<b>2.644</b>	<b>1.669</b>	<b>4.442</b>
<b>TOTAL ASSETS</b>	<b>8.958</b>	<b>6.547</b>	<b>10.386</b>	<b>4.645</b>	<b>3.953</b>	<b>7.054</b>
<b>EQUITY &amp; LIABILITIES</b>						
<b>Equity</b>						
Share capital	2.849	3.092	3.646	4.193	4.822	5.545
Share premium reserve	58.128	62.776	75.566	77.355	79.818	80.532
Other equity including result for year	-62.784	-73.394	-87.638	-96.453	-101.204	-99.758
<b>Total equity</b>	<b>-1.807</b>	<b>-7.526</b>	<b>-8.427</b>	<b>-14.905</b>	<b>-16.565</b>	<b>-13.681</b>
<b>Long-term liabilities</b>						
Liabilities to other lenders	4.715	2.537	5.102	4.592	4.132	3.719
<b>Total long-term liabilities</b>	<b>4.715</b>	<b>2.537</b>	<b>5.102</b>	<b>4.592</b>	<b>4.132</b>	<b>3.719</b>
<b>Current liabilities</b>						
Liabilities to other lenders	2.609	7.776	9.132	9.589	10.068	9.565
Accounts payable - trade	0.167	0.395	0.364	0.491	0.663	0.895
Income tax liability	0.011	0.005	0.002	0.000	0.000	0.000
Other liabilities	0.183	0.241	0.347	0.433	0.541	0.677
Accrued expenses & deferred income	3.080	3.119	3.866	4.446	5.113	5.879
<b>Total current liabilities</b>	<b>6.050</b>	<b>11.536</b>	<b>13.711</b>	<b>14.959</b>	<b>16.385</b>	<b>17.016</b>
<b>TOTAL EQUITY &amp; LIABILITIES</b>	<b>8.958</b>	<b>6.547</b>	<b>10.386</b>	<b>4.645</b>	<b>3.953</b>	<b>7.054</b>

Source: Hardman & Co Research, Company data

## Cashflow

### Artificial Solutions – cashflow statement

Year-end Dec., (€m)	2016	2017	2018	2019E	2020E	2021E
Operating loss	-8.389	-9.435	-11.579	-9.415	-5.508	0.348
Depreciation	2.293	2.641	2.320	2.552	2.807	3.088
Other items excluded from cashflow	1.036	0.320	0.030	0.000	0.000	0.000
	<b>-5.061</b>	<b>-6.474</b>	<b>-9.229</b>	<b>-6.863</b>	<b>-2.701</b>	<b>3.436</b>
Interest received	0.208	0.363	0.298	0.120	0.150	0.165
Interest paid	-0.879	-0.888	-1.740	-2.072	-2.201	-2.155
Taxation paid & received	-0.513	0.140	0.000	0.000	0.000	0.000
<b>Operating cashflow before working capital changes</b>	<b>-6.245</b>	<b>-6.858</b>	<b>-10.671</b>	<b>-8.815</b>	<b>-4.752</b>	<b>1.446</b>
<b>Changes in working capital</b>						
(Increase)/Decrease in receivables	0.066	0.359	-1.961	-0.607	0.352	0.454
Increase/(Decrease) in liabilities	-0.435	0.360	0.821	1.248	1.426	0.631
<b>Net change in working capital</b>	<b>-0.369</b>	<b>0.719</b>	<b>-1.139</b>	<b>0.641</b>	<b>1.779</b>	<b>1.084</b>
<b>Cashflow from operating activities</b>	<b>-6.613</b>	<b>-6.139</b>	<b>-11.810</b>	<b>-8.174</b>	<b>-2.973</b>	<b>2.531</b>
<b>Investing activities</b>						
Purchases of tangible fixed assets	-0.112	-0.063	-0.025	-0.033	-0.043	-0.056
Purchases of intangible fixed assets	-0.640	-0.882	-1.244	-0.622	-0.311	-0.155
Change in fixed assets	0.000	0.000	0.000	0.000	0.000	0.000
<b>Cashflow from investing activities</b>	<b>-0.752</b>	<b>-0.945</b>	<b>-1.269</b>	<b>-0.655</b>	<b>-0.354</b>	<b>-0.211</b>
<b>Financing activities</b>						
Issue of new shares	8.267	3.833	12.820	4.500	0.000	0.000
Costs of new share issues	-0.179	-0.187	-0.346	-0.225	0.000	0.000
Issue of new non-registered shares	1.244	0.000	0.000	0.000	0.000	0.000
Change in loans	-1.304	3.118	4.678	1.000	2.000	0.000
<b>Cashflow from financing activities</b>	<b>8.029</b>	<b>6.764</b>	<b>17.152</b>	<b>5.275</b>	<b>2.000</b>	<b>0.000</b>
<b>Net change in cash &amp; cash equivalents</b>	<b>0.664</b>	<b>-0.320</b>	<b>4.073</b>	<b>-3.554</b>	<b>-1.327</b>	<b>2.319</b>
Cash & cash equivalents at start of year	0.147	0.810	0.491	4.564	1.010	-0.317
<b>Cash &amp; cash equivalents at end of year</b>	<b>0.810</b>	<b>0.491</b>	<b>4.564</b>	<b>1.010</b>	<b>-0.317</b>	<b>2.003</b>

Source: Company data, Hardman & Co Research

## Artificial Solutions management

### *Åsa Hedin (Non-Executive Chairman)*

Åsa has 30 years of experience within high-tech industries, medical devices and life sciences. She was most recently former Executive Vice President at Elekta AB and President Elekta Instrument AB, a leading radiation oncology solutions manufacturer. Before this, Ms. Hedin was a Senior Vice President of Corporate and Strategic Development at Gambro AB, responsible for managing Gambro's M&A activities, as well as Corporate strategy. She is today non-executive board member for several public and private companies, including Nolato AB, Tobii AB, Cellavision AB, C-Rad AB, Immunovia AB and E J:or Öhman Fonder AB. She is also industry advisor to the Department of Microtechnology and Nanoscience (MC2) at Chalmers University of Technology.

### *Lawrence Flynn (CEO)*

With over 20 years of experience in managing international companies within the IT industry, Lawrence joined Artificial Solutions in May 2010 as CEO, and his focus has been on strategy and innovation. His initiatives to re-engineer the organisation to suit market circumstances and drive growth have placed the company at the forefront of the natural language revolution. Prior to joining Artificial Solutions, he led several companies to profitable trade exits across a wide range of sectors, including ERP, Supply Chain and Web Content Management. In his previous role as CEO of MediaSurface, Lawrence floated the company on the London Stock Exchange, and subsequently sold the company to Alterian, having grown revenues fivefold.

### *Chris Bushnell (CFO)*

Chris joined Artificial Solutions in January 2011, bringing extensive experience of working in international environments, particularly in Europe, Middle East and Africa. As VP Finance Europe at Marcam, an International ERP vendor, he helped the company grow from a startup to revenue of \$25m, through to its eventual acquisition by Invensys. Later as Regional CEO at Systems Union, he was part of the team that grew revenue to £40m in Europe, and again prepared the Group for disposal. Since qualifying as a Chartered Accountant, Chris has spent almost his entire career in the IT industry.

### *Andy Peart (CMSO)*

Andy is responsible for the strategic positioning of Artificial Solutions in the wider natural language and AI marketplace. He has over 25 years' experience in managing marketing operations for sector-leading software and services companies in the UK, Europe and the US. Andy started his career with engineering software specialist PAFEC, and went on to hold executive marketing management roles at software companies including ACT, Kalamazoo and Magic Software. He was CMO at London Stock Exchange-listed Mediasurface, where he was part of the executive management team that led various successful acquisitions and the subsequent sale of the company to Alterian. He went on to oversee marketing operations at Alterian as VP Marketing, and joined the senior management team of Artificial Solutions in 2010.

### *Andreas Wieweg (CTO)*

Andreas leads Artificial Solutions' product strategy, design and development for its next-generation natural language interaction platform. He is responsible for the company's technology vision and product strategy, product design and development, and quality assurance and documentation. Under Andreas's leadership, the product portfolio has successfully grown to include a wide range of applications in areas such as language technology, voice automation, search

technology, knowledge management, virtual avatars, email management, live-chat, SMS services, and analytics. Andreas's educational background is in engineering, and he has been a key player in growing Artificial Solutions from a small startup company.

### *Peter Roost (COO)*

As Chief Operating Officer at Artificial Solutions, he is responsible for all post-sales functions, including Customer implementations, Professional Services, Support & Maintenance, Hosting & IT, Education & Training, Best Practices, as well as Legal and Commercial support for the entire business. Peter has successfully worked in senior leadership roles within the European IT industry for 25 years, ranging from an ERP software and professional services business, a tier 1 System Integrator and a public company providing CAD/CAM solutions to global manufacturing.

### *Johan Ekesiöö (non-executive director)*

Johan has more than 30 years of experience in the IT industry at IBM in Sweden, Nordics and the US. He has also served as MD for Antfactory, a private VC company, worked on the restructuring of Framfab, and has been partner and owner of Inveritas, a management consulting company. Over the last five years, he has served as Chairman or a board member of several software companies. He presently serves as Chairman at T&V Holding and Metaforce AB, and is a board member of Zenterio AB, Ripasso Energy AB, AB Svensk Bilprovning, WTS AB and Lingit AS.

### *Bodil Eriksson (non-executive director)*

Bodil has nearly 30 years' experience in executive management roles, covering a broad range of industries, including oil, insurance, automotive, and food and pharmacy retail. Currently CEO of Volvo Car Mobility, Bodil was previously Executive VP for Volvo USA, heading the product, marketing and communication team in the US. During the last 10 years, Bodil has held board positions with companies in the banking, cosmetic, retail and healthcare sectors. She is currently a board director of Swedbank AB.

### *Johan A. Gustavsson (non-executive director)*

Johan was a co-founder of Artificial Solutions in 2001. He is also the founder and CEO of Vencom Group and Chairman of Hop Lun International, Aros Bostad and Hobbex.

### *Fredrik Oweson (non-executive director)*

Fredrik is a co-founder and partner of Scope Capital Advisory AB, which was established in 2001. He was previously with the Swedish investment holding company, Proventus, and with Goldman Sachs Intl. Previously a director of MySQL, he is currently a director of Scope Capital, Mijesi, Wright Trafikkskole and Zenterio.

### *Dr Jan Uddenfeldt (non-executive director)*

Jan is one of the main inventors of wireless technology, and credited for moving Ericsson and Sony from the cellular industry into the broadband era. As the former global CTO and Senior VP at Ericsson, he headed R&D during the 15-year period when Ericsson innovated and developed wireless technologies such as GSM, 3G and Bluetooth. He is currently advising tech companies, and is on the board of several startup companies in Silicon Valley.

# Risks

Artificial Solutions is a small vendor delivering potentially complex software solutions to major enterprises. This gives rise to a number of different risks.

### *Pace of industry developments*

The company needs to keep pace with industry developments, which are moving at a rapid and possibly even accelerating rate. Failure to target the appropriate development initiatives and maintain a productive R&D organisation could result in Teneo falling behind. At present, the company is acknowledged to be an industry leader.

### *Competition from global technology vendors*

The level of investment into AI by the world's largest technology companies is immense, in the form of both organic development and acquisitions of smaller, innovative businesses. The competitive landscape for Artificial Solutions will remain intense, which is to be expected in a technology segment with such enormous potential magnitude and global relevance.

### *Staff retention*

The AI segment is a hot area at present, which is reflected in relatively high rates of churn among specialists in this field. Recruiting and retaining talented employees will become increasingly challenging over time, although the company's recent listing may help in creating scope to offer stock-based incentivisation to key employees.

### *Systems integrators (SIs) reduce visibility*

The company's progressively increasing reliance on systems integrators as a primary route to market may create reduced visibility into the pipeline of new opportunities. SIs will have their own distractions and priorities, so Artificial Solutions will need to maintain a close dialogue with its main SI partners to retain a degree of visibility.

### *Lengthy and costly sales cycles*

Large customers tend to require lengthy sales cycles, which will represent a burden on Artificial Solutions' resources, where it is either engaged in a direct sale or where the customer is seeking input from the software vendor. Finding an appropriate balance when allocating technical resources to pre-sales activities will be important.

### *Customer concentration*

Customer concentration is a source of risk, particularly in the context of usage-based revenue streams, which are expected to grow as a proportion of total revenue. Any customer losses or decisions by customers to change divisional structures or pare back specific initiatives could adversely impact Artificial Solutions' revenue to a significant extent. This effect has been seen, to some extent, in the revenue mix in the last two years.

# Notes

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