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AI Enabled Imagery-based Intelligence: Evolving Opportunities and Business Models

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Core Strategic Questions

EARTH OBSERVATION

Market Trends

Applications and their Evolution

Evolving Revenue Opportunities

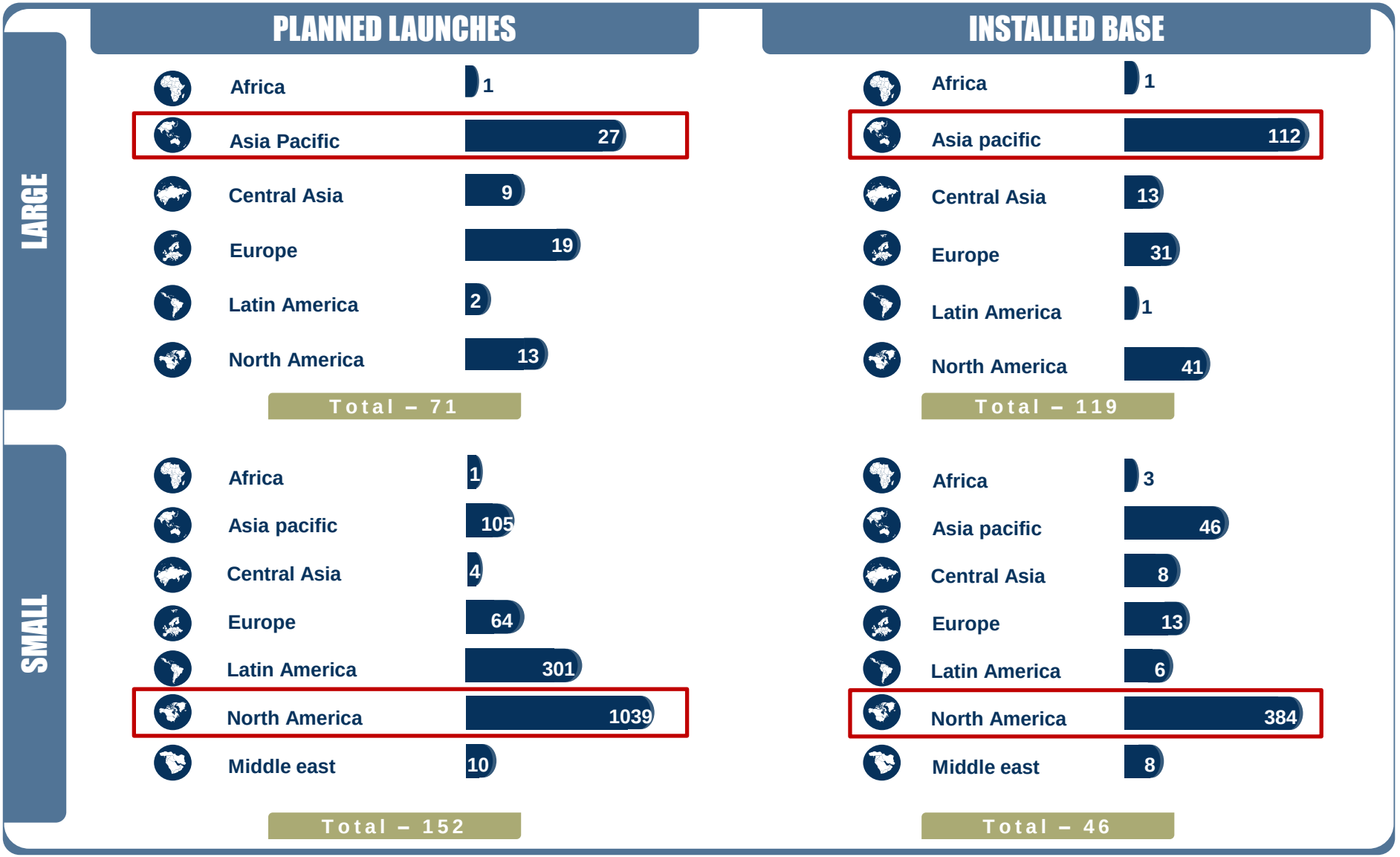
Tech Enablers

Earth Observation: Market Trends

The Geospatial Market: Overview

Service Providers (Value Added/Geospatial)

Large and small Satellites: Planned & Installed base



Source: Frost & Sullivan

Earth Observation: Applications and their Evolution

Maritime Surveillance is a Model Application Area

Elementary Maritime Domain Awareness Coverage

- Cooperative Vessels
- Stand-alone Surveillance Data Systems

Future Near-real-time Maritime Domain Awareness Coverage

- Cooperative Vessels
- Non- cooperative Vessels
- Marine Resources
- Integrated Data Sharing

Terrestrial capabilities with no/limited real-time approach to detection and tracking	Inclusion of satellite data overlay (AIS/SAR/Electro-Optical (EO))	Terrestrial and space-based capabilities with near real-time approach to detection and tracking

Timeline

2005 — 2019

Limited Surveillance → **Event-based Ad Hoc Integration** → **Automated Integration and Web-based Delivery**

Source: Frost & Sullivan

The more the data, the better is the solution…

Maritime Surveillance Technology Evolution, Level of Data Inclusion, Global

Assets/Data Sources	Level 1	Level 2	Level 3	Level 4
Terrestrial Radar	✓	✓	✓	✓
Terrestrial AIS	✓	✓	✓	✓
VMS		✓	✓	✓
LRIT		✓	✓	✓
Aerial EO		✓	✓	✓
Satellite EO		✓	✓	✓
Satellite AIS			✓	✓
Satellite SAR			✓	✓
Constellation Data (EO/AIS/SAR)			✓	✓
Vessel-based Sensor Data				✓

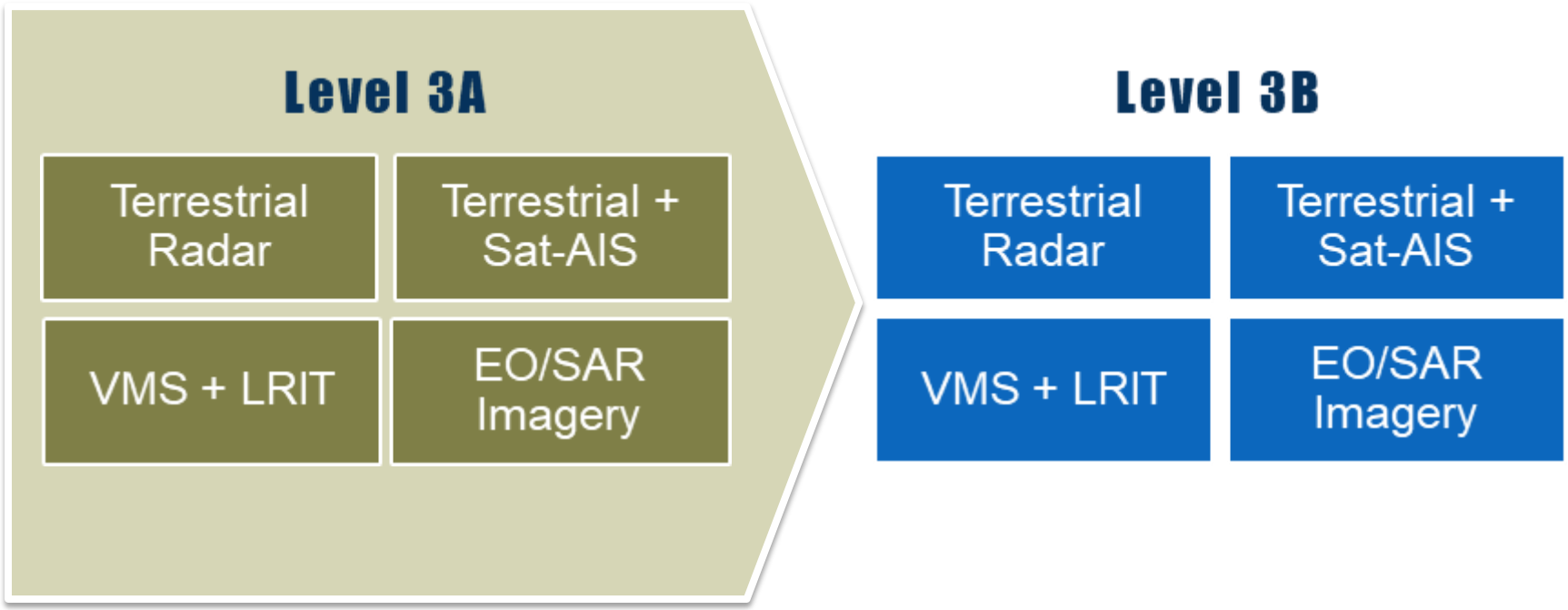
Note: This grid indicates the potential viability of inclusion of diverse data sources and does not represent any specific solution. Source: Frost & Sullivan

Evolving Maritime Surveillance Capability Composition

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Terrestrial Radar	Terrestrial Radar	Terrestrial Radar	Terrestrial Radar
Terrestrial AIS	Terrestrial AIS	Terrestrial + Sat-AIS	Terrestrial + Sat-AIS
	EO (Sat/Aerial)	VMS + LRIT	VMS + LRIT
	VMS + LRIT	EO/SAR (Sat/Aerial)	EO/SAR (Sat/Aerial)
• Short-range coastal surveillance • Terrestrial/fixed assets	• Medium-range coastal surveillance through integrated data analysis (terrestrial and space) • Integration covering aerial imagery subject to investigation requirements and asset availability (UAV/fixed/rotary/aerostat)	• Long-range surveillance with delayed and limited threat detection through integrated data analysis (terrestrial and space (EO/SAR)) • Integration covering aerial imagery subject to investigation requirements and asset availability (UAV/fixed/rotary/aerostat)	• Very long-range distributed surveillance with near-real-time domain awareness providing threat detection, classification, and tracking (terrestrial + space (EO/SAR) + naval (mobile/static)) • Integration covering aerial imagery subject to investigation requirements and asset availability (UAV/fixed/rotary/aerostat)
Meets regional requirements covering short-range distances and cooperative vessels	• Meets regional requirements covering cooperative vessels • Requirements to be met with relatively long wait times between updates	Meets regional and global requirements covering frequent updates and cooperative/non-cooperative vessels	Meets regional and global requirements including military needs covering cooperative/non-cooperative vessels

Source: Frost & Sullivan

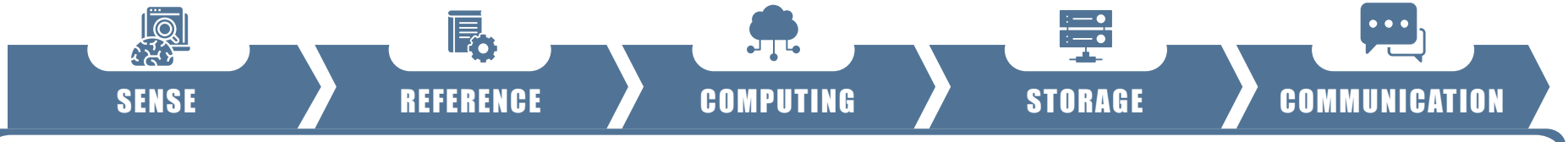
Diversity in Integrated Surveillance Capabilities



The responsibility of integrating multiple data sets, inclusion of large volume of historical data and customized analytics development is increasingly taken up by the industry unlike previously where the customer trained to use the solution and was responsible for most of the work.

Source: Frost & Sullivan

Time is ripe for integration and distribution….

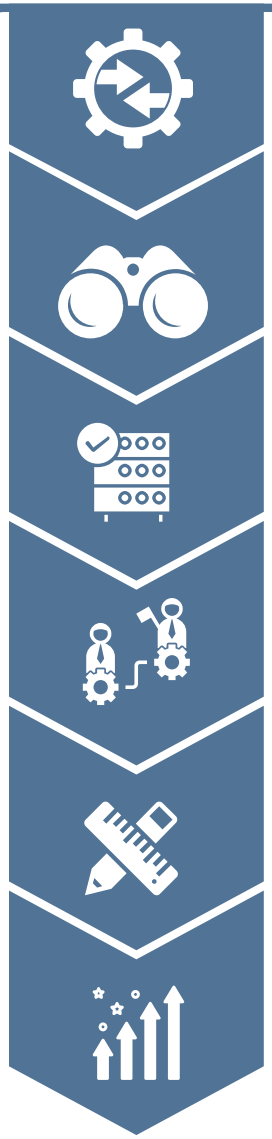


Key Features	Description
Decentralized centralization	• The system will comprise terrestrial, naval (static/mobile), and space assets, with each mobile naval asset capable of acting as an ad hoc command and control center. • Each platform will have its own integrated processing capability that will evaluate the environment surveyed based on the data available and share it with the network. The cumulative integration can be executed by the vessel with access to the maximum information possible at any given time.
Modularity	• Each naval platform will have multiple sensors and will have access to send and receive data through LOS and non-LOS communication channels.
Multi-level data integration	• The data from each of them will be integrated and processed locally before being shared with other partners of the system; all the partners will have access to a common processed domain awareness.
Near-real-time domain awareness	• The system will be self-configurable and constantly evaluate the data shared by every partner of the system, providing a wide-area domain awareness, with the coverage varying with the location of key naval assets.
Satellite capabilities used	• Position and tracking (GNSS), communication, EO/SAR data

Source: Frost & Sullivan

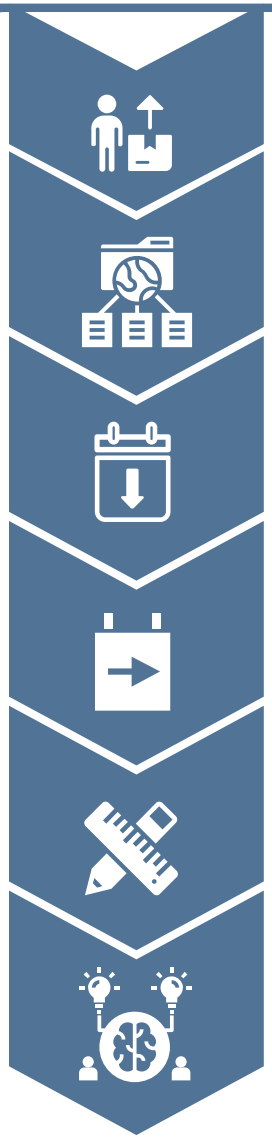
Earth Observation: Tech Enablers

Tech Enablers of the Geospatial Markets: Key Trends



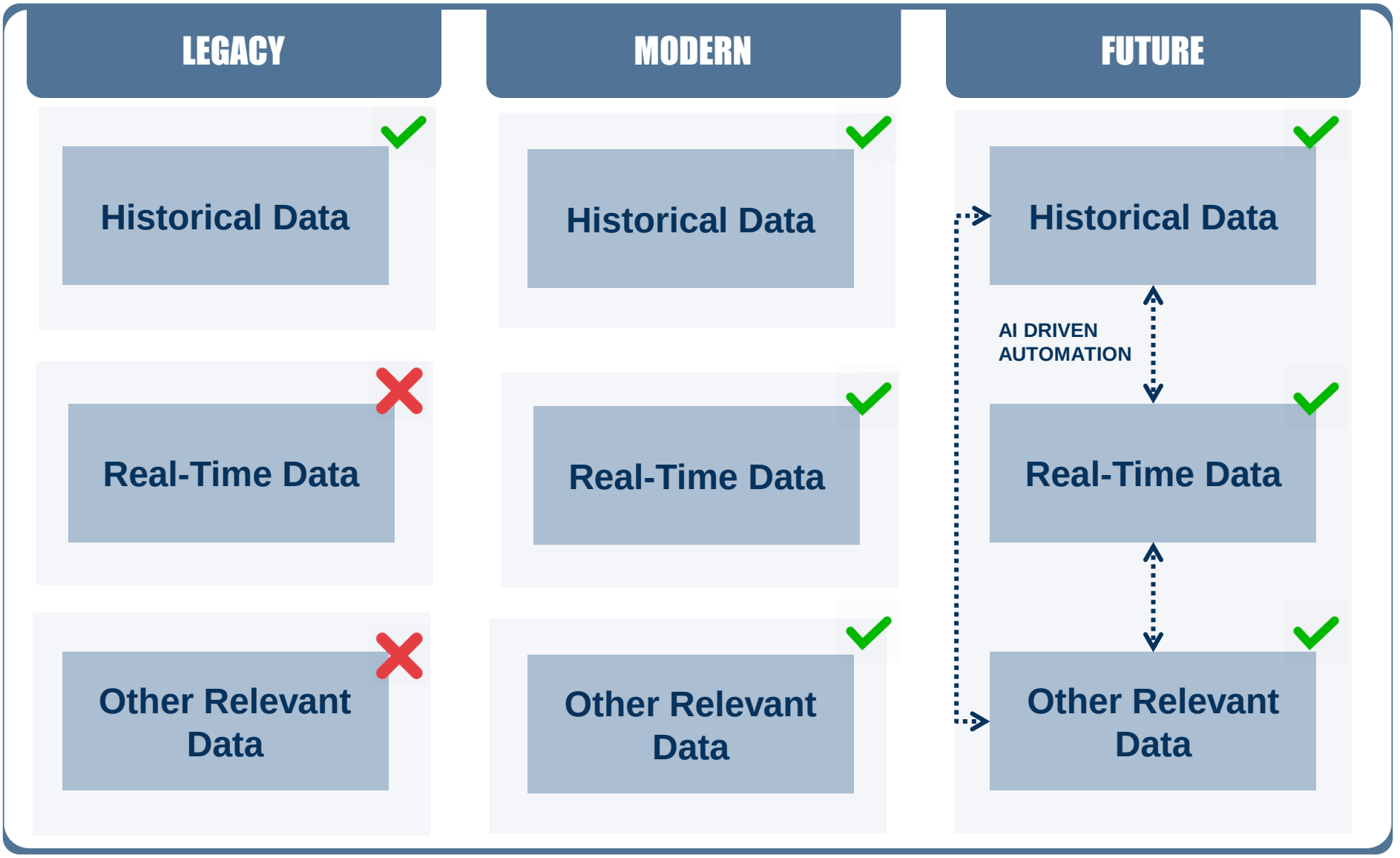
- Integrate multiple data sets (structured & unstructured)
- Identify associations between data-sets
- Establish patterns across multiple associations
- Train the system to follow the patterns
- Design the system to evolve its own patterns in an ongoing basis
- Enhance the system to accommodate large volume of historical data

Tech Enablers of the Geospatial Markets: Key Trends



- Deliver relevant actionable intelligence to diverse stakeholders
- Enable seamless data-sharing
- Current state: AI is a nice-to-have (new solutions)
- Future state: AI is a must-have (standardized integrated solutions)
- Design, train and deploy
- Intelligence enhances over time

More Integration & Automation in the Future



Earth Observation: Evolving Opportunities

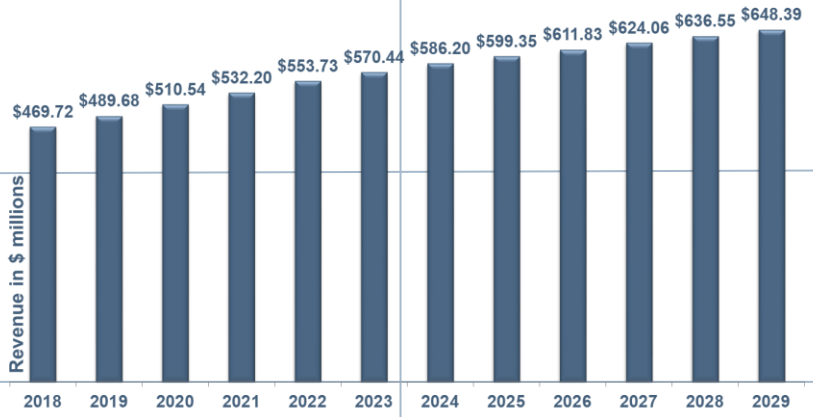
Geospatial Market: The Future is Bright with AI

Assessing the impact of global megatrends, disruptive technologies, and new business models on the future of Earth Observation market

Seamless availability of EO data

Rise in demand for near real-time analytics

Rise in government investment, Smart cities,



Mapping as a Service, Pay-per-Image pricing,

Senor Miniaturisation, Artificial Intelligence, Complimentary drone imagery

Startups, Small-satellites, New applications

Macro to Micro Implications

Visioning Scenarios for the Earth Observation Market

Source: Frost & Sullivan

Geospatial Market: Growth Opportunities

Autonomous Vehicles

Autonomous vehicle capabilities depend on the availability of a comprehensive 3D mapping solution that will enable the vehicle access the local-roadways in an error free manner

Smart Cities

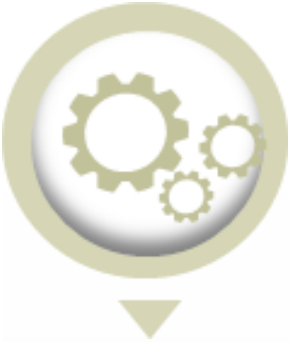
The aim to realize forward looking technologically advanced urban areas is driving the need for enhanced mapping solutions that can provide real-time insights

Artificial Intelligence & Big-Data

Seamless availability of diverse data sets from multiple sources including small-satellite operators will enable the development of data-rich actionable insights

Government Applications

Government agencies are working to wards 'Comprehensive and Shared' GIS capabilities to maximize their return on investment and enable seamless data sharing across agencies



Blockchain

Blockchain, when integrated as an enhancement tool to GIS applications will improve the integrity of the insights and deliver new insights as the Proof-of-Location information from the system is more reliable than before

Source: Frost & Sullivan

Top predictions

1. Rising number of earth observation satellites
2. New geospatial solutions involving diverse data sets
3. Increasing use of artificial intelligence & big data capabilities
4. Affordable imagery products and pay-per-use business models
5. Industry consolidation as incumbents expand their portfolio
6. Maritime surveillance/smart cities/business intelligence/automotive

Source: Frost & Sullivan

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