A Report for

European Commission- Directorate General Maritime Affairs

Sustainability and Efficiency of Visions for CISE

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Engagement: 330012909

Gartner

Table of Contents

PART 1-Engagement summary, key findings & implications

Executive summary

This report assesses the Cost-Efficiency and Sustainability of five Architectural Visions for the future Common Information Sharing Environment (CISE) for maritime surveillance. The five Visions constitute different organizational and technical approaches to the integration of information from seven different User Communities in the 28 EU Member States. The Visions are briefly characterized as follows:

- Core Vision: Multiple Providers of CISE Services at National level & for EU initiatives
- Vision A: Multiple Providers of CISE Services Coordinated by User Communities & EU initiatives
- Vision B: Multiple Providers of CISE Services Coordinated by Member States & EU initiatives
- Vision C: Single National Providers of CISE Services & EU initiatives
- Hybrid Vision (combining Vision A, B and C): Multiple providers of CISE services coordinated by Member States & User Communities as well as EU initiatives.

Our analysis shows that CISE can be realized over a ten year period for a cost between 83 and 142 m€, depending on the Vision chosen. The costs include developing and maintaining the necessary Information Exchange standards, governance and IT components to support CISE as well as interconnect existing EU sector-specific systems and Member State systems. As a reference value, a Member State on average runs 7 IT systems for Maritime Surveillance today, whereby the system on average has cost 15 m€ to establish and is operated for 10% per annum of the investment amount.

Vision C bears the lowest Total-cost-of-Ownership (TCO), with a TCO at 58% of the TCO of the most expensive Vision. The Hybrid Vision shows a medium TCO of 107 m€. Visions with low Capital Investment (CapEx) also result in low Operating Expenses (OpEx) over the life cycle of CISE. This is due to the fact that investments are coordinated among authorities to a larger extent. As a general rule, the Cost Model demonstrates that a lack of coordination of investments is the greatest cost driver to CISE at the Member State level.

The EU- level cost amount to between 22 m € to 26 m€ (CapEx & OpEx together), whilst cost at the Member State level, per Member State, amount to between 2 m€ and 4 m€ for the ten year budgeting period.

Despite significant differences in cost between the Visions, Gartner underpins that cost considerations must never be the only criterion to base an implementation choice on. Examples of other relevant decision criteria are the effectiveness, sustainability and feasibility of the implementation as well as its expected benefits.

The Efficiency analysis shows that the most tangible benefit of CISE are the cost savings generated through the so-called Reference implementations for Nodes and Gateways. These Reference implementations will be provided by the EU and distributed to Member States for “plug and play”. If taken up by all, cost of more than 71 m € could be saved.

Another benefit of CISE lies in its potential to simplify the landscape of Maritime Surveillance systems in Europe. This potential has not been factored into the Cost Model as its magnitude is very difficult to predict. It in fact depends on the extent the EU and its Member States use CISE as an opportunity to revise their Maritime Surveillance set-ups to increase effectiveness & efficiency.

Finally, the analysis shows that the most sustainable Vision for CISE is the Hybrid Vision. Due to the flexibility it offers, it caters for Member State investment cycles and current governance & organizational arrangements, leveraging on capabilities of the status quo rather than imposing a uniform implementation of CISE where one size is likely not to fit all.

1.0 Introduction

1.1 Engagement background

Gartner has been charged with costing the most viable technical Visions for the "Common Information Sharing Environment (CISE)" for Maritime Surveillance in the European Union domain. The report at hand is the final deliverable of this engagement.

The two objectives for this Gartner engagement were:

- To refine and validate the Architectural Visions for CISE as elaborated in preceding works commissioned by DG MARE
- To enable an objective, budget-based comparison of the Visions

Through reaching the first goal Gartner prepared the grounds for a successful engagement. This meant that Gartner considered the Visions to cost as relevant and sufficiently clear to provide a budgetary estimate.

The second goal formed the core of the assignment: to support DG MARE's Visioning with accurate financial estimates. The estimates would contribute to giving DG MARE a robust view on whether the Visions were effective and efficient in reaching CISE's goals.

Effectiveness and cost efficiency is what the European Institutions unanimously expect from CISE:

"An integrated approach to Maritime Surveillance should improve the effectiveness of the authorities responsible for Maritime activities by making available more tools and more information necessary for the performance of their duties. This should result in more efficient operations and reduced operating cost. The potential savings at EU level are significant given the growing need to detect, identify, track and intercept amongst others illegal migration, illegal fishing as well as to prevent accidents at sea, to safeguard the environment and to facilitate trade. The benefits to flow from this process will positively affect national security, Maritime security and safety, the protection of the marine environment, border control and, in general, law enforcement."[1]

The results in this document are related to the Impact Assessment work DG MARE is conducting in order to address efficiency and effectiveness considerations in detail.

1.2 About this report

Gartner herewith provides a model for costing CISE. Per definition, a model is never a 1:1 transposition of reality but a simplified viewpoint on how an ICT program can be implemented. The assumptions underlying this simplification have been collated over time and are backed up by a wide range of quantitative, qualitative and anecdotal evidence the Gartner team has been able to gather.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52009DC0538:EN:NOT.

Whilst Cost Models are a rather technical deliverable, it is important not to forget their reason-to-be. That is to support the Impact Assessment process and specifically its Business Case so that it can guide decision-making for leaders and participants in the CISE program. This Business Case should provide a sound view on both the cost and benefits of CISE, under different implementation scenarios. Based on the budgets the Cost Model generates, decisions will be taken about implementing CISE, including nuances in the way to implement it. The main questions the Cost Model can help answering comprise:

- What should be the total budget for CISE?
- Which option is the most cost-efficient over time?
- What is the distribution of cost between the EU and the Member States?

Cost is only one half of the equation and benefits as well as other not necessarily tangible considerations will play an equally important role in the final judgment call for the CISE program's implementation.

This report illustrates how the Gartner Costing methodology has been applied to CISE which can be considered one of the largest, ambitious initiatives of its kind. For decision makers, the report illustrates the results of the costing and gives guidance on the interpretation of the results. These are provided in Part I of this report. Part II provides the details of the methodology and illustrates the working of the model in greater granularity.

1.3 Key findings

The engagement has modelled cost for the following Architectural Visions for CISE:[1]

Core vision	**Vision A**	**Vision B**	**Vision C**	**Hybrid Vision**
Multiple Providers of CISE Services at National level (+ EU initiatives)	Multiple Providers of CISE Services Coordinated by User Communities (+ EU initiatives)	Multiple Providers of CISE Services Coordinated by Member States (+ EU initiatives	Single National Providers of CISE Services (+ EU initiatives)	Multiple providers of CISE services coordinated by Member States and User Communities (+ EU initiatives). The Hybrid Vision is a combination of Visions A, B and C.

Table 1: Overview of major elements in the Cost Model

Our analysis shows that CISE can be realized over a ten year period for a cost between 83 and 142 m€ , depending on the Vision chosen. Cost include developing and maintaining the necessary Information Exchange standards, governance and IT components to support CISE as well as interconnect existing EU sector-specific systems and Member State systems.

Costs do not include Member State investments in specific Maritime Surveillance solutions based on CISE, such as assembling data sets to form a tailor-made Maritime picture or

[1] Status as of 18 June 2013. Source documents will become available here once the policy initiative supported by this Impact Assessment becomes public: http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm

support a specific analytical process. This reflects the very nature of CISE which is in essence geared towards *exchanging* information across sectors and countries.

Even within the limits of a single Vision, one cannot foresee with certainty how implementation will take place, therefore the Cost Model had to make assumptions around the most probable ways of realizing CISE.[1]

Comparing all Visions in terms of cost clearly indicates that Vision C bears the lowest Total-cost-of-Ownership (TCO), whereby this TCO equals 58% of the TCO of the most expensive Vision. The Hybrid Vision- which combines the approaches of earlier Visions- shows a medium TCO. Despite significant differences in cost, Gartner underpins that cost considerations can never be the only criterion to consider when choosing a suitable implementation Vision for CISE. Other relevant decision criteria are for example the effectiveness, sustainability and feasibility of the implementation[2] as well as its expected benefits.[3]

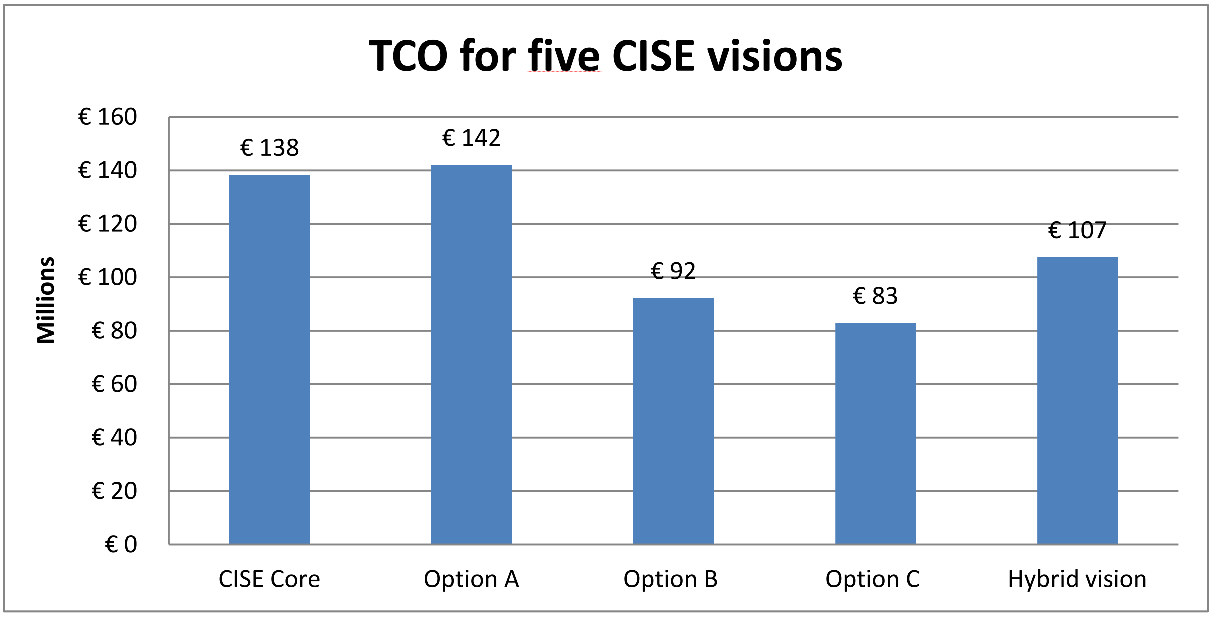

Figure 1 TCO for five CISE Visions

In addition to benefits such as the improvement of Maritime Surveillance and reducing the number of systems necessary to support the Maritime domain, CISE will lower the cost of exchanging Maritime Surveillance information through the provision of so-called Reference Implementations.[4] The latter could generate cost savings of up to 71 m€ for the CISE implementation.[5] The amount of cost savings achieved depends on the uptake of the Reference implementations by CISE participants.

The TCO combines one-off cost (CapEx) and ongoing cost (OpEx) over the ten year period. The Figure below shows the distribution of these for the Hybrid Vision.[6]

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[1] See 4.0 onwards detailing the assumptions made.

[2] See also Key Observations further below, and 2.0.

[3] Benefits are illustrated in detail in the DG MARE Impact Assessment. Source documents will become available here once the policy initiative supported by this Impact Assessment becomes public: http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm

[4] For the definition of Reference implementations please see section 4.3.2.

[5] See more in section 4.8 on Benefits calculations.

[6] The same graph is provided for all Visions in the Additional graphs section.

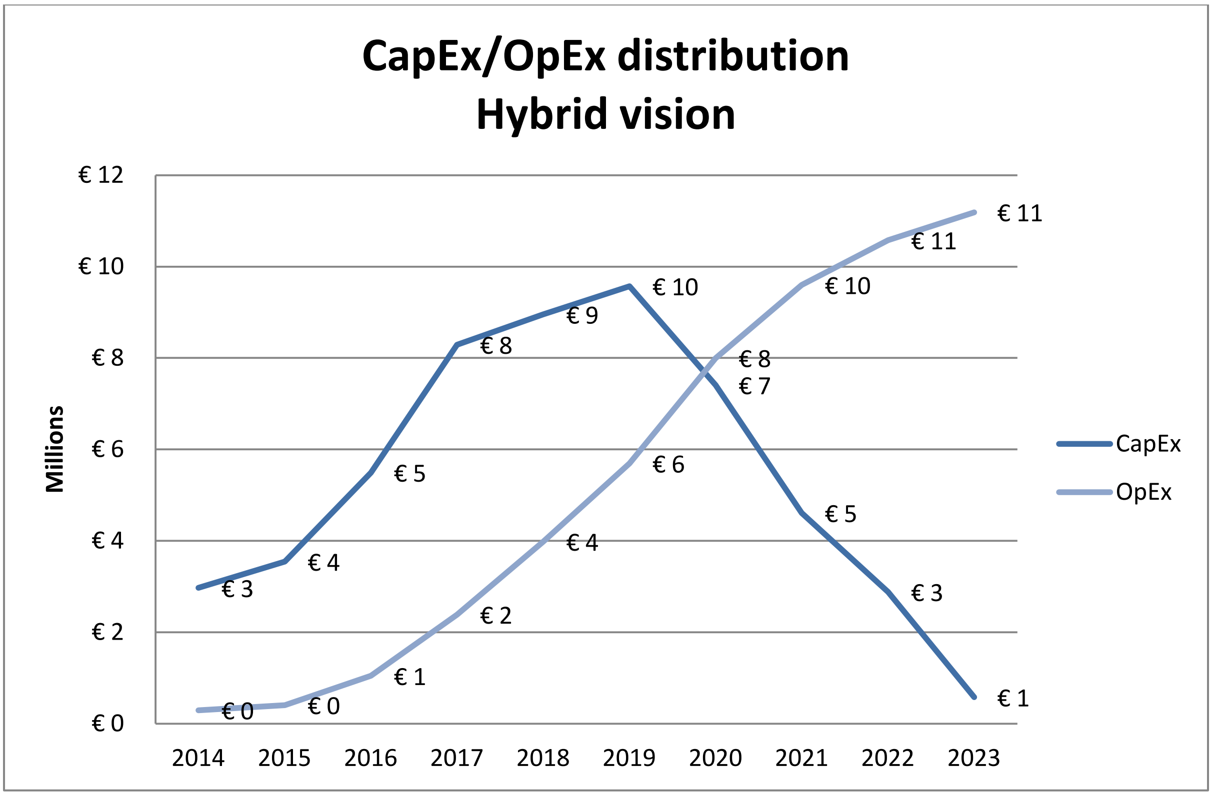


Figure 2 CapEx/OpEx distribution of Hybrid Vision

It should be noted that the OpEx includes both EU-level and Member State level operating cost for CISE. Whilst the CapEx diminishes to zero as investments get finalized, the OpEx reaches its maximum level in 2023 when all CISE participants are effectively using and maintaining the CISE environment. The 2023 OpEx is therefore representative for the OpEx to expect in the years thereafter in terms of a conservative i.e. higher-end estimate. Reductions in the OpEx from retiring and consolidating Member States' IT systems for Maritime Surveillance are not included in the calculation.

Interconnection with CISE is expected to result in an overall simplification of Maritime Surveillance systems (organizationally, process-wise and technically) in the Member States; a simplification that could partly offset the OpEx calculated as part of this Cost Model. Such a cost reduction has however not been integrated in the Cost Model as of yet as the guiding principle for our work was to rather provide a conservative than an (overly) optimistic estimate.

Whilst the above Figure stems from the Hybrid Vision as one example, the other Visions show similar distributions of cost over the budgeting period as the next Figure demonstrates.

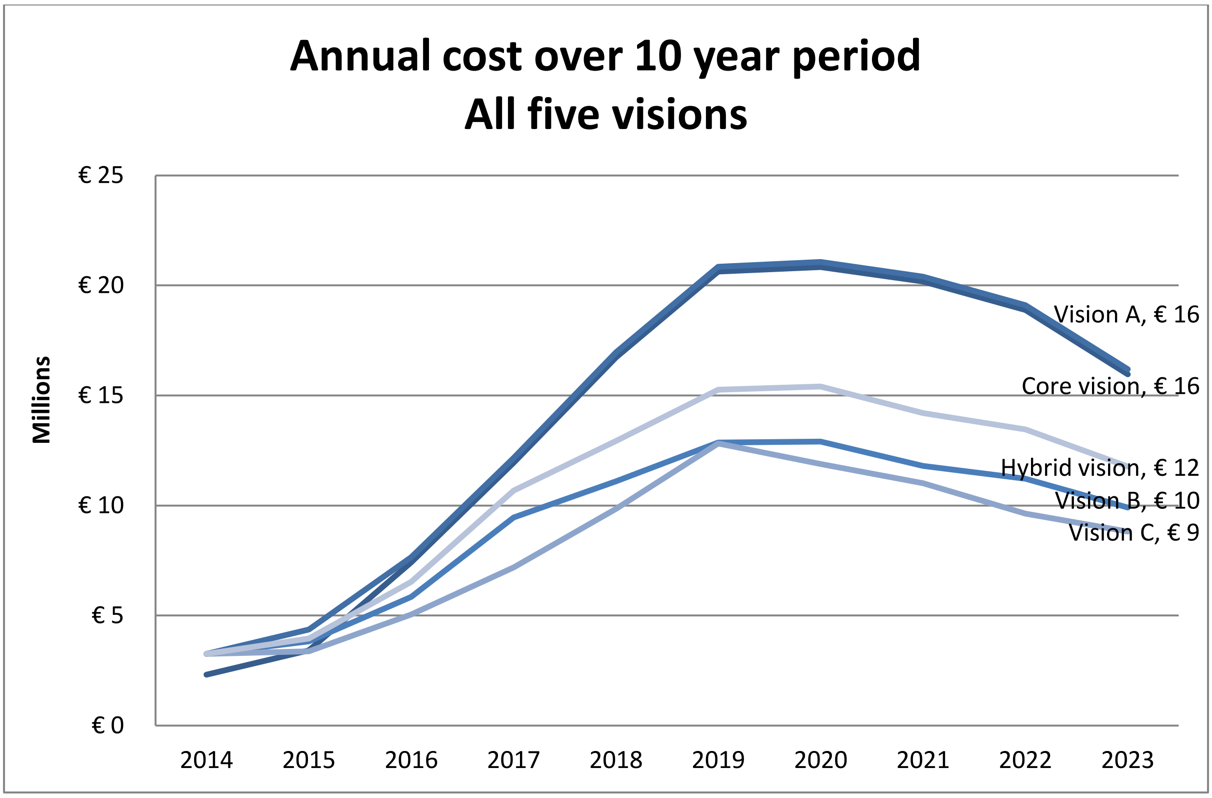


Figure 3 Annual total cost over 10 year period for all five Visions

The Cost Model indicates that more coordinated (or possibly centralized) investments in Maritime Surveillance result both in a lower CapEx as well as a lower OpEx. This contradicts a paradigm oftentimes seen in budgeting exercises where a lower (e.g. incremental or minimum) initial investment induces higher Operating Expenditures at a later stage and vice versa.

The next visual splits the TCO in Central Cost (occurring at the EU level) versus Member State-level cost. The distribution of cost over the 10 year budgeting period shows a limited initial investment needed at EU-level for developing the Information Exchange Model, the Reference Implementations and key support systems to CISE and a larger cost of the (gradual) connection of country systems to CISE.[1]

The initial investments at EU-level are thus followed by investments at the Member State level when Interfaces and Nodes are implemented. The investments in the Member States are assumed to follow a bell-curve where few will invest early, and the peak of investments will be in year 5 and 6 of the budgeting period. This implies that the adoption of CISE at the Member State level is modelled to follow investment cycles in the Member States and not a centrally managed rollout plan.[2]

[1] The same graph is provided for all Visions in the Additional graphs section.

[2] See sections 4.5 and 4.6for assumptions concerning adoption of CISE over time.

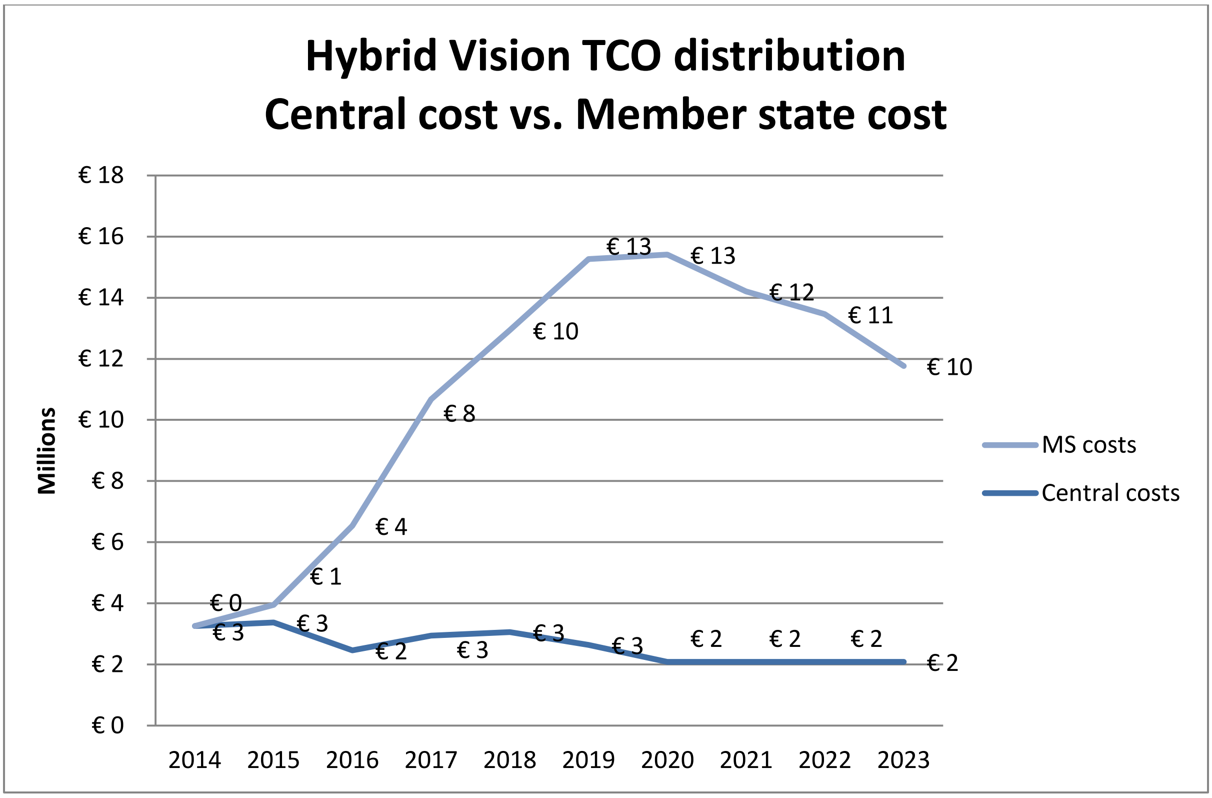


Figure 4 TCO Distribution of Central versus Member State Cost for Hybrid vision

In total, Central Cost at EU-level amount to between 22 and 26 m€ (see next Figure). The differences across Visions in Central Cost arise from differences in the types of References implementations that are provided.

The yearly Operating Expenditure for CISE is expected to be between 9 and 15 m€ approximately for all CISE participants (reference year 2023), i.e. both EU and Member States, whereby the average OpEx per Member State per annum would amount to between 240.000 and 500.000€ approximately.

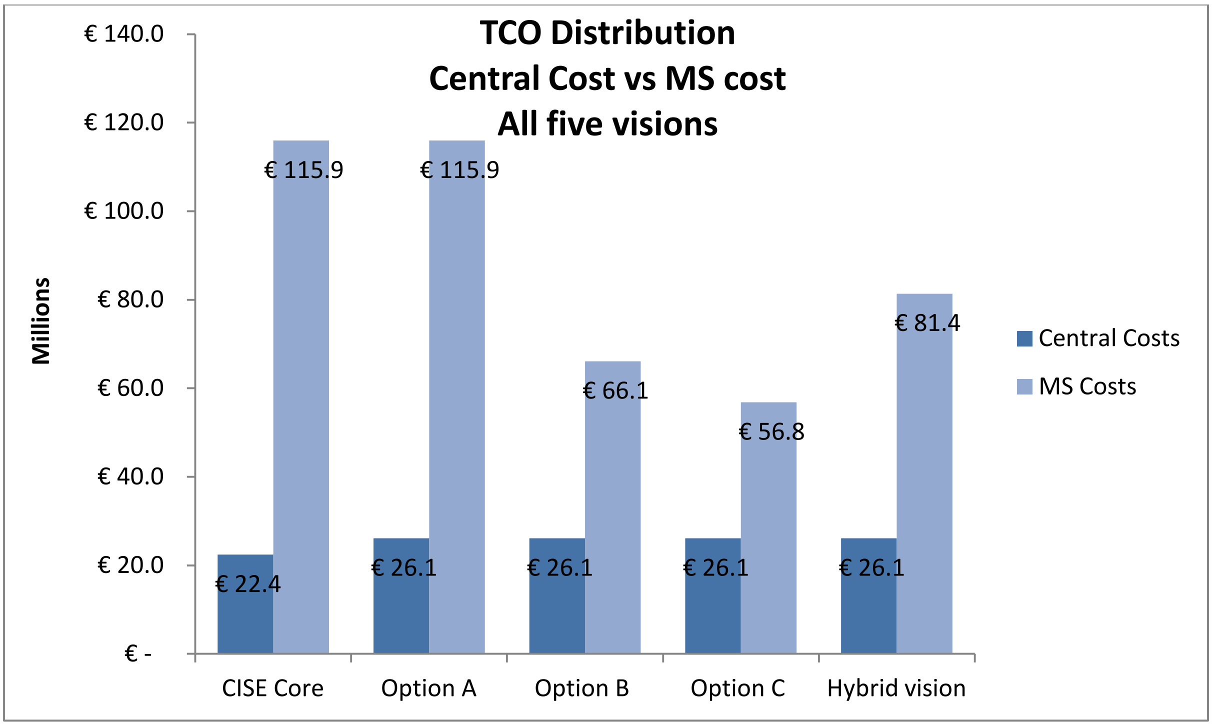


Figure 5 TCO Distribution of Central versus Member State Cost for all five Visions

The study in general does not assess by whom cost should be borne, i.e. who the financing body/ies should be.

The distribution of cost over the budgeting period provides the following Net Present Value (NPV), assuming a 4% annual discount rate of future cash flows.[1] The NPV of the Hybrid Vision would amount to approximately 81 m€.

[1] This discount rate of 4% is the rate to use in all official Impact Assessments- see Section 11.6 on Discounting of Part III: Annexes to Impact Assessment Guidelines, version 15 January 2009.

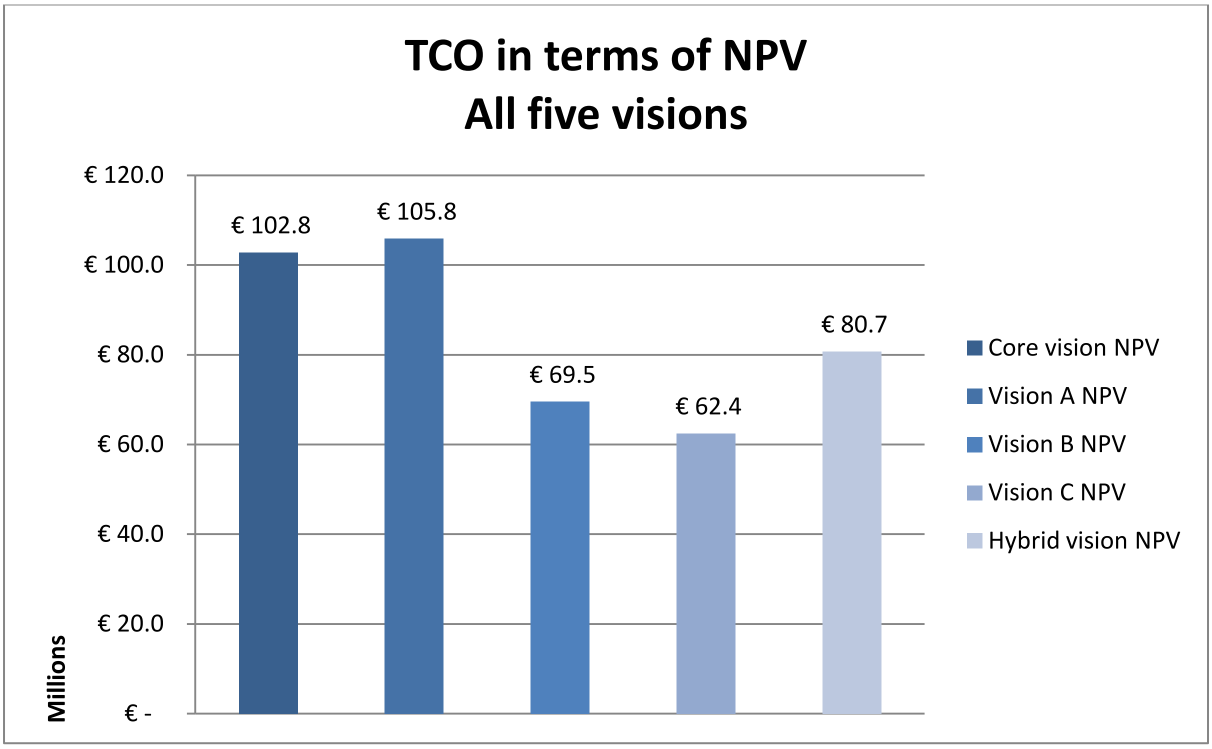


Figure 6 TCO in terms of NPV for all five Visions

Across all calculations, the Core Vision and Vision A show similar TCO values. This is due to the fact that Maritime Surveillance in Member States is already organized alongside User Communities[1], implying that implementation of CISE is likely to materialize in a similar way in the Core Vision (which does not as such suggest a focus on User Communities) and Vision A (which in turn is explicitly axed around User Communities).

1.4 Key observations

There are a number of important observations that emerge from the study, in addition to the quantifications given above.

First of all, the realization of CISE is not a Greenfield endeavour. Member States have, are and will continue to invest in Maritime Surveillance and already today have a wide range of IT systems in the Maritime Domain in place – these are sector-specific as well as cross-sectorial systems. Indicatively, the engagement depicted an average of seven Maritime Surveillance IT systems per Member State.[2] At the same time, several EU-level systems are already operational, enabling countries to collaborate across borders, albeit typically within the limits of a single User Community. CISE is not meant to substitute for these but will leverage on current capacities and capabilities. This justifies that the cost of CISE modelled for this engagement focus on cost explicitly generated by CISE and exclude ongoing and planned investments in Maritime Surveillance in the EU Member States.

As shown in the previous section, the cost comparison indicates that greater centralization generates a smaller Total Cost of Ownership (TCO). Thereby, Vision C bears the lowest cost

[1] This is a finding stemming from the Member State survey- see also section 4.9 and the Appendix.

[2] This is a finding from the Member State survey used- see also section 4.9.

followed by Vision B and so forth. This is the effect of more streamlined investments and shared operations at the MS level - both at IT and organizational levels.

However- from an implementation perspective- a high degree of centralization is expected to encounter major barriers. Barriers would arise in different respects, for example: lack of fit with countries' individual investment plans and governance structures; political resistance; and a considerable risk of seeing the transformation fail as one intervenes too strongly in the status quo.

To leverage on the current Maritime Surveillance landscape, Visions which are more flexible and can cater for diversity therefore seem more suitable for implementing CISE:

- The *fit of CISE with Member State investment cycles* is both a requirement as well as a design principle for the Cost Model. Member States will continue requiring (some) latitude to decide when to invest into CISE. Their investment cycles will follow a different pace, driven by the timings at which their IT systems need to be upgraded or renewed. The Cost Model reflects this latitude by distributing Member State investments over time.[1]
- The *fit with divergences in Member State Governance* follows a similar rationale. making Visions which leave room to Member States to maintain and/or build on their existing administrative structures more relevant than Visions which impose a "one-solution-fits-all" i.e. uniform implementation.

These considerations counter the cost advantage of Visions B and C and increase the attractiveness of the Hybrid Vision significantly.

The Gartner engagement also shows that Reference Implementations for Nodes & Gateways will make an essential contribution to the efficiency and effectiveness of CISE. They are estimated to halve capital and Operating Expenditure for key Building Blocks of the program for CISE participants. Savings can account for up to 71 m€ with a more than eleven-fold return-on-investment if the Reference Implementations are fully adopted.[2]

Finally, the interconnection of existing EU-level systems appears to be what one would call a "low-hanging fruit" for Maritime Surveillance in the EU. The cost to interconnect these systems is relatively low compared to the total CISE budget as it can be realistically assumed that EU-level systems will require implementing an Interface only to connect with CISE. Interconnecting these systems will immediately allow key data sets to be exchanged both across sectors as well as across borders. However, it needs to be noted that EU systems only cover a fraction of the data that could be of interest to share. So even if the EU systems were interconnected, this would still mean that additional information would need to be exchanged outside these interconnections.

The next section outlines how (key) findings and observations from the engagement's Cost Model in particular, and Cost Models in general, can serve as a decision-making tool to policy makers in Europe.

1.5 Cost analysis as a Decision-Making tool

The lack of accurate cost information is a major challenge when it comes to pan-European information and communications technologies (ICT) projects: firstly, these projects are significant in size and imply high investments and potentially also risk; secondly decision

[1] See sections 4.6 and 4.7 for assumptions concerning adoption of CISE over time.

[2] See section 4.8 for the detailed savings calculation.

making is spread across various government tiers and public bodies which requires that multiple actors contribute to and agree on the costing; thirdly there is oftentimes little experience (and hence historical data) with costing any such programs.

This lack of accurate information on cost for information and communications technologies hampers effective decision making on ICT programs & projects.

The paradigm of "spending wisely" has made EU decision makers well-aware of this challenge and many EU institutions have by now started or are planning to start costing exercises, either as a separate piece of work or embedded in another project e.g. a formal Impact Assessment. The EU's driver is to improve allocation of public resources and increase the success rate of large-scale ICT projects, amongst others to withstand political & public scrutiny in a context of recurrent economic turmoil.

Obtaining relevant cost data requires: identifying the main cost drivers of the ICT project; determining the components/elements to cost; and using an appropriate methodology to ascertain the total cost of the initiative on the long run.

By going through these steps, the Gartner Cost Model is able to provide the total cost of ownership of EU IT systems, providing for more accurate estimates of resource requirements and returns on investment right at the outset of the program. This is typically the time when "one knows the least about the project", but the most important investment & strategic choices are to be made.

In project management, this is referred to as the *Cone of Uncertainty. T*he Cone of Uncertainty describes the evolution of the amount of uncertainty during a project. At the beginning of a project, comparatively little is known about the product or work results, and so estimates are subject to large uncertainty. As more research and development is done, more information surfaces about the project, and the uncertainty then tends to decrease. This usually happens by the end of the project i.e. by transferring the responsibilities to the internal IT department or an external provider. But even then, uncertainties remain and costs must be re-assessed and above all controlled as a project progresses (which in the worst case can lead to projects with an unfavourable cost-balance to be stopped during execution). Gartner's Cost Model is aimed at reducing the uncertainty to the greatest possible extent, and as upfront as possible.

Following the Gartner methodology, cost is estimated:

- bottom-up (i.e. element by element, adding up to the total);
- using a "black-box" approach.

The latter means that Gartner has no (and does not ask for any) access to existing cost data on the initiative. This ensures an objective, external health-check on numbers (or myths around them).

Gartner is in the unique position to apply this methodology because it owns the world's largest ICT Benchmark data base in which more than 5.000 IT Benchmarks are entered every year. For thousands of data points, comparative numbers are available at the very granular level of an ICT initiative (e.g. a Function Point[1]); for many others, the data base stores comparable peer cases at a higher level of aggregation. These case-based numbers

[1] Function points measure the size of an application system based on the functional view of the system. The size is determined by counting the number of inputs, outputs, queries, internal files and external files in the system and adjusting that total for the functional complexity of the system.

provide for continuous sanity checks of values. Every number needs to withstand the continuous, rigorous scrutiny of Gartner research analysts.

2.0 Comparison across Visions

2.1 About the Visions

The engagement has modelled cost for the Architectural Visions for CISE as of 18 June 2013: Core vision, Vision A, Vision B, Vision C and the Hybrid Vision which is a combination of Vision A, B and C.

Details on the Visions can be found in the DG MARE source documents[1]. For the sake of completeness, we recall that the Visions in essence differ in terms of the scale & scope of the collaboration they require: the Core Vision focusing on technical and semantic interoperability, the other Visions increasing the extent of collaboration, expanding to organizational interoperability agreements and possibly also legal interoperability.

2.2 Criteria for comparing Visions

In order to compare the various CISE Visions, two parameters were considered:

- Efficiency, i.e. a measure of how economically resources (cost, time) are converted to results.
- Sustainability, i.e. the probability of continued long-term benefits after major initial investments have been completed (resilience to risk on the net benefit flows over time).

In the light of these criteria, Gartner would only evaluate the technical set up and performance of the Visions. Policy set up and impacts were out of scope.

Efficiency first and foremost refers to the financial viability of the CISE project in terms of Total-Cost-of-Ownership through demonstrating overall investment size and investment longevity (i.e. the length of time required to execute the activities required for the investment). The characteristics of cost are important to consider in this respect: cost can for example be constant over the entire project duration; one-off, staggered; in/decreasing; possibly optional in case there are different implementation scenarios. TCO can be split into capital investment (CapEx), Operating Expenditure (OpEx) as well as its distribution over time.

In the efficiency assessment, only the cost directly attributable to CISE are taken into account. These are cost that would not be incurred by the EU and/or Member States without the Common Information Sharing Environment being in place. Current and ongoing investments of Member States into Maritime Surveillance to maintain and evolve operations as of today are not such directly attributable cost as they remain under Member State's budgetary competence, with full decision latitude on the Member State side as to how much to invest, when and for what purpose.

[1] Source documents will become available here once the policy initiative supported by this Impact Assessment becomes public:
http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm

Sustainability- for the purpose of this study- refers to the sustainability of the *environment* underlying CISE. This is expressed in the future environment's ability to present an evolving life-cycle in the face of: changing requirements, changing technologies, the environment's capability to overcome technological barriers, the manageability of resource allocation to operate & evolve IT systems, the environment's capability to ensure maximum activity and attract new participants and IT systems' portability in terms of ease of implementing and adapting CISE concepts and approaches to other (pan-European) environments.

2.3 Factsheets per Vision

What follows is an assessment per Vision, looking into the key parameters of this engagement- Total-Cost-of-Ownership, CapEx versus OpEx, Sustainability considerations key qualitative observations- to help CISE decisions makers compare the Visions more consistently.

To start with, we capture the different elements each CISE Vision is composed of. These are on the one hand Central Components i.e. elements which overarch the various CISE Visions and are considered EU level cost for the purposes of the Cost Model; as well as Building Blocks such as Interfaces and Nodes which will be implemented by the wider range of CISE participants, with variations in number and complexity depending on how CISE is implemented.

These elements are summarized in the Figure below. A detailed description of each element can be found in section 4.3. Section 4.4 explains how the related volumes have been estimated. Put in simplistic terms, the Total Cost of a Vision is obtained by multiplying the CISE elements' cost with the volumes per element.

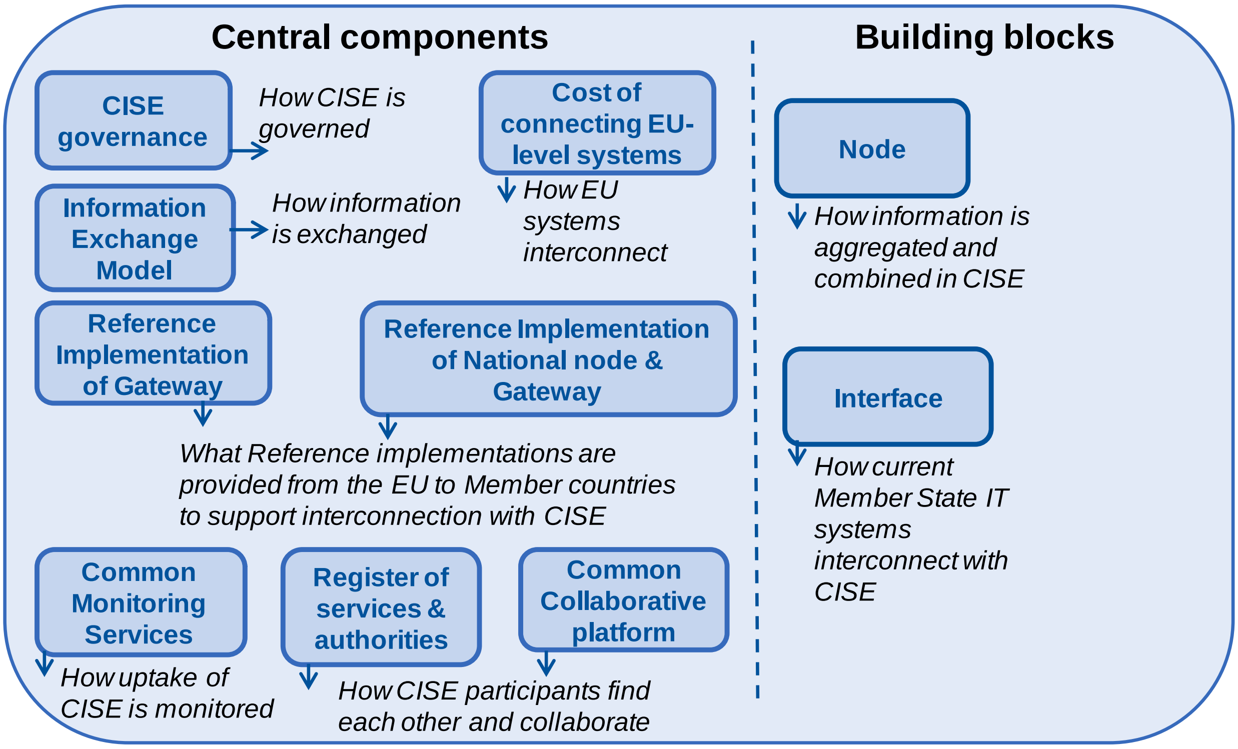


Figure 7 – Summary Overview of elements composing CISE

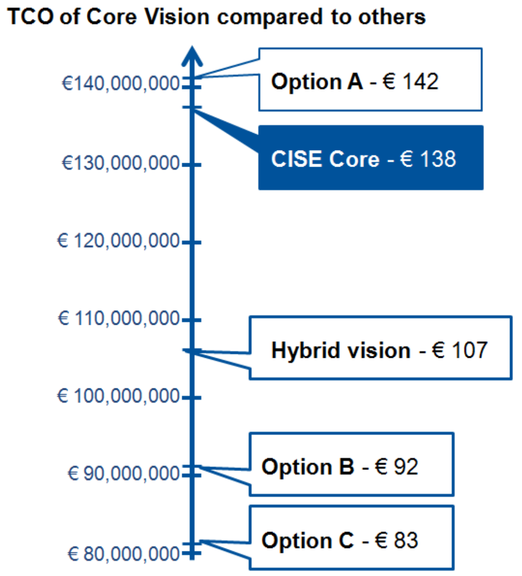
The Cost Model assumes that investments are distributed over time which is one of the reasons for variation in CapEx & OpEx over the years. This is further explained in Section 4.6.

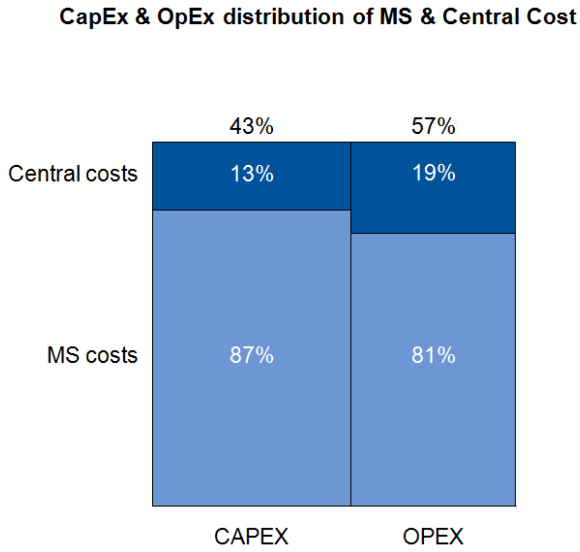
For clarity's sake we highlight that the Reference implementation of the Node includes the implementation of the messaging protocol as well as aggregation and correlation rules for data. The Gateway in turn only implements the messaging protocol. In the Core Vision we will for example see that only a Reference Implementation of the Gateway would be put into place.

2.3.1 Core Vision

The Vision in brief

Multiple Providers of CISE Services at National level (+ EU initiatives)





Key elements

Central Component	Volume
CISE Governance	1
IEM	1
Register of services & authorities	1
Common Collaborative Platform	1
Common Monitoring Services	1
Reference Implementation of National Node	0
Reference Implementation of Gateway	1
Cost of connecting EU-level systems	1
Building Block	**Volume**
Node	0
Interface	141.2

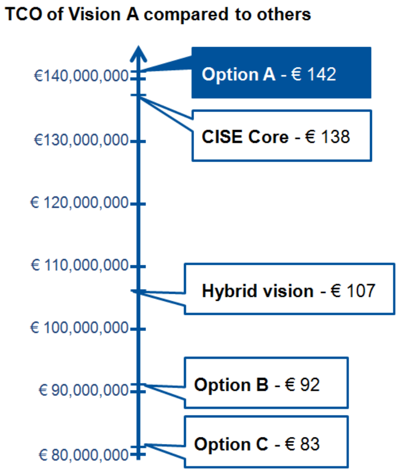
Assessment overview:

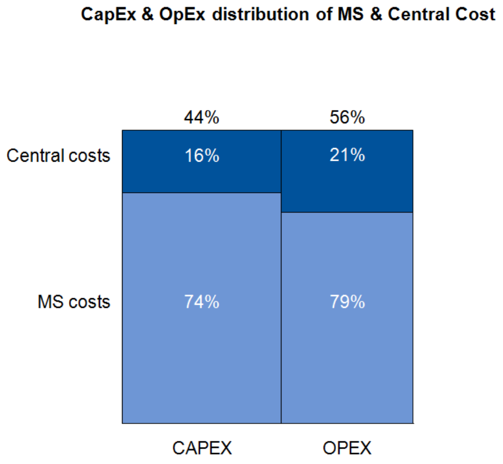
- The main cost driver of this Vision is the lack of centralization meaning that neither investments nor operating cost and procedures are streamlined.
- All Central Components except the Reference implementation of the National Node, are put into place in this Vision. The degree of absorption of these EU-level investments is difficult to predict as usage of the Central Components by Member States is entirely voluntary.
- In terms of sustainability, this Vision will not lead to an improved Maritime awareness picture. The accuracy and usefulness of the awareness picture risk being jeopardized by: heterogeneity in source data quality; the lack of coordination of information content & flows in the exchange; and the lack of common rules for aggregation & analysis.
- The Vision leaves full flexibility to Member States as regards their investments into the Maritime Surveillance domain and the governance structures ruling it.

2.3.2 Vision A

The Vision in brief

Multiple providers of CISE services coordinated by User Communities (+ EU initiatives)





Key elements

Central Component	Volume
CISE Governance	1
IEM	1
Register of services & authorities	1
Common Collaborative Platform	1
Common Monitoring Services	1
Reference Implementation of National Node	1
Reference Implementation of Gateway	0
Cost of connecting EU-level systems	1
Building Block	**Volume**
Node	0
Interface	141.2

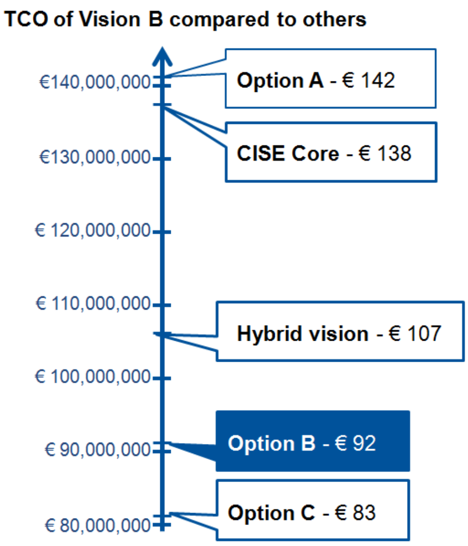
Assessment overview:

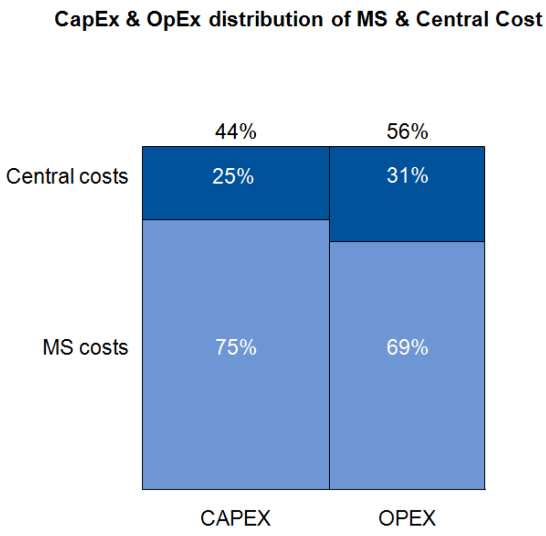
- The main difference to the Core Vision is that a Reference Implementation is provided also for the Node.
- Like for the Core Vision, the main cost driver of this Vision is the lack of centralization meaning that neither investments nor operating cost and procedures are streamlined.
- By their nature, these significant excess cost occur at the level of Member States. CISE is thereby not used as an opportunity to increase cost efficiency through harmonization and collaboration.
- In terms of sustainability, this Vision bears significant risk induced by a possibly poor Maritime awareness picture. This is due to: heterogeneity in source data quality; the lack of coordination of information content & flows in the exchange; and the lack of common rules for aggregation & analysis.
- The Vision leaves full flexibility to Member States as regards their investments into the Maritime Surveillance domain and the governance structures ruling it.

2.3.3 Vision B

The Vision in brief

Multiple providers of CISE services coordinated by Member States (+ EU initiatives)





Key elements

Central Component	Volume
CISE Governance	1
IEM	1
Register of services & authorities	1
Common Collaborative Platform	1
Common Monitoring Services	1
Reference Implementation of National Node	1
Reference Implementation of Gateway	0
Cost of connecting EU-level systems	1
Building Block	**Volume**
Node	6
Interface	63.2

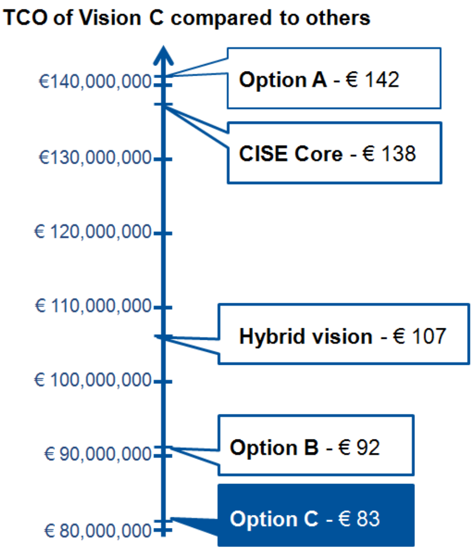
Assessment overview:

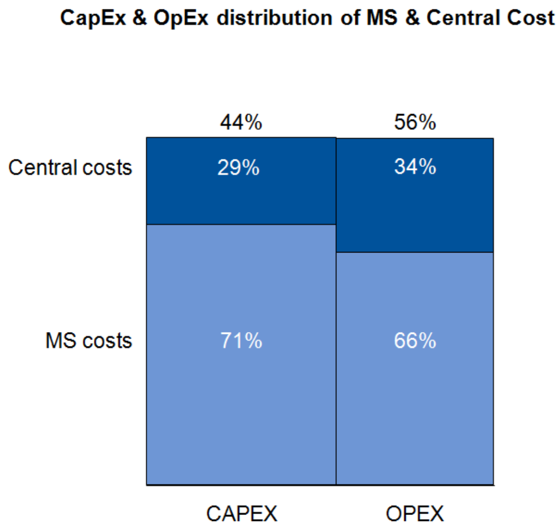
- This Vision's cost efficiency results from a high degree of harmonization of Maritime Surveillance in the Member States. Efficiency gains are both driven by lower CapEx as well as OpEx.
- In addition, Member States (can) benefit from the Reference Implementation of the National Node & Gateway, which potentially halves their investment and Operating Expenditures for information exchange in Maritime Surveillance.
- Compared to the Core Vision and Vision A, it is expected that Vision B increases the extent of cross-sectorial collaboration within Member States.
- Compared to Vision C, Vision B leaves room to Member States as to how to implement the interconnection with CISE in respect of their current governance structures and ongoing & planned financial investment cycles. Member States are not obliged to build a National Node.

2.3.4 Vision C

The Vision in brief

Single national providers of CISE services (+ EU initiatives)





Key elements

Central Component	Volume
CISE Governance	1
IEM	1
Register of services & authorities	1
Common Collaborative Platform	1
Common Monitoring Services	1
Reference Implementation of National Node	1
Reference Implementation of Gateway	0
Cost of connecting EU-level systems	1
Building Block	**Volume**
Node	26
Interface	2

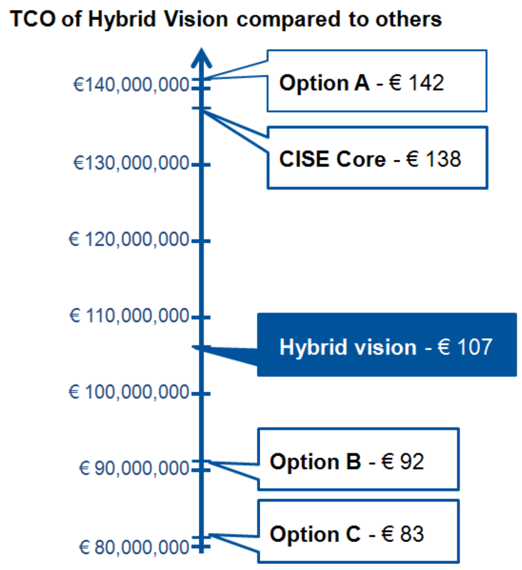
Assessment overview:

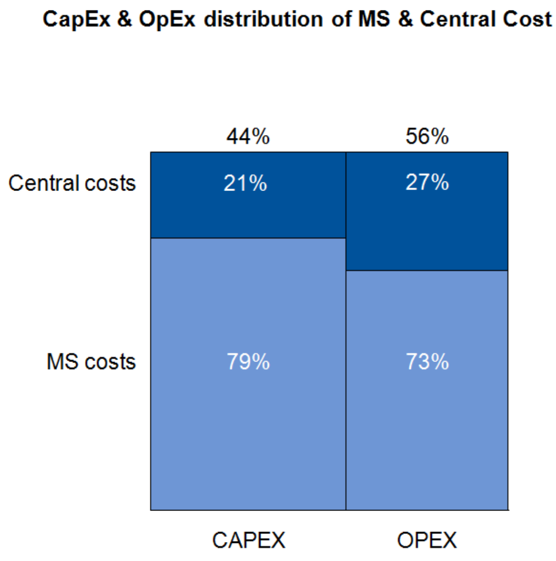
- CapEx and OpEx are low as it is expected that both investments as well as operations are shared in Member States and redundancies get eliminated.
- The main driver for cost-efficiency lies precisely in this high degree of centralization, going beyond harmonization.
- The Reference Implementation of the Node encapsulates standard functionalities such as common rules for aggregation & analysis, thereby increasing the quality of the Maritime Surveillance picture.
- This Vision imposes every EU Member State to implement a National Node. This obligation may or may not fit with current Maritime Surveillance priorities and resources in the countries.
- Investments may need to be made at a moment in time and at a scale that do not correspond to actual requirements for IT to be upgraded or replaced in the EU Member countries.

2.3.5 Hybrid Vision

The Vision in brief

Multiple providers of CISE services coordinated by Member States and User Communities (+ EU initiatives)





Key elements

Central Component	Volume
CISE Governance	1
IEM	1
Register of services & authorities	1
Common Collaborative Platform	1
Common Monitoring Services	1
Reference Implementation of National Node	1
Reference Implementation of Gateway	0
Cost of connecting EU-level systems	1
Building Block	**Volume**
Node	6
Interface	81.8

Assessment overview:

- This Vision attempts to combine the "best" of the other Visions whist maintaining implementation flexibility. The cost increase this flexibility induces compared to the most cost-efficient Visions amounts to +13% in comparison with Vision B and +21% in comparison with Vision C respectively.
- Therefore, the estimated TCO reflects well the compromise between centralization, decentralization, harmonization and incentivization.
- Member States maintain significant decision latitude as regards the number of service providers to CISE and can choose whom to designate as coordinator of the country's CISE services towards the EU/other Member States.
- Member States can implement the interconnection with CISE respecting both their current governance settings as well as their financial investment cycles.

PART 2- Methodology and Cost Model in detail

3.0 Costing methodology

3.1 The reason-to-be of Cost Models

Cost Models emerge from the need to predict future cost based on limited information. They typically use a moderate level of abstraction and are used to cost initiatives where there is little or no (reliable) historical data available.

This is also what distinguishes Cost Models from economic models and accounting techniques. The former usually rely on a great level of abstraction, reflecting universal economic principles (e.g. optimality of choices). The latter register and report cost of an existing operation which can only be built on for predicts if cost are considered replicable.

The main advantages of Cost Models are:

- Ease to interpret due to limited abstraction
- Suitability for business decisions (e.g. comparing alternative designs, predicting investments for new IT systems, …)
- Possibility to customize flexibly to specific scenarios
- Possibility to incorporate engineering knowledge and assumptions, whilst
- Assumptions remain limited in number and are made explicit

3.2 Basic typology of Cost Models

Today, there is a panoply of Cost Models for ICT initiatives available. The bad news on this are that it is easy to get lost in the information overload and that there is no single best-method to pick & choose from. The good news are that costing remains acknowledged as the only way forward for informed decision-making and that several methods (and in particular combinations of them) have proven their accuracy in the past.

From the methodological standpoint, there are two top level categories to costing:

- Expert estimation: the estimate is produced based on a judgmental (but methodologically guided) processes of one or more expert(s)
- Formal estimation: the estimate is based on a computation process e.g. the use of a formula

When it comes to formal estimation, there again, a distinction can be made based on the following categories:

- ❑ Generative Costing: the estimate decomposes total cost into estimates for individual processes, activities, and resources which are estimated on current data inputs. This reflects a bottom-up approach. This method is used when fine detail is available.
- ❑ Parametric Estimating: the estimate uses historical data to identify statistical relationships between cost and design parameters. This method is most often used when fine detail is not available.

- Analogy: here, estimates are established comparing similar and like for like projects. This method is also used when detailed data are not available or unfeasible to gather.

Gartner experience shows that all approaches and models can yield useful results and that hence there is no "best approach". The relative accuracy of each model rather depends on the context, the data available, knowledge about cost-drivers and the feasibility of investing in a cost-model.

- Formal estimation models only produce accurate results when they are tailor-made to an ICT project's particularities. Availability of historical data significantly improves formal estimations' accuracy.
- Expert estimation can be as accurate as model-based estimations. This is the case when key information is missing or estimates are vulnerable to changing conditions in an unstable, little predictable context. Pre-condition for the success of any expert estimation is the experts' independency and professional dedication to objectiveness.

As a general rule, a combination of Cost Models will increase the estimation's accuracy. Whilst one methodology can be used to drive the estimate, others should complement it to health check findings.

In addition, other factors such as the ease of understanding and communicating the results of an approach or the ease of use and cost of implementing an approach should be considered in a selection process.

3.3 Costing principles @ Gartner

Gartner is oftentimes asked to cost IT environments across all types of organizations: public & private, local or multinational. These costings are always aimed at seeking to unravel key aspects of a fairly complex puzzle:

- What are the main cost drivers of ICT activities?
- What does an IT system cost?
- What does an ICT project cost?
- How can an organization estimate the cost of a given ICT configuration compared to another?
- How can an organization estimate the cost of a given ICT configuration compared to peers?

As a first step, Gartner's costing approach reduces this complexity by thinking in elements and components rather than the full picture. These fine elements are then costed using one of the following three data sources:

- IT Key Metrics Data Base (ITKMD). Most aspects of the budget are matched against Gartner's key metrics based on average cost (e.g. running a server or a service-desk with 10.000 annual calls). This method is the stronghold of most of Gartner's estimates.
- Peer case Benchmark data base. Where the activity or service in its totality can be benchmarked against reference cases in the Gartner benchmark database, this method is used to compare the budget of a given IT system to the Gartner database

average, under the condition that complexity drivers e.g. complexity of IT environment, number of transactions,…are similar. These are typically useful for infrastructure and infrastructure services comparisons.

- Case-based. The IT initiative may be comparable to other actual IT initiatives and looking at these (publicly available) budgets can provide an indication of the realism of the budget. This technique is only deployed for projects or investments where no relevant Gartner data can be identified. An example from the project at hand is the comparison of (parts of) CISE cost with budgets of the Cooperation project[1], a national Maritime Surveillance implementation or pilot projects like MARSUNO[2] or BlueMassMed.[3]

Gartner ITKMD

The Gartner IT Key Metrics Data reports contain important database averages from a subset of metrics and prescriptive engagements available through Gartner Benchmark Analytics.

The 2013 edition is published across 93 documents and is representative of 7,649 data points captured from more than 80 countries, across 21 vertical industries.

These key metrics reports are broadly defined by five key areas of the IT portfolio:

Key Industry Measures across 21 vertical industries;

Key Infrastructure Measures;

Key Applications Measures;

Key Information Security Measures;

Key Outsourcing Measures.

Gartner Benchmark analytics is consumed by 15,000+ Gartner research clients every year.

Box 2 - About Gartner ITKMD

Through the triangulation of various data sources, Gartner automatically deploys a mix of estimating techniques, combining their benefits where they can best be reaped. This includes expert judgement & formal estimation techniques.

- IT Key Metrics- through fine detail- provide for the generative elements. They are clearly the basis of the estimate in the Gartner approach.
- The Gartner benchmark data base and Case based numbers complement with parametric elements and analogy by completing the picture and/or providing a (top-down) health-check on numbers.

Total-Cost-of-Ownership

All Gartner estimates are provided in terms of Total-Cost-of-Ownership. This means that all types of cost (IT as well as non- IT: electricity, floor space, personnel etc.) are reflected rather than providing a mere IT-centric budget. Cost are calculated for either the entire life-cycle or budgeting period of the project (e.g. 10 years in the case of the Cost Model at hand). By taking such a holistic view, the TCO calculation considerably reduces the risk of having to bear additional cost to the owner of an ICT project once budgets have been finalized and allocated to the initiative.

[1] http://www.coopp.eu/

[2] http://www.marsuno.eu/

[3] http://www.bluemassmed.net/

As the concept's creator, Gartner has a wide range of experience with applying the Total-Cost-of-Ownership model to IT investments of all kinds.

3.4 Additions on how to successfully deploy Cost Models

For Gartner, a Cost Model is not just a document. It is the result of an inclusive, collaborative process for defining objectives, identifying resources, and creating a roadmap for transformation.

The collaborative process contributes to understanding and developing a social capital around the ICT initiative and the creation of a healthy, receptive environment for presenting the Business Case. Social capital and a receptive environment are as important as the investment justification because, without them, the technology and/or business transformation will fail and adoption of the initiative will be hampered.

Indeed, lack of adhesion and underutilized potential are the most common reasons for stalled ICT initiatives, much rather than budgetary or for example technical constraints; this regardless of the government tier conducting the program, may it be EU, national or local.

4.0 Appliance of costing method to CISE

The Gartner Benchmark approach consists of a number of steps that, combined, give insight into the cost of CISE.

In essence, the costing went through four phases:

- A preparatory phase to understand the nature and main cost drivers of CISE
- A desk research phase where Gartner determined the components/elements to cost including relevant (Gartner) data sources
- The design and finalization of the Cost Model applying a suitable level of abstraction
- The population of the model to ascertain the total cost of the initiative on the long run

This is shown in the Figure below.

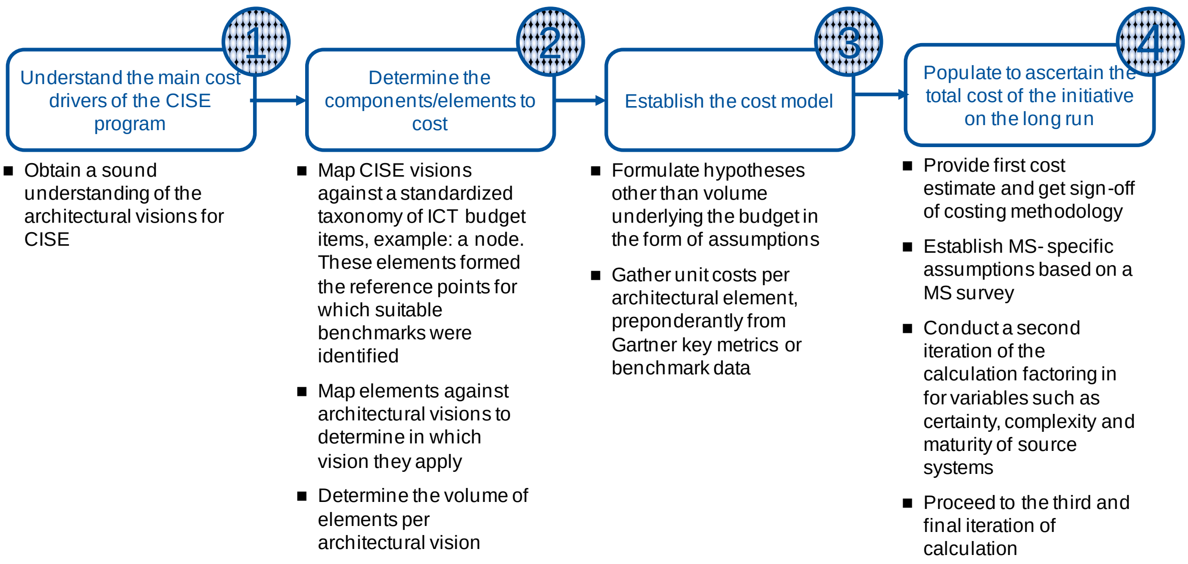


Figure 8 - Cost Model approach

DG MARE has provided continuous feedback on the costing during the execution of the assignment. Specific feedback points have been built into the approach for supporting the matching of architectural elements with Visions and underlying hypotheses, signing off the methodology and reviewed the interim and final cost estimates.

4.1 Tooling behind Cost Model

The Cost Model is built in Excel, supported by in-house statistical tools such as SAS and ETL (electronic transformation and loading). The Box below provides snapshots of the Cost Model to illustrate the look & feel of the CISE data tooling.

Excerpt Consolidated Cost Estimates

	Architecture Options	Consolidated Cost Estimates 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Total Investment (CapEx + OpEx)											
	CISE Core	€ 3,062,215	€ 4,358,988	€ 8,554,550	€ 13,262,553	€ 18,239,665	€ 21,574,863	€ 21,782,061	€ 21,122,988	€ 19,829,816	€ 16,907,840
	Vision A	€ 4,011,336	€ 5,308,108	€ 8,778,306	€ 13,486,309	€ 18,463,421	€ 21,798,619	€ 22,005,817	€ 21,346,744	€ 20,053,571	€ 17,131,595
	Vision B	€ 4,011,336	€ 4,758,627	€ 6,981,898	€ 10,777,138	€ 12,607,410	€ 13,811,002	€ 13,850,999	€ 12,739,968	€ 12,161,154	€ 10,853,301
	Vision C	€ 4,011,336	€ 4,313,406	€ 6,172,760	€ 8,505,338	€ 11,348,599	€ 13,763,503	€ 12,838,892	€ 11,961,997	€ 10,581,652	€ 9,765,617
	Hybrid vision	€ 4,011,336	€ 4,889,657	€ 7,664,892	€ 11,992,437	€ 14,438,543	€ 16,210,468	€ 16,350,363	€ 15,152,513	€ 14,403,352	€ 12,710,593
CapEx		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	CISE Core	€ 2,768,169	€ 3,762,872	€ 7,267,122	€ 10,251,229	€ 13,235,337	€ 13,943,429	€ 10,941,727	€ 7,957,620	€ 4,973,512	€ 994,702
	Vision A	€ 3,717,290	€ 4,711,992	€ 7,267,122	€ 10,251,229	€ 13,235,337	€ 13,943,429	€ 10,941,727	€ 7,957,620	€ 4,973,512	€ 994,702
	Vision B	€ 3,717,290	€ 4,162,511	€ 5,587,474	€ 7,990,898	€ 8,258,800	€ 7,867,930	€ 5,965,191	€ 3,561,768	€ 2,226,105	€ 445,221
	Vision C	€ 3,717,290	€ 3,717,290	€ 4,872,942	€ 5,940,702	€ 7,632,411	€ 8,486,619	€ 5,338,802	€ 3,203,281	€ 1,067,760	€ 0
	Hybrid vision	€ 3,717,290	€ 4,293,541	€ 6,242,625	€ 9,039,139	€ 9,700,132	€ 9,571,322	€ 7,406,523	€ 4,610,009	€ 2,881,256	€ 576,251
OpEx		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	CISE Core	€ 294,046	€ 596,116	€ 1,287,429	€ 3,011,324	€ 5,004,329	€ 7,631,434	€ 10,840,333	€ 13,165,369	€ 14,856,303	€ 15,913,137
	Vision A	€ 294,046	€ 596,116	€ 1,511,184	€ 3,235,080	€ 5,228,084	€ 7,855,190	€ 11,064,089	€ 13,389,124	€ 15,080,059	€ 16,136,893
	Vision B	€ 294,046	€ 596,116	€ 1,394,424	€ 2,786,241	€ 4,348,610	€ 5,943,072	€ 7,885,808	€ 9,178,200	€ 9,935,049	€ 10,408,080
	Vision C	€ 294,046	€ 596,116	€ 1,299,817	€ 2,564,636	€ 3,716,188	€ 5,276,884	€ 7,500,090	€ 8,758,716	€ 9,513,891	€ 9,765,617
	Hybrid vision	€ 294,046	€ 596,116	€ 1,422,267	€ 2,955,298	€ 4,738,411	€ 6,639,146	€ 8,943,839	€ 10,542,504	€ 11,522,097	€ 12,134,342

Introduction | Consolidated Cost Estimates | Volumes | Volumes nodes and gateways | Base Unit Costs

Example illustration of Volume Estimates

J6 | 45%

	This breakdown quantifies the number of nodes and gateways needed for costing.									7	Average number of systems per MS		
										4.1	Average number of cross-sectoral systems per MS		
							Distribution IT system maturity						
		#	Sample countries				Monolithic	29%					
	MS category 1	4	UK, Finland				Two-tier	45%			Data sets per Gateway		
	MS category 2	12	France				Web service	26%			15		
	MS category 3	12	Spain										
	Hybrid					Vision A					Vision B		
	Category 1					Category 1					Category 1		
2	50%	1	1 gateway		2	50%	1	Gateway		2	50%	1	Gateway
6	50%	3	X gateways (perhaps 3)		6	50%	3	Gateways		6	50%	3	Gateways
	Category 2					Category 2					Category 2		
49.2	No of gateways	4.1	Avg cross-sectoral		49.2	100%	4.1	Gateways		49.2	100%	4.1	Gateways
	Category 3					Category 3					Category 3		
6	50%	1	Node		84	100%	7	Gateways		6	50%	1	Node
24.6	50%	4.1	Average # of systems							24.6	50%	4.1	Gateways
	National nodes	6					National nodes	0			National nodes	6	

Consolidated Cost Estimates | Volumes | Volumes nodes and gateways | Base Unit Costs | Central Compor

Example illustration of Base Unit Cost

C5 | Cost per contact

Base Unit Costs

Base Unit Costs	Unit Cost Types	Unit of Measure	Volume	Unit Price (€)	Total Expected Price for EU (€)
Service desk	Cost per contact	*Environment Size*	*# ΣAnnual Contacts*		
		Large	> 240.000	€ 11	
		Medium	100.000 - 240.000	€ 14	
		Small	< 100.000	€ 17	
	Personnel cost (per FTE)	per IT Service Desk FTE (for Regular calls)	1	€ 75,000	€ 75,000
Server	Per production Server instance	*Availability (of Server instances)*	*# Server instances*		
		Normal	1	€ 5,805	€ 5,805
		High (Per server instance * 2,2)	1	€ 12,771	€ 12,771
		Continuous (Per server instance * 6,5)	1	€ 37,733	€ 37,733
		Multisite Continuous (Per server instance * 8,5)	1	€ 49,343	€ 49,343
	Personnel cost (per FTE)	per Win FTE	1	€ 80,000	€ 80,000
Network	Cost per Active port	*Environment Size*	*# Active ports*		
		Large	> 35.000	€ 80	
		Medium	15.000 - 35.000	€ 88	
		Small	< 15.000	€ 95	
	Personnel cost (per FTE)	per LAN FTE	1	[illegible]	[illegible]

Volumes nodes and gateways | Base Unit Costs | Central Components | Central Components - Detailed

Box 1 – Illustrations of Cost Model Tooling

The subsequent sections explain the Cost Model further, from a methodological standpoint.

4.2 Delimitations of Cost Model

As the Member State survey conducted as part of this engagement shows (see also section 4.9 and the Appendix), Member States today run an average of 7 IT systems for Maritime Surveillance. A bit more than half of them interconnect more than 1 user community; on average they connect nearly 3 user communities.

This underpins the assumption mentioned earlier that CISE is not a Greenfield but will be put in place on top of the existing Maritime Surveillance landscape including current investments. The consequence is a clear delimitation the Cost Model makes.

- Ongoing & planned investments in specific solutions for Maritime Surveillance in the Member States are not accounted for in the Cost Model as they are not directly attributable to CISE.
- Are accounted for in the Cost Model: the cost generated by the CISE program to realize cross-border, cross-sectoral Information Exchange.

All cost elements of CISE are listed below[1]. As a general rule, CISE cost are cost of Central Components i.e. systems, processes and organizations that are set up for all CISE participants to share and jointly benefit from; as well as the interconnection of existing Member State and EU- level systems.

	EU- level Building Blocks	MS- level Building Blocks
CapEx	■ Develop Information Exchange Model ■ Establish Register of services & authorities ■ Establish Common Collaborative platform ■ Establish Common Monitoring services ■ Establish Reference impl. of National Node and Gateway ■ Establish Reference impl. of Gateway ■ Connecting EU solutions for cross-sectorial Information Exchange	■ Establish Nodes ■ Establish Gateways

[1] Some elements only apply to certain Visions. Please refer to the Vision summary sheets to determine which elements are included in a Vision.

OpEx	■ CISE governance ■ Maintain Information Exchange Model ■ Operate and maintain Register of services & authorities ■ Operate and maintain Common Collaborative platform ■ Operate and maintain Common Monitoring services ■ Operate and maintain Reference implementation of National Node and Gateway ■ Operate and maintain Reference implementation of Gateway ■ Operate and maintain interconnections of EU systems	■ Operate and maintain Nodes ■ Operate and maintain Gateways

Table 2: Overview of Cost elements in the Cost Model

These Cost elements are then used as input for the TCO model, adding the following factors:

- Volumes: Each Vision has an estimated number of Nodes and Interfaces that will be implemented in the Member States. These volumes are detailed in section 4.4.
- Implementation timeline: The implementation of CISE is modelled over a 10 year period with an assumed rate of adoption of both Central Components and Member State Building Blocks over time. The adoption rates are detailed in section 4.6

4.3 Details of Cost elements and Base Unit Costs

The Cost elements are modelled using a number of Base Unit Costs as well as assumptions that are detailed in this section. The figure below illustrates the Central Components and Building Blocks and the Base Unit Costs used for the Cost Model.

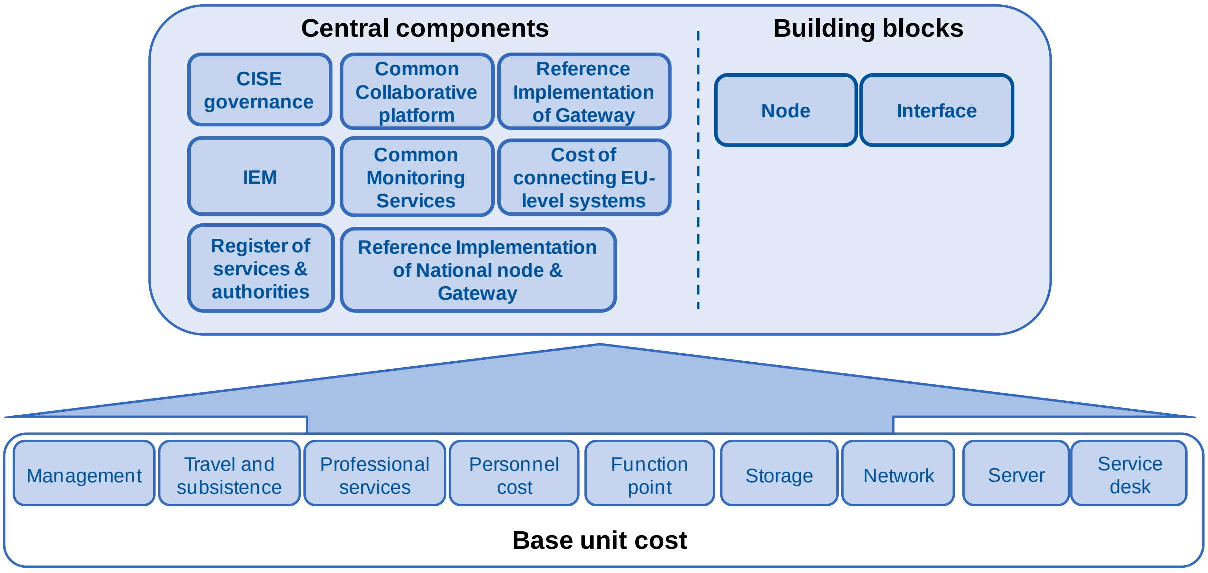


Figure 9 - Overview of elements constituting the Cost Model

4.3.1 Base Unit Cost

The following Base Unit Cost are used for costing CISE:

- Service desk: The service desk is set up for Nodes and for CISE centrally to handle inquiries. Gartner uses a standard cost per handled contact, which is derived from our benchmark of IT service desks. This costs includes FTEs, systems and other directly related cost associated with handling an inquiry.
- Server annual cost: Gartner uses an annual cost for managing a server including hardware depreciation, software and maintenance. The annual cost are dependent on availability requirements and are used to estimate OpEx for IT systems.
- Storage annual cost: Gartner uses an annual cost per Terabyte of storage, which is used to estimate OpEx for IT-systems.
- Cost per Function point (FP): FPs measure the complexity of IT-systems in a way that is agnostic to the actual technologies used to implement it. Gartner uses FPs to cost development and maintenance of applications, such as the collaboration platform or the Node. It is done by assessing the complexity of the application (in terms of complexity of data model, number of Interfaces of different kinds and number of user Interface screens) and multiplying by unit cost of developing and maintaining one Function Point. Function point development & maintenance are either costed as i) fast/routine; ii) standard or iii) complex, assuming different productivity ratios (highest for fast and so forth).
- Personnel cost: As personnel is assumed as EC-internal, personnel has not been costed in monetary terms. This to be in line with EU budgeting guidelines.
- Management: Management costs are modelled as a percentage of the number of staff.
- Travel and subsistence: these are costed per two-day trip using average costs from EU
- Professional services: these are costed based on an annual cost of an external FTE and estimated as FTE equivalents.

4.3.2 Central Components[1]

The Central Components of the Cost Model are investments and ongoing costs at EU- level required for CISE to be realized.

These components are costed excluding required European Commission staff/FTEs in order to adhere to EC budgeting rules. The estimated required FTEs are 3 to 4 in number. These would be two to three FTEs to support CISE governance and one to coordinate the maintenance of the Information Exchange Model

All elements of the EU- level investments and ongoing cost are described below. The amounts estimated for each component are available in Section 4.4 below.

CISE Governance:

Definition:

[1] Source documents will become available here once the policy initiative supported by this Impact Assessment becomes public: http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm

- 294.046 € is estimated annually for the ongoing governance of CISE. The necessary activities include governing the overall program through systematic strategic and tactical steering and establishment and maintenance of all central agreements such as Service Level Agreements between public authorities. It also includes dissemination activities.

Base unit items:

- Costed: Annual travel and subsistence cost of 30.142 € are estimated to support the travel of project officers and Member State representatives for advisory boards. Also, 100.000 € annually is estimated for dissemination and marketing activities.
- Counted in FTE but not costed: Managerial coordination of network of national contact points and advisory boards (Advisory and Policy Board, Administrative Advisory Group, Legal Advisory Group, Financial Advisory Group) by EC officials.

Annotations:

- The estimate considers two to three project officers and includes travel and subsistence cost for all personnel.

Information Exchange Model:

Definition:

- The Information Exchange Model is the core of CISE and establishes a syntactic and semantic model for the exchange of Maritime Surveillance information and enables CISE to follow a decentralized approach whereby public authorities are able to work in an interoperable manner, based on common semantic standards.
- The Information Exchange Model is used for building and maintaining data formats and semantic interoperability agreements describing how information is structured and what controlled vocabularies and taxonomies are used to describe it. It includes a commonly agreed coded value for confidence intervals and for optional priority levels, meta data information on relevant characteristics of the information as well as an information classification scheme.
- The Information Exchange Model also includes agreeing on security standards e.g. in terms of integrity, non-repudiation and network security.

Base unit items:

- NA

Annotations:

- A project budget of 4,6 €m has been calculated based on the experience from the Cooperation Project.[1]
- A 50 % efficiency gain is assumed for agreeing on data sets not covered by the Cooperation Project (71 of 92 identified data sets are not modelled by the Cooperation Project). This to reflect the learning curve expected to result from the Cooperation Project.
- An FTE is estimated to centrally coordinate the maintenance of the Information Exchange Model.

[1] http://www.coopp.eu/

Register of services & authorities:

Definition:

- Is a contact directory containing the list of services and contact details of CISE participants.

Base unit items:

- Costed: The development and ongoing operation and maintenance of the system is costed over the 10 years. The estimate is based on an assessment of the complexity of the system and the expected usage and is constructed from: Function points for development and maintenance, Server, Storage, Personnel for managing the registry.

Annotations:

- Function points cover: Service (internal logical file), contact (internal logical file), graphical user Interface for operator, Interfaces for automatic updates, add/edit/delete/print item and query/find information.

Common Collaborative Platform:

Definition:

- Is a central application containing a set of tools allowing virtual collaboration between public authorities. These tools include secure audio, video, instant messaging and white boarding.

Base unit items:

- Costed: The development and ongoing operation and maintenance of the system is costed over the 10 years. The elements used are: Function points for development and maintenance, Server, Storage, Personnel (platform manager, content specialist, admission manager, data base administrator).

Annotations:

- Function points cover: Across all Visions, the assumption is to have one Collaborative Platform only.

Common Monitoring Services:

Definition:

- Is a set of tools that will help monitor the performance and availability of IT systems and aggregates and analyzes statistics of the exchange of information including usage statistics delivered by CISE participants.

Base unit items:

- The development and ongoing operation and maintenance of the system is costed over the 10 years. The elements used are: Function points for development and maintenance, Server, Storage. Personnel (manager, report designer, report producer).

Annotations:

- Function points cover: tables, monitoring design, input gathering (data collection and collation), running trace file, query and find information, reports.

Reference Implementation of National Node and Gateway:

Definition:

- Supports all key functionalities of the actual implementation and is distributed to CISE participants for re-use. The Reference Implementation comprises the facilitation of testing the interconnect-ability with CISE (CISE compliance) as well as a software component to be deployed by the Member States.

Base unit items:

- Costed: Reference Implementation of the following functionality: Gateway functionality for existing systems to expose data to CISE, functionality to build aggregate services, including templates, service discovery functionality, security and access management. The reference implementation will include an operational copy that can be used to test MS compliance with the CISE Information Exchange Standard and the Gateway. Software to be installed, adapted and used by Member States.

Annotations:

- It is assumed that the Reference Implementation can also be used by EU- level systems to connect to CISE.
- For the TCO estimate, it is assumed that 50% of MS will be using the reference implementation and that the rest will implement CISE compliant solutions on their own.

***Cost of connecting EU level systems for cross-sectorial Information Exchange*:**

Definition:

- Estimates the cost of interconnecting the following nine systems with CISE: Eurosur, Marsur, D.E.H., SEIS, EmodNet, SIENA, E-Customs, SafeSeaNet (IMDatE), Single Window.

Base unit items:

- Costed: The connection of existing EU- level systems to CISE through the implementation and deployment of an Interface.

Annotations:

- This is the cost of connecting the 9 existing EU- level systems to CISE. It is assumed that the EU- level systems will be using the Reference Implementation of the Gateway.
- It is possible that the implementation of CISE Interfaces could enable a simplification of the existing architecture and that thus the overall impact on OpEx would be neutral.

4.3.3 Building Blocks[1]

Building Blocks are composed of elementary items and form the basis of the CISE architecture. The Interface and the Node are the two Building Blocks that are the core

[1] Source documents will become available here once the policy initiative supported by this Impact Assessment becomes public: http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm

Member State elements in the CISE architecture. The functioning of the Interface is illustrated below:

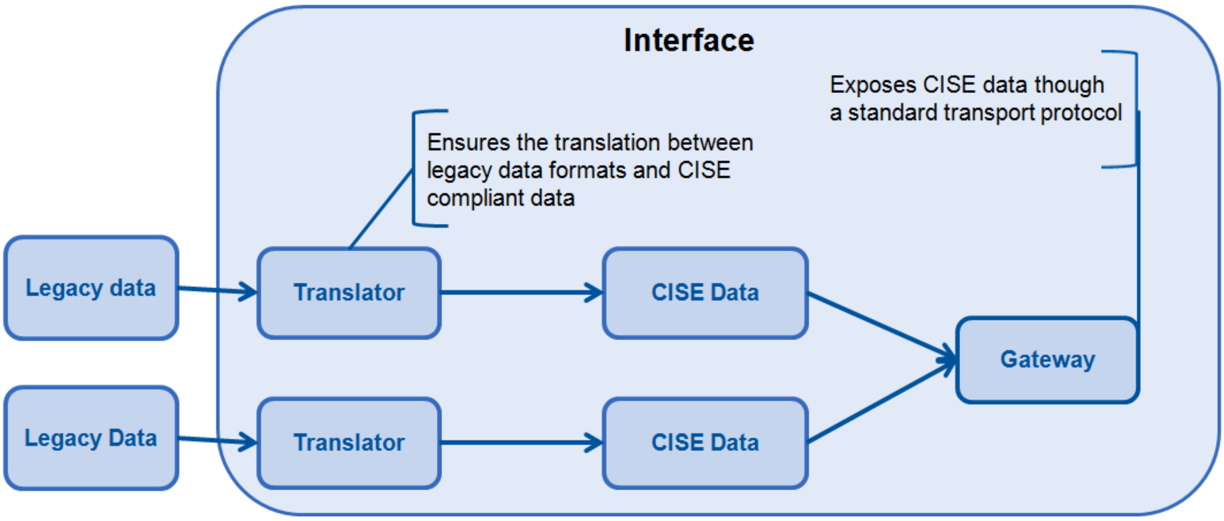


Figure 10 – Illustration of Interface

Interface

Description:

- The Interface has as function to make a data set available to CISE. It has two sub-components:
  - ❑ The Gateway which technically enables the interconnection of data through a shared boundary or physical connection between the source system and CISE.
  - ❑ The translator guaranteeing conformity of data with the CISE Information Exchange Model. Data exists in a number of different legacy formats that need mapping to the CISE Information Exchange Model. The translator translates between the legacy and the CISE IEM.
- The Gateway is assumed as a standard component for all CISE participants. The translator is non-standard as it is dependent on the age and architecture of the legacy systems as well as the internal data model in use.

Base unit items:

- Function points for development and maintenance, Server, Storage, Personnel (account manager).
- Function points cover: Tables, bi-directional logical/physical Interface, security, and activities. Activities for monolithic: data scraping & retrieval, storage, demand queries, web service build. Activities for two-tier: demand queries, web service build. Existing web service: demand queries and minor configurations.

Annotations:

- For the translators, the estimate applies a distribution between legacy architectures based on the Member State survey. It assumes three different legacy systems: monolithic, two-tier and SOA. The legacy architecture affects the cost of building translators. For the TCO it is assumed that 29% are monolithic systems, 45% are two-tier, and 26% are SOA-based systems. The cost of the average translators for 5 data sets is estimated at 92.000 € for a SOA-based, 322.000 € for a two-tier and 586.000 € for a Monolithic legacy system

- Test & build includes: definition of business requirements, functional specifications, building application, testing application, user testing.
- Man hour cost are based on a Developer profile.
- Maintenance is assumed 25% of Test & build.
- The average Interface, which is built includes 15 data sets. This number was derived from the JRC matrix[1] by dividing the available number of data sets across all User Communities and Member States (3096) with the number of user communities (7) and Member State (28).

Node

Description:

- A Node holds numerous, cross- sectorial information sources of authorities or other Nodes that have connected to it. The Node pre-processes this information (e.g. through correlation, fusion, aggregation) with the help of integrated intelligence capabilities. The information can be complemented with meta data such as quality, provenance etc.
- The Node includes an Interface such as the one modelled above and thus also the Gateway components and translators. The Node will use data made available through its own Gateway as well as other CISE Gateways to build aggregate services, which could combine data sources, build derived statistics, etc.
- The Node also supports the exchange of files of varying size and formats. Authorities retrieve Maritime Surveillance information by connecting to their Node. Compliance with CISE standards is a pre-condition for using and providing services via the Node.
- The Node also includes security and monitoring capabilities as well as registry capabilities to facilitate the management of a large number of data sets and services for different users.
- The Node would include the setup of some type of organization and governance structure in order to manage it. This can be done in numerous ways and fit with existing initiatives in the Member States. Therefore no specific costs have been included for a governance organization. However, costs related to the operation and maintenance of the Node is included.

Base unit items:

- Those of Interface, local Register of services, and Monitoring services.
- Additionally: Aggregation functionalities and security determined in FP's.
- Project cost in FTE.

Annotations:

- It is assumed in the modelling of the Node, that the average Node will have 9 aggregate services and have 15 data sets made available through its internal Gateway. The number of aggregate services is derived from generic experience Gartner consultants have gained with aggregating data services in projects carried out for the European Institutions. The working hypothesis for this Cost Model is that each Node should at a minimum deliver one aggregate service per User Community,

[1] This matrix contains an overview of data sets available or desirable to be exchanged within and amongst Maritime Surveillance User Communities. It is available at https://webgate.ec.europa.eu/maritimeforum.

plus two additional services. The CAPEX for an additional aggregate service in a Node is estimated at 48.000 €.

4.4 Volumes

Depending on the Vision chosen, vary the volumes of both Central Components and Building Blocks. The below tables provide an overview of the volumes used in the cost estimate.

As the first table illustrates, the number of Central Components is fairly stable across all Visions.

Central Component	**Core Vision**	**Vision A**	**Vision B**	**Vision C**	**Hybrid Vision**
CISE Governance	1	1	1	1	1
IEM	1	1	1	1	1
Register of services & authorities	1	1	1	1	1
Common Collaborative Platform	1	1	1	1	1
Common Monitoring Services	1	1	1	1	1
Reference Implementation of National Node & Gateway	0	1	1	1	1
Reference Implementation of Gateway	1	0	0	0	0
Cost of connecting EU-level systems	1	1	1	1	1

Table 3 - Central Component volumes

As the second table illustrates, the number of Nodes and Interfaces varies considerably across Visions. This variance above all reflects the decentral or central approach the Visions adopt.

Building Block	**Core Vision**	**Vision A**	**Vision B**	**Vision C**	**Hybrid Vision**
Node	0	0	6	26	6
Interface	141.2	141.2	63.2	2	81.8

Table 4 - Building Block volumes

The number of Nodes and Interfaces estimated for each Vision is based on a grouping of Member States according to the extent to which they have already invested in cross-sectorial information exchange.

The categories are described in section 4.9. The number of Member States per category is depicted already here:

Category	Number of Member States in this category	Sample countries
Member State category 1	4	UK, Finland
Member State category 2	12	France
Member State category 3	12	Spain

Table 5 – Categorization of Member States

The calculation of the number of Interfaces and Nodes is illustrated using the Hybrid Vision as an example.[1]

Total number of units		Units	Description
#	**MS Category 1**		
2 Interfaces	50%	1 Interface	Interface implemented to connect the national Node to CISE
6 Interfaces	50%	3 Interfaces	Interfaces implemented to connect the Nodes to CISE
#	**MS Category 2**		
49,2 Interfaces	Average number of Interfaces	4,1 Interfaces	It is assumed that this group of countries will implement a number of Interfaces. The average number of cross-sectorial systems (source: MS survey) is used
#	**MS Category 3**		
6 Nodes	50%	1 Interfaces	It is assumed that 50% of countries in this category will implement one Node as the integration point with CISE and connect onto national systems through this Node.
24,6 Interfaces	50%	4,1 Interfaces	It is assumed that the other 50% in this group will implement Interfaces connecting existing cross-sectorial systems. It thus uses the average number of cross-sectorial systems (source: MS survey)
	Total Nodes	**6**	
	Interfaces	**81,8**	

Table 6 – Calculation of number of Nodes and Interfaces for Hybrid Vision

[1] Similar tables are provided for the other Visions in the following section: Additional tables.

4.5 Adoption rates

The adoption rate of CISE has been estimated using a combination of data from the Member State survey (see section 4.9 and the JRC analysis[1] of the number of relevant data sets).

The current TCO model thus estimates the integration of a certain number of systems with CISE using a number of Nodes and Interfaces. For the Hybrid Vision, the number of nodes implemented is 6 and the number of interfaces if 81,8. This implementation assumes a certain level of adoption of providing data sets into the CISE information exchange. Each interface thus assumes an average integration of 15 data sets. In total this adds up to approximately 1.300 data sets. This is 43% of the total number of data sets identified as potentially interesting to share via CISE.[2]

Different policy initiatives will likely result in different levels of adoption of information sharing as they utilize different means to foster collaboration: removing legal barriers, creating incentives to integrate Maritime Surveillance Information, or possibly even legal obligations to share.

The Cost Model allows estimating the cost implications of working with different levels of adoption in terms of the number of data sets made available in CISE.

The table below show the implication on the TCO if the adoption of the number of data sets as a percentage of the potential data sets varied. 43% is included in the table as this is the number included in the TCO calculation of the Hybrid Vision.

TCO versus Adoption rate	10%	20%	30%	40%	50%	43%
TCO nodes (m€)	8,6	10,3	11,9	13,6	15,2	14,2
TCO interfaces (m€)	32,9	43,3	53,7	64,0	74,4	67,2
TCO nodes and interfaces (m€)	41,5	53,5	65,6	77,6	89,6	81,4

Table 7: TCO implications of different rates of adoption of data sets

4.6 Implementation timelines

The implementation of Central Components and Building Blocks is assumed to take place gradually. This hypothesis reflects the fact that a large-scale project of this kind will not be implemented through a “Big Bang” approach in practice.

The TCO is calculated over 10 year using a commonly used timeframe, which is guided partly by an expected realistic rollout schedule that accommodates Member State investment cycles as well as typical technology depreciation cycles. The number of years across which CapEx and OpEx are distributed is shown in the table below.

Central Component	**Distribution of CapEx in nr. of years/all Visions**	**Distribution of OpEx in nr. of years/all Visions**
CISE Governance	0	10
IEM	4	6

[1] See data matrix available at https://webgate.ec.europa.eu/maritimeforum .

[2] See data matrix available at https://webgate.ec.europa.eu/maritimeforum .

Register of services & authorities	6	4 years 100%, 3 years 50%[1]
Common Collaborative Platform	6	4 years 100%, 3 years 50%
Common Monitoring Services	6	4 years 100%, 3 years 50%
Reference Implementation of National Node & Gateway	2	8
Reference Implementation of Gateway	2	8
Cost of connecting EU- level systems	5	7[2]

Table 8 - Implementation timeframe for Central Components

The timeline for the implementation of both Nodes and Interfaces is modelled as a Bell Curve, reflecting the fact that not all countries will be making investments at the same pace. According to the Bell Curve, the number of implementations increases over time, reaching a maximum number of implementations around the midst of the implementation period, whilst the number of implementations thereafter declines in a similar way it originally rose.

To illustrate this, the distribution of the implementation of Nodes and Interfaces in the Hybrid Vision is shown.[3]

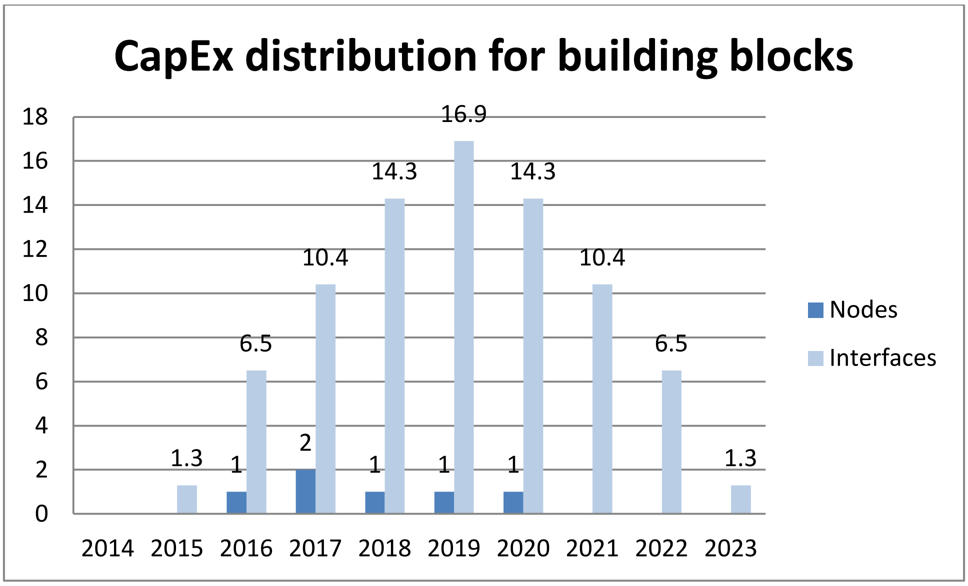


Figure 11 - Implementation timeline for Building Blocks in Hybrid Vision

This rollout of Building Blocks implies that in the Hybrid Vision 31,0 years of Node OpEx is included in the TCO calculation, as well as 327,2 years of Interface OpEx- resulting from multiplying the number of active Building Blocks (i.e. those Building Blocks whose implementation has at a minimum been initiated) times their volume.

[1] This rollout schedule implies a gradual implementation, which will gradually introduce full OpEx. So it is assumed the three first years will be without OpEx, the three next years will be 50% of OpEx because parts of the systems have been implemented.

[2] Assumed average number of OpEx years across all EU- level systems.

[3] The same graph is provided for all Visions in the Additional graphs section.

4.7 Cost estimates

To provide an overview of the results of the cost calculation, the next table summarizes both the CapEx and the OpEx of the CISE Building Blocks: Node and Interface. All assumptions and input parameters used to calculate these cost can be found in this chapter, section 4.3.3.

Building Block	**CapEx**	**OpEx**
Node	€ 1,424,000	€ 336,000
Interface	€ 592,000	€ 126,000

Table 9 - Building Block estimate

Significant efficiency gains can be realized by making use of the Reference implementations. This is also further detailed in the next section, dedicated to the Benefits Calculation of our Cost Model.

The following table details the CapEx and OpEx for the Central Components. Again, we advise to visit section 4.3.2 for all assumptions and input parameters incorporated in the costing.

Central Component	**CapEx**	**Annual OpEx**
CISE Governance	NA	€ 294,046
IEM	€ 4,462,857	€ 30,142
Register of services & authorities	€ 124,852	€ 45,107
Common Collaborative Platform	€ 1,249,500	€ 395,986
Common Monitoring Services	€ 236,572	€ 420,885
Reference Implementation of National Node & Gateway	€ 2,847,361	€ 335,634
Cost of connecting EU-level systems with Reference Implementation	€ 2,662,872	€ 565,840

Table 10 - Central Component estimate

The Central Components to be provided at EU level will constitute a major contribution of CISE to increase the effectiveness and efficiency of Maritime Surveillance in Europe. They will be put at the disposal of all CISE participants, forming the basis for Maritime Surveillance collaboration. At the same time, they only come “into life” when effectively used, by as many Maritime Surveillance authorities as possibly useful.

The EU-level cost for Central Components is relatively uniform across the Visions. The difference in essence lies in the complexity of the Reference Implementation. In the Core Vision- where only Interfaces and Gateways are used as Building Blocks- the cost of developing and maintaining the Reference Implementation will be lower. In Visions A, B, C and the Hybrid Vision, Nodes form an important part of the architecture and involve a more complicated and costly Reference Implementation.

The next visual illustrates the CapEx distribution for EU- level cost. Connecting EU- level systems and establishing the Information Exchange Model account for the greatest investment, followed by the Reference Implementations. However, as we will see further below, the operational cost to maintain these is insignificant. The Collaboration Platform also comes with relatively high cost due to the platform's assumedly fairly complex audio, video, and other real-time interaction features resulting in a large number of Function Points.

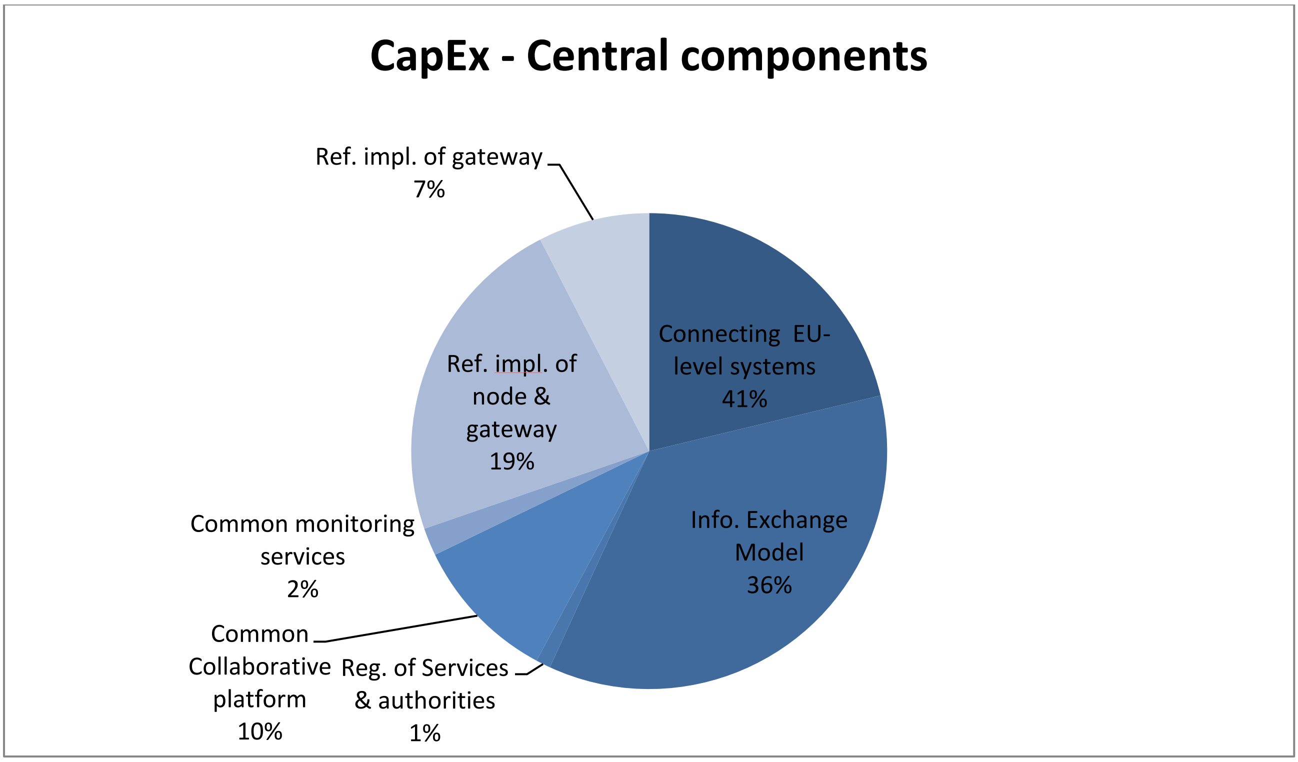


Figure 12 - CapEx ratio of Central Components

The next Figure illustrates the OpEx distribution for EU-level cost. Here, the Common Monitoring services stand out in terms of cost, assuming they require qualified personnel for running them to develop and maintain reliable, up-to-date monitoring reports across the entire CISE life-cycle.

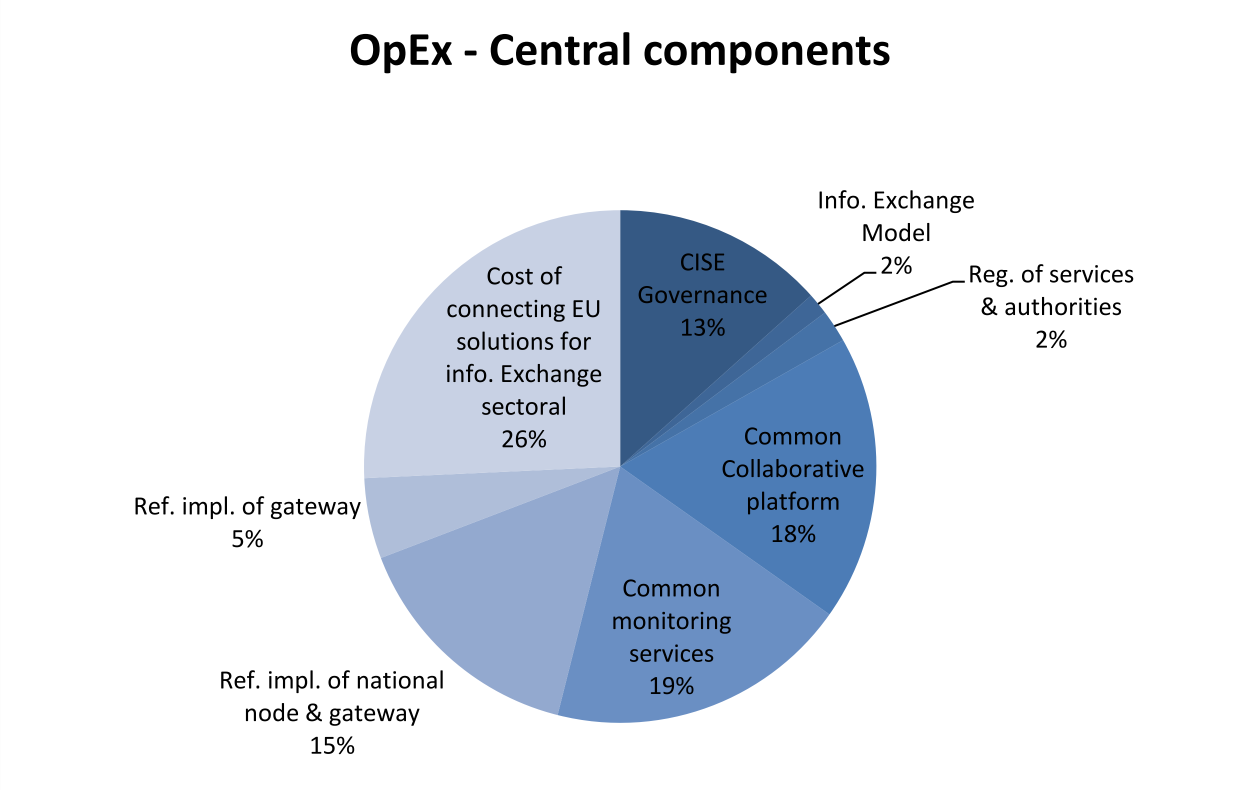


Figure 13 - OpEx ratio of Central Components

4.8 CISE benefits calculations

Whilst the focus of the engagement was on modelling the cost for CISE, two types of benefits were also incorporated into the calculation, partly offsetting cost. These are:

- Efficiency gains resulting from the use of the Information Exchange Model
- Efficiency gains resulting from the use of the Reference Implementations

The Information Exchange Model is a core element in CISE. It will allow Member States to bring down the cost of exchanging Maritime Surveillance data.

Gartner has quantified this type of saving based on its experience with the cost of designing IT systems and the use of Information Exchange standards. Based on this experience, Gartner assumes that the cost of investing in the implementation of an Interface or a Node in the Member State will be reduced by 20% with the IEM in place. This reduction in cost stems from simplified processes regarding the design and negotiation of Information Exchange structures.

In a market place, the savings will be much bigger as commercial operators implement the standard in solutions sold to multiple customers, whereby the effect of the standard is multiplied. 20% should therefore be considered a very conservative estimate of the savings effect.

The effects of implementing the IEM in the context of CISE are depicted below. This calculation assumes that Nodes and Interfaces are implemented in the Member States to the extent assumed in the overall cost estimates for CISE.[1]

Information Exchange Model effects	**Core Vision**	**Vision A**	**Vision B**	**Vision C**	**Hybrid Vision**
Central cost IEM (CapEx and OpEx)	€4,583,425	€4,583,425	€4,583,425	€4,583,425	€4,583,425
Member States savings (20% CapEx reduction)	€16,711,002	€16,711,002	€9,188,128	€7,639,838	€11,389,436
Net savings[2]	€12,127,577	€12,127,577	€4,604,703	€3,056,413	€6,806,011
ROI (Net savings/Central cost)	265%	265%	100%	67%	148%

Table 11 - Benefits stemming from IEM

The calculation shows that Net savings and Return-on-Investment (ROI) are higher for Visions with low centralization/streamlining of investments into Maritime Surveillance. This can be explained by these Visions having a by far higher number of Nodes and Interfaces in place. When only counting the direct effects of the IEM on Member State cost- compared to a scenario where the IEM is not developed- a saving of € 7.7 m or a ROI of 169% could be realized, on average across all Visions over the 10 year period budgeted.

This calculation does not take into account the following effects, which will materialize:

- Additional effects on CapEx and OpEx as a market of solution providers will implement the IEM and multiply the effect of the savings.
- Additional take up due to the fact that a lower CapEx and OpEx will produce a larger number of positive Business Cases helping Member States justify the investment in Maritime Surveillance.

It is further suggested to build Reference Implementations in the CISE Visions, which has a dual purpose:

- Firstly, it provides a Reference Implementation of the IEM and the messaging protocol, which can be used for compliance testing purposes.
- Secondly, it provides Member States with a standard software solution, which can be customized to fit the specific purpose of a country, driving down both the CapEx and OpEx for the Member State Node or Interface.

Gartner has also estimated the effect of providing the Reference Implementations. Based on experience with the economies of standard software, Gartner estimates that using a Reference Implementation in a Member State will generate a reduction of 50% in CapEx and a 50% reduction in OpEx as a consequence of choosing the Reference Implementation rather than a bespoke i.e. tailor-made/non standard solution.

Reference Implementation and IEM- 50% adoption	**Core Vision**	**Vision A**	**Vision B**	**Vision C**	**Hybrid Vision**
Central cost IEM and Reference implementations (CapEx and OpEx)	€6,427,568	€10,115,854	€10,115,854	€10,115,854	€10,115,854

[1] See section 4.4 for volumes

[2] Calculated as Member State savings minus Central cost

MS savings (50% reduction on CapEx and OpEx)	€38,643,565	€38,643,565	€22,033,234	€18,936,657	€27,123,675
Net savings[1]	€32,215,997	€28,527,711	€11,917,380	€8,820,802	€17,007,821
ROI (net savings / Central cost)	501%	282%	118%	87%	168%

Table 12 - Benefits stemming from Reference Implementation and IEM- 50% adoption scenario

In the overall Cost Model, Gartner has conservatively assumed an adoption of 50%. By adoption it is meant that the Member State will use the Reference Implementation as the basis for building a Node or a Gateway, instead of developing a bespoke, i.e. tailor-made solution.

In this conservative adoption scenario, the Return-on-Investment is 269% on average across all Visions, with again the Core Vision leading to the highest ROI due to the per definition higher number of Nodes and Interfaces.

Reference Implementation and IEM- 100% adoption	**Core Vision**	**Vision A**	**Vision B**	**Vision C**	**Hybrid Vision**
Central cost IEM and Reference implementations (CapEx and OpEx)	€6,427,568	€10,115,854	€10,115,854	€10,115,854	€10,115,854
MS savings (50% reduction on CapEx and OpEx)	€77,287,131	€77,287,131	€44,066,467	€37,873,313	€54,247,350
Net savings[2]	€70,859,563	€67,171,277	€33,950,613	€27,757,459	€44,131,496
ROI (net savings / Central cost)	1102%	664%	336%	274%	436%

Table 13 - Benefits stemming from Reference Implementation and IEM- 100% adoption scenario

If adoption was 100%, the ROI would increase further, being on average across all Visions more than six-fold the investment amount. The Hybrid Vision- as one example- shows a somewhat more than 4-fold ROI. Numbers for all Visions are provided in the table above.

4.9 Member State survey

EU-wide, there are about 400 authorities engaged in Maritime Surveillance. The key information gap for this engagement was that no comparative information was available on the IT systems these authorities are running or are planning to operate. To fill this gap, a survey was sent to representatives of the Member State Expert Group on Maritime Surveillance.

The survey did not only relate to the engagement at hand, but also covered off other CISE projects running at DG MARE in parallel. These are not made reference to here. Within the scope of this engagement, the survey captured relevant IT systems of Member States, the systems' key characteristics and information integration initiatives (which aim at interconnecting data beyond IT systems).

[1] Calculated as Member State savings minus Central cost

[2] Calculated as Member State savings minus Central cost

As illustrated above, the Member State survey responses were inputed into the Cost Model to count the number of Interfaces and Nodes that would be developed. The following categories of Member States and number of Member States falling in each of the categories were used:

Category	**Description**	**Assumption**	**Number of Member States in the category**
National Information Sharing Environment	Member States with a National Information Sharing Environment are those countries who have already established a centralized/streamlined environment for information sharing across sectors.	In as far as a country's systems already are integrated through a National Information Sharing Environment (such as Finland's FIMAC or the UK's NMIC), the assumption is that 50% of these Member States will connect to CISE via a single Interface, while the other 50% will adopt the new node.	4
Few main systems	Member States with 2-3 main systems are those countries where a few systems already cover many/all user communities.	If there are only a few systems in the country- with possibly some cross-sectorial integration- it is unlikely that the country will establish a National Node. Instead, the country will opt for connecting its few main systems to CISE via separate Interfaces.	12
Many separate systems	Member States with many separate systems are those countries where Maritime Surveillance is separated into several separate systems.	Many separate systems can either be connected to CISE via a newly established National Node or through separate i.e. many Interfaces. It is difficult to predict the investment path a country will take, therefore it is assumed that 50% of countries in this Category will build Nodes and the rest will install one Interface for each system in place.	12

Table 14– Number of IT systems in Member States- current plus expected numbers for CISE

Further, the Member State survey was used to categorize Member State IT systems in terms of their capability to interconnect with CISE. The following distribution resulted from the survey results:

- 29% of Member State IT systems for Maritime Surveillance are Monolithic IT systems:

  A Monolithic IT System has been built as a standalone system without the view to integrate to other systems. Functionalities (display, business logic, data storage & manipulation) cannot be modified independently, hence these types of IT systems are very inflexible to changes and adaptations.

- 45% are Two-tier IT systems:

Functionalities (display, business logic, data storage & manipulation) are separated to facilitate access to the system by other systems. The output of the system can be reused by another system as input (i.e. is machine-readable, structured).

- 26% are Web-based IT systems:

  Functionalities are built as software components and can be reused for different purposes. Services are loosely coupled with operating systems and other technologies that underlie them.

The assumption underlying this grouping is that a monolithic system will be more costly and complex to interconnect with CISE than a two-tier one and then again a web-based IT system. All survey questions and results have been summarized in the Appendix.

5.0 Sustainability Assessment

5.1 About the Sustainability Assessment

The Sustainability Assessment forms a complement to the costing, providing a qualitative expert judgment on each Architectural Vision. It looks into aspects other than cost to ascertain that the Visions suggested are feasible to implement and effective in reaching CISE's goals over time.

For the purpose of the engagement, sustainability refers to the sustainability of the *IT environment* underlying CISE. This precision is crucial as it rules out other aspects (such as culture, governance, and political considerations) from the Gartner opinion- aspects which are equally important and in-depth dealt with in the Impact Assessment of CISE.[1]

The sustainability of the IT environment is expressed in the environment's ability to present an evolving life-cycle, and that despite technical barriers, evolving functional requirements and technologies, resource constraints, and changing user preferences.

The Sustainability Assessment answers questions such as:

- Generally speaking, is the IT environment underlying CISE designed in a way that CISE goals can be reached effectively?
- Which are the main technical barriers the Visions will encounter and how will they impact CISE's effectiveness?
- How suited are the Visions in overcoming the identified barriers?

As a central theme of the Sustainability Assessment, Gartner has identified two groups of technical barriers that CISE will face:

- The varying capacity of source systems to exchange surveillance and monitoring information
- The lack of interoperability of the current IT systems' landscape

Both types of barriers are rooted in the way the IT systems of Maritime Surveillance authorities are designed as of today.

Example: If a source system in a Member country relies on an old, monolithic IT architecture, holds erroneous or incomplete data or cannot be interconnected with other IT systems due to non-standard messaging protocols and data formats, interconnection with CISE will be difficult to achieve and vice versa for modern, flexible, open IT systems.

The next sections illustrate the technical barriers in greater detail evaluating both their impact on CISE's effectiveness as well as the adequateness of each Vision to address the barriers.

[1] Source documents will become available here once the policy initiative supported by this Impact Assessment becomes public: http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm

5.2 Technical barriers to CISE

5.2.1 Varying capacity of source systems to exchange surveillance and monitoring information

As regards this first group of technical barriers, the following four items have been identified:

Machine-dependent, old architectures make it cumbersome to interconnect with CISE

Machine-dependent, old architectures will prevent some systems from providing data to CISE before being renewed. For these systems, it will be cumbersome to implement operational Interfaces, thus limiting the amount of data available for exchange in CISE.

A significant portion of about 1/4th of Member State IT systems still relies on a monolithic architecture[1] hence this barrier could have a significant impact on implementing the CISE "ecosystem" (i.e. the interconnection of a wide range of participants) as the program progresses. It is thus very important that CISE is leveraged upon as an opportunity to renew IT systems for Maritime Surveillance in the Member States whilst at the same time respecting the investment cycles the Member countries have foreseen to renew them.

Varying data quality across source systems reduces trustworthiness of CISE

A system's output (in the case of CISE for example the Situational Awareness picture for Maritime Surveillance) depends by definition on its inputs (e.g. the data used to establish the Awareness picture). There is not sufficient evidence available today to properly judge on the quality of the available Maritime Surveillance information. We therefore may or may not assume (for example deriving a working hypothesis based on the heterogeneity in IT systems' maturity[2]) that data currently collected, stored and exchanged by source systems is of heterogeneous quality.

In case it is, there are many different ways to deal with heterogeneous data in a complex environment like CISE. One is to flag data in terms of its degree of trustworthiness. The other is to put in place mechanisms for data validation such as cross-checks with related data points or checks on the metadata's completeness. Ensuring that data is exchanged and aggregated in a consistent way is yet another. Putting in place Nodes can for example help to ensure Situational Awareness pictures are assembled correctly, using up-to- date and quality- checked information.

Varying degrees of cross-sectorial integration of Maritime Surveillance within countries create strong imparities in terms of effort to connect to CISE

The Member State survey also highlighted the differences in terms of Maritime Surveillance collaboration *between sectors* in the different Member States.[3] Some countries are already well advanced in terms of collaborating across sectors whilst in others, informational silos per User Community continue to persist. Some countries have streamlined their IT system landscape by reducing the number of Maritime Surveillance IT systems to only a few. These

[1] See results of the Member State survey in section 4.9

[2] See results of the Member State survey in section 4.9

[3] See again section 4.9 for further detail.

few IT systems are then used as shared resources across sectors. Yet in others, a long list of IT systems remains up and running, with each system focusing on one or a few segments of users. Where User Communities operate independently, a technical solution will need to be found for each of them to interconnect with CISE, bilaterally or via a Node as an intermediary. CISE should in this case be viewed as an opportunity to break down information silos, also within the individual Member States and streamline the IT systems landscape.

There is a lock-in into modern commercial platform solutions

The Member State survey revealed that about 85% of Member States' Maritime Surveillance IT systems are non-standard i.e. have been custom built.[1] There can therefore be cases where the provider of the IT system designed the system in a way that it is not (well) suited to communicate with other systems and can only be upgraded or adapted using components from the same IT provider. This is what is commonly referred to as vendor lock-in.

When investing in Maritime Surveillance systems in future, CISE could be used as an opportunity to limit such vendor lock-in. This would require that CISE becomes more than just an (IT) environment, but creates a community in which CISE participants share knowledge and experiences to jointly challenge and incentivize the provider market for Maritime Surveillance IT systems. This for example implies investigating into whether requirements for IT systems for Maritime Surveillance could not be further harmonized (across sectors or countries), or whether certain IT components could not be re-used amongst CISE participants. The market would in turn be incentivized to provide more generic solutions, seeing his (potential) customer base increase through being able to sell the same or similar components across a broader range of clients. In general, Gartner observes that awareness around vendor lock-in has significantly increased in the public sector, regardless of the government domain.

5.2.2 Lack of interoperability of current systems' landscape

Interoperability is a cross-fertilizing barrier, with non-interoperable solutions within a certain government tier/Member State or across tiers/Member States jeopardizing interoperability of the overall ecosystem of CISE participants. It is a major technical barrier to pan-European system integration and should ideally be addressed at the EU level in order to foster seamless, pan-European exchange of information.

For this engagement, Gartner highlights five items related to interoperability.

There are no common information models (as of yet)

This barrier is dealt with in establishing the Information Exchange Model which is one of the key outputs of CISE. Benefits arising from the Information Exchange Model will accrue as information standards get adopted by an increasing number of CISE participants.

There are no common technical protocols (as of yet)

[1] See again section 4.9

Common technical protocols will enable much more efficient and effective interaction between the data source and its user, i.e. an IT system providing a data set to CISE and an end user retrieving this data set to use it for analytical or operational purposes. Implementing a Reference implementation of a Node is the most effective way to deal with this barrier.

Immature and/or diverging definitions of meta data between user communities hamper cross-sectorial sharing of information

Conflicts in meta data will be a barrier to connect a CISE source system with a CISE user system or a Node. The Information Exchange Model provides a basis for harmonizing the definitions of meta data across CISE participants. Implementing a Node is an even more effective solution as it supports a uniform aggregation of information exchange.

Data and metadata will be in different languages

Having data and metadata defined and/or collected in different languages is likely to create misunderstandings between the CISE source and user systems. This will be dealt with through the data model to be established as part of the CISE program. English may be used as the pivot language, similarly to what has been done in the Maritime Surveillance pilot projects BlueMassMed[1] and Marsuno.[2]

Existing Node models will need to be integrated

Some Member States will already have built Nodes which may limit their interest in investing much further in Maritime Surveillance. In these cases, building Interfaces rather than additional Nodes will be the most appropriate solution to utilize previously made investments. This has been taken into account in the CISE Cost Model when estimating the volumes of Nodes and Interfaces.[3]

5.3 Effectiveness of CISE Visions to counter technical barriers

To conclude the Sustainability Assessment, we summarize the CISE Visions' effectiveness in countering the technical barriers highlighted above.

The rating scales used are:

- Fully: the barrier is fully or to a very large extent addressed by the Vision
- Partly: the barrier is partly addressed by the Vision
- Not: the Vision is not suited for addressing the barrier.

This gives an overview of the (potential) impact of barriers and helps to identify those Visions which the most adequately deal with the technical barriers to CISE.

[1] http://www.bluemassmed.net/

[2] http://www.marsuno.eu/

[3] See also section 4.9

Varying capacity of source systems to exchange surveillance and monitoring information	**Adequateness of Vision**				
	Core	**A**	**B**	**C**	**Hybrid**
Machine-dependent, old architectures make it cumbersome to interconnect with CISE	Partly	Partly	Partly	Fully	Fully
Varying data quality across source systems reduces trustworthiness of CISE	Not	Not	Not	Fully	Partly
Varying current cross-sectorial integration of Maritime Surveillance within countries creates strong imparities in effort to connect to CISE	Not	Not	Not	Partly	Fully
There is a lock-in into modern commercial platform solutions	Partly	Partly	Partly	Not	Fully
Lack of interoperability of current systems' landscape	**Adequateness of Vision**				
	Core	**A**	**B**	**C**	**Hybrid**
There are no common information models (as of yet)	Fully	Fully	Fully	Fully	Fully
There are no common technical protocols (as of yet)	Partly	Partly	Partly	Fully	Fully
Immature and/or diverging definition of metadata between user communities hampers cross-sectorial sharing of information	Partly	Partly	Partly	Fully	Fully
Data and metadata will be in different languages	Fully	Fully	Fully	Fully	Fully
Existing Node models will need to be integrated	Fully	Fully	Fully	Partly	Fully

Table 15 – Adequateness of Visions to face Technical Barriers

When looking at the full set of technical barriers to CISE, the Hybrid Vision turns out the most sustainable. In terms of source systems' varying capacity to interconnect with CISE, the Hybrid Vision allows to tackle three out of four barriers. The rating reflects the flexibility this Vision provides for, by respecting the current set up of Maritime Surveillance environments in the EU Member countries. Where machine-dependent, old architectures persist or authorities find themselves locked into commercial platform solutions, the Vision leaves full decision making latitude to governments as to how to best connect their systems with CISE. It can in this case safely be assumed that Member States know their systems the best and are therefore the best placed to make investment and transformation choices.

As Member States are already strongly organized around User Communities[1], the Hybrid Visions leaves room to governments to pursue their efforts to expand such collaboration on a needs basis. Vision C in turn is best suited to address the issue of varying quality in the source data. It does so by making Nodes obligatory which are the most effective way to collate and aggregate data accurately from various incoming sources. The Hybrid Vision

[1] See Member State survey in section 4.9

would need to counterbalance data quality issues by flagging data according to quality levels or building in quality checks into the information exchange mechanism.

When it comes to interoperability, the Hybrid Vision again performs slightly better than Vision C, once more due to the flexibility it offers in letting Member States choose whether to build on existing Node models or not, depending on their individual governance structure and investment cycles.

However, in this group of barriers it is evident that all Visions address technical and semantic interoperability at least in part. As a matter of fact, Gartner underpins that technical barriers to CISE are relatively few and can be addressed through continuous and systematic collaboration like it is already taking place today. It may well be the case that technical barriers will be less preponderant than legal or organizational barriers to creating CISE. The Impact Assessment work of DG MARE will advise on the latter.

Appendix

Member State survey

This annex presents the MS survey questions and key findings from the survey of Gartner, extracted from a broader survey sent to Member State representatives to support DG MARE's Impact Assessment work for CISE.

Questions

Please list and specify the main IT systems your country has in place to support Maritime Surveillance:

- Name of IT system
- Public Authority operating the system
- User Community/ies using the system[1]

Please provide additional information for each system that you have listed.

- Name of IT system
- EU organization to which the system is connected (bodies directly hosting a system)
- Other EU-led initiatives/organizations to which the system is connected

Please provide the Key properties of the IT systems in place

- Name of IT system
- Year when system was first operational
- Initial development cost for the system (until first year of operations) in €
- Ongoing annual cost for maintenance and operation of the system in €.
- System Characteristic 1: Architecture of system
  - ❑ Monolithic IT system: System has been built as a standalone system without the view to integrate to other systems; Functionalities (display, business logic, data storage & manipulation) cannot be modified independently
  - ❑ Two-tier IT system: Functionalities (display, business logic, data storage & manipulation) are separated to facilitate access to the system by other systems; Output of system can be reused by another system as input (is machine-readable, structured)
  - ❑ SOA-based IT system: Functionalities are built as software components and can be reused for different purposes; Services are loosely coupled with operating systems and other technologies that underlie them
- System Characteristic 2: Standard or bespoke system
  - ❑ Standard : System has been procured from a vendor or based on open source; System is configured for the setting where it is used but non-standard code is limited
  - ❑ Bespoke: System is developed specifically for the setting where it is used; System may be built from standard components but the applications running on it have been developed specifically

[1] Maritime Safety, Customs, Maritime Pollution, Fisheries Control, Border Control, General Law Enforcement, Defense

In your country, please list any examples of integrating Maritime Surveillance IT to exchange information

- Name of integration initiative
- Member states involved (EU and EEA)
- User Community/ies involved

Please provide the following additional information about each integration initiative:

- Name of integration initiative
- Type of information being exchanged
- Status of the project:
- If operational please specify the start date

Response pattern

- Coverage of User communities in IT systems: [Counts the number of times a User Community has been ticked as being covered by an existing IT system]
  - Maritime Safety: 32
  - Customs: 18
  - Maritime Pollution: 23
  - Fisheries Control: 19
  - Border Control: 34
  - General Law Enforcement: 25
  - Defence: 30
- Total number of IT systems: 72
- Total number of IT systems (covering more than 1 UC): 42
- Average number of UCs per IT system: 2.72
- Number of IT systems connected to EU initiative: 16
- Average number of IT systems per MS: 7
- Average number of IT systems (1+UC):3.5
- Average age of IT systems: 10.1 years
- Average initial development cost per system: 15,102,285 €
- Average operating cost per system: 1,518,167 €
- Distribution of System Characteristics:
  - Monolithic: 17
  - Two-tier: 26
  - Web-based: 15
  - Standard: 8
  - Bespoke: 49
- Participation of User communities in information integration initiatives: [Counts the number of times a User Community has been ticked as being covered by an information integration initiative]

  - Maritime Safety: 26
  - Customs: 16
  - Maritime Pollution: 19
  - Fisheries Control: 16
  - Border Control: 22
  - General Law Enforcement: 17
  - Defence:
- Total # of integration initiatives: 41
- Average # integration initiatives per MS: 3.42
- Average # UCs per integration initiative: 3.9
- Number of initiatives involving more than 1 MS (but excluding EU systems): 16
- Average number of MSs involved in an integration initiative: 7.07
- Stage information integration initiative is in
  - Approved and planned: 3
  - Being developed: 7
  - Operational: 25
- Average start date of information integration initiative: 2006

Additional graphs

Figure 2ff CapEx/OpEx distribution for Visions other than the Hybrid Vision

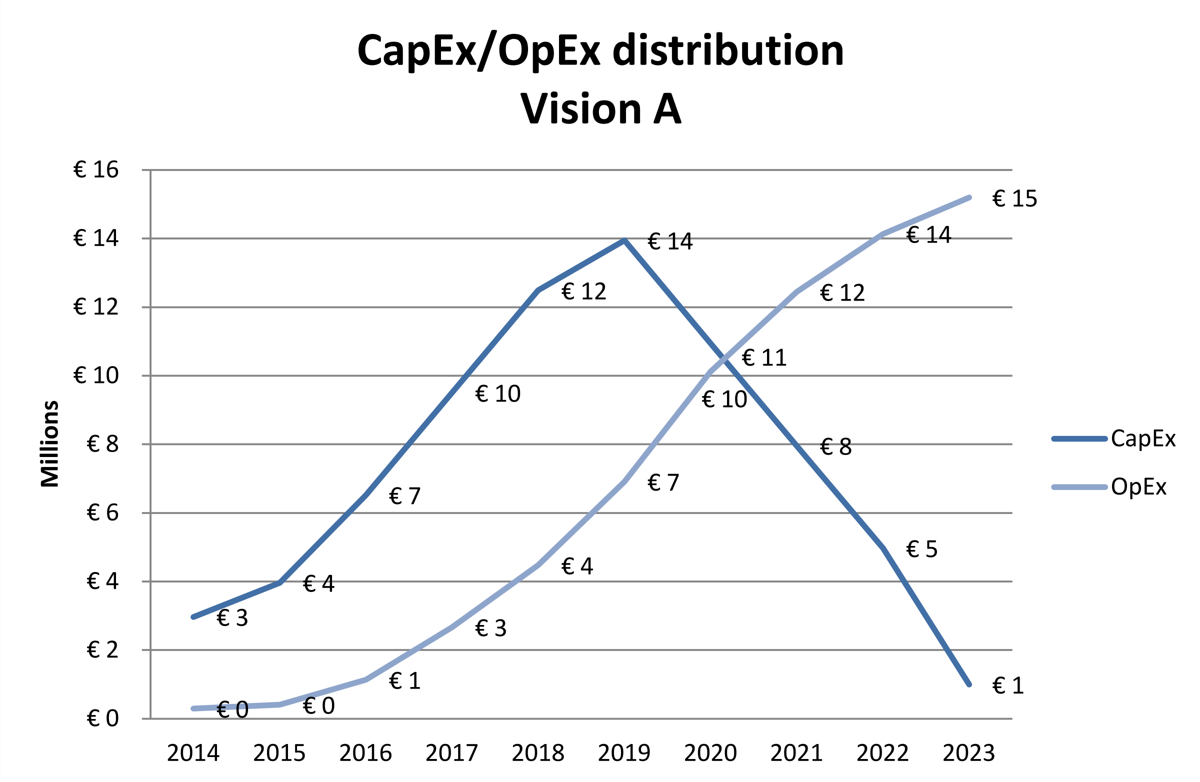


Figure 2i CapEx/OpEx distribution of Vision A

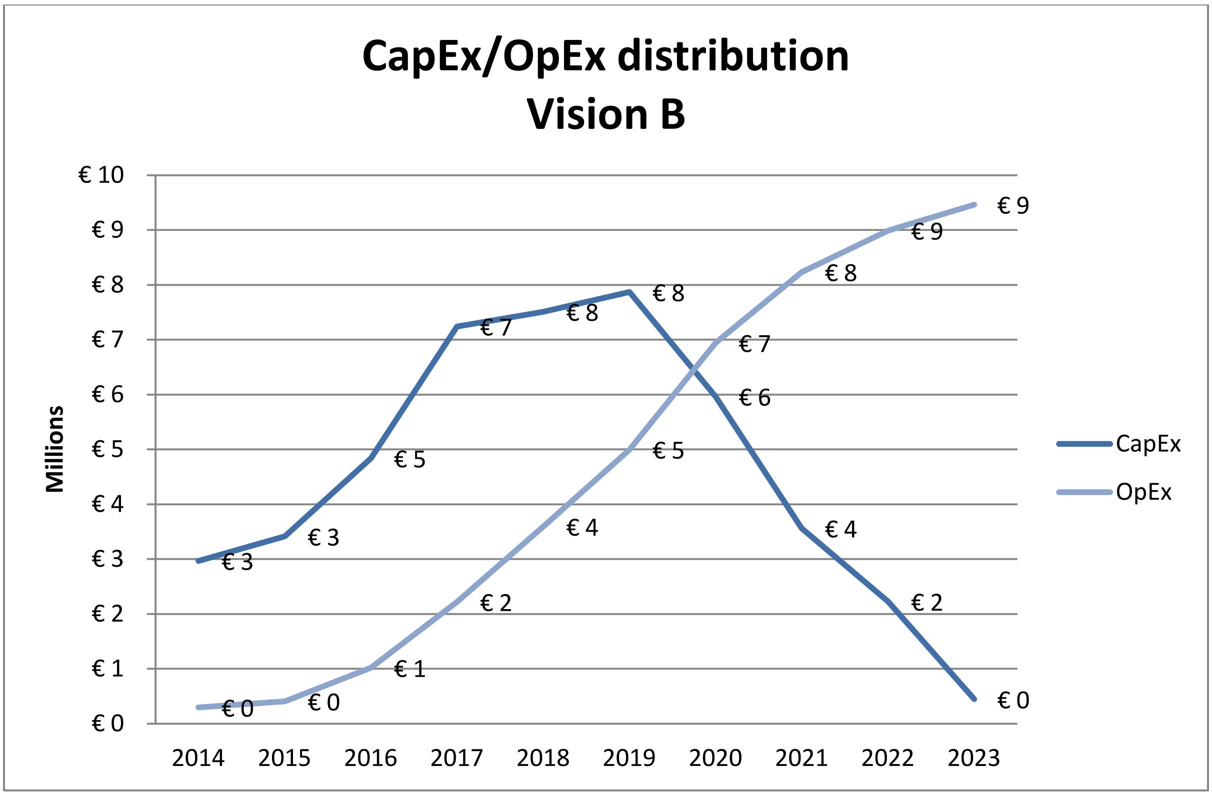


Figure 2ii CapEx/OpEx distribution of Vision B

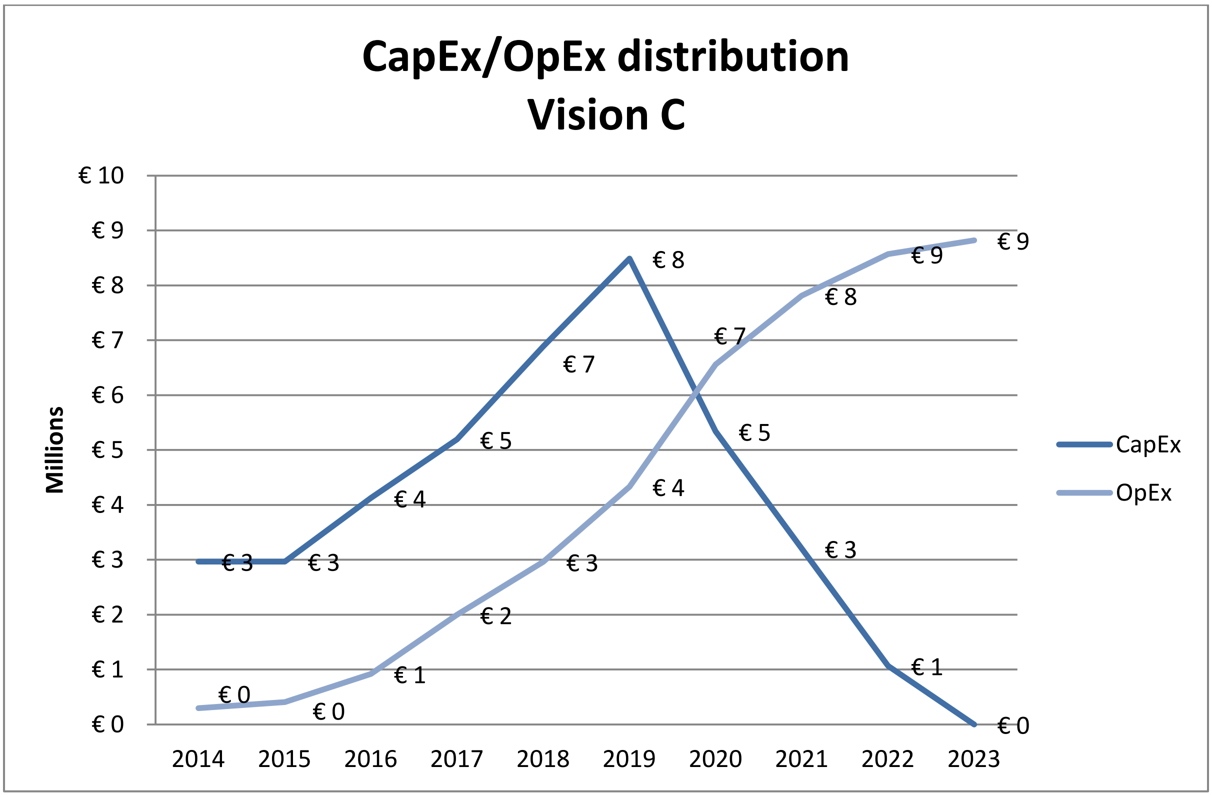


Figure 2iii CapEx/OpEx distribution of Vision C

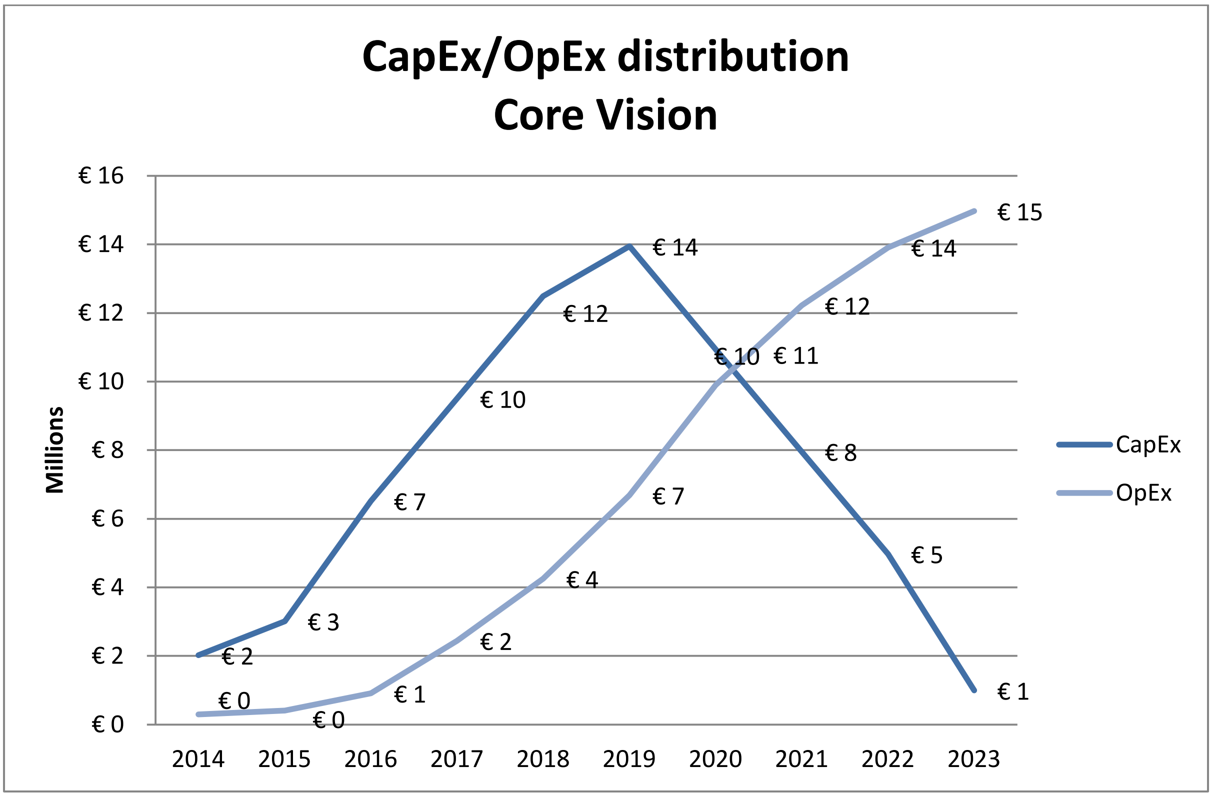


Figure 2iiiI CapEx/OpEx distribution of Core Vision

Figure 4ff Distribution of Central versus Member State Cost for Visions other than the Hybrid vision

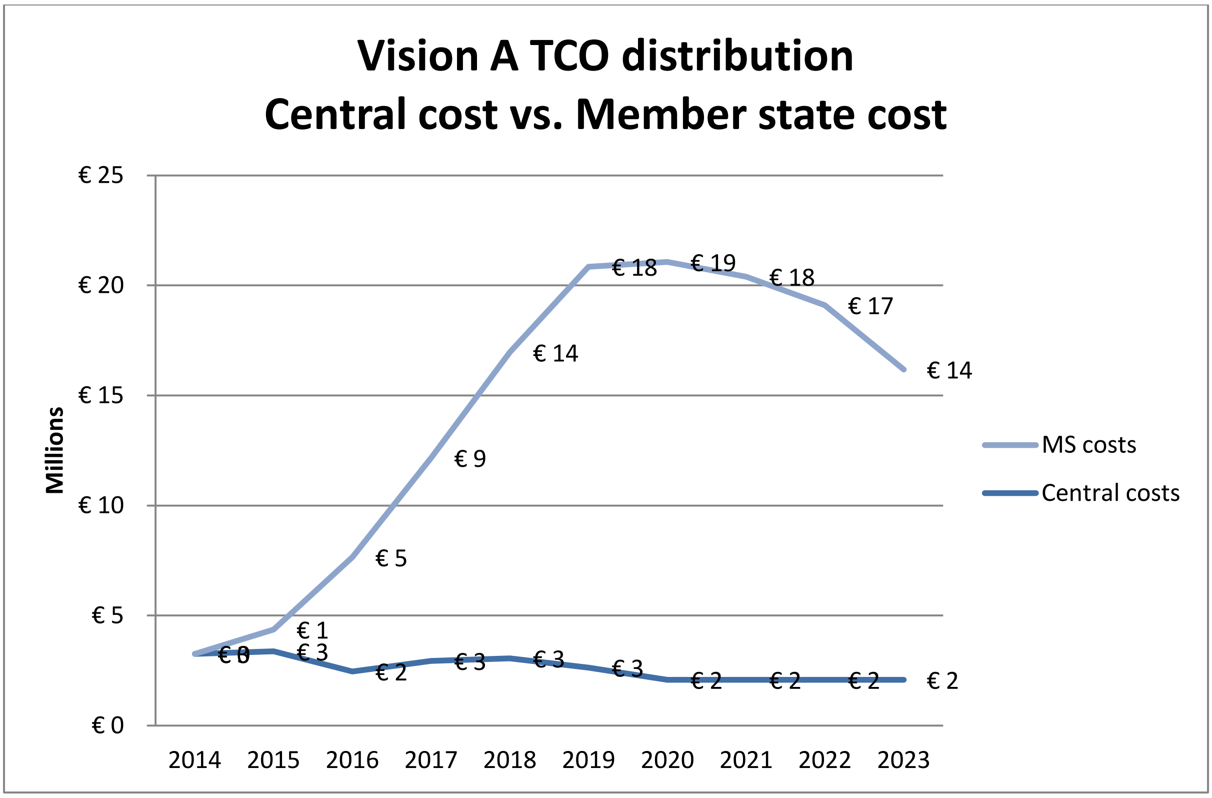


Figure 4i TCO Distribution of Central versus Member State Cost for Vision A

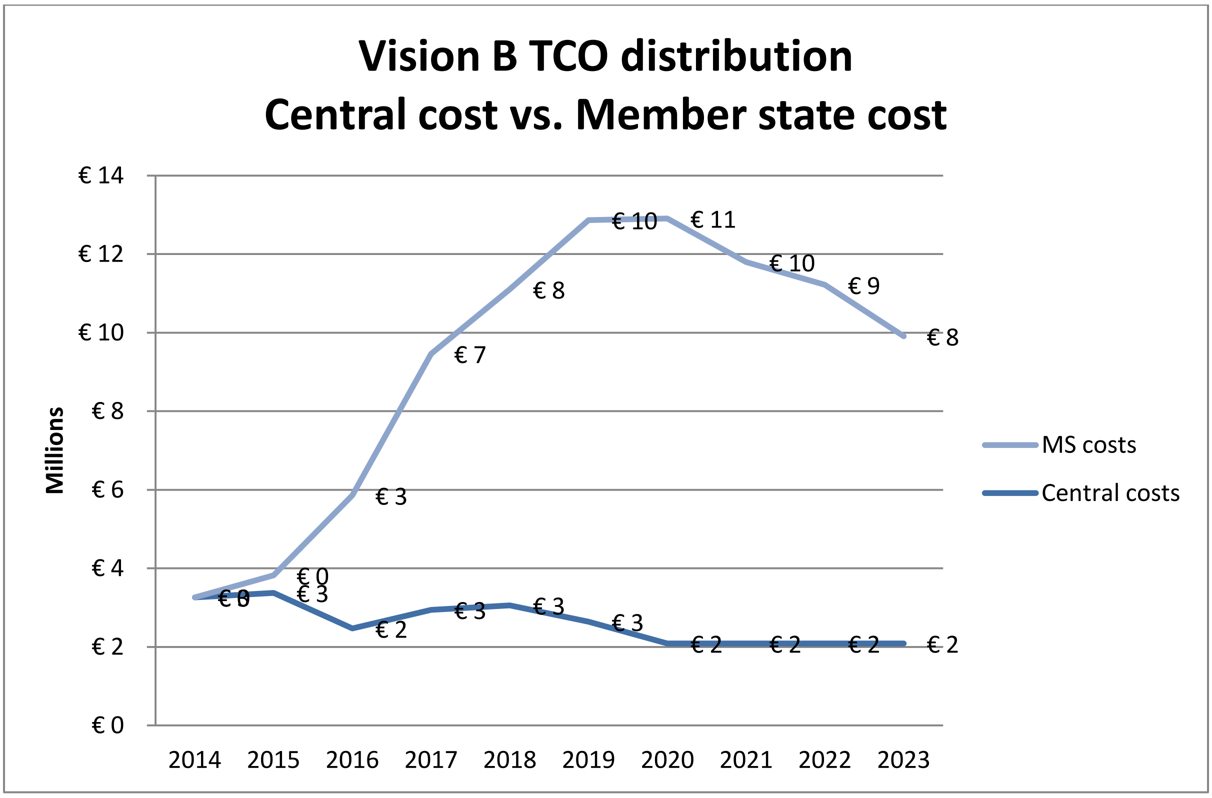


Figure 4ii TCO Distribution of Central versus Member State Cost for Vision B

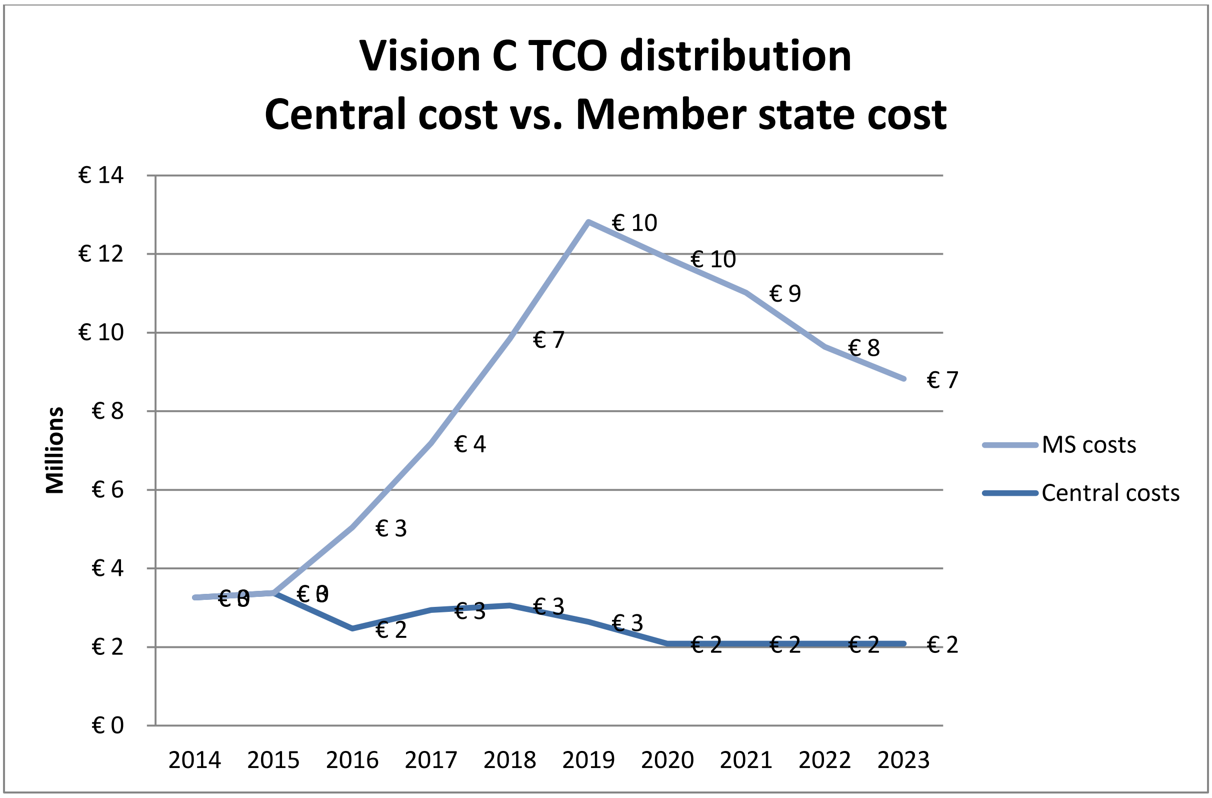


Figure 4iii TCO Distribution of Central versus Member State Cost for Vision C

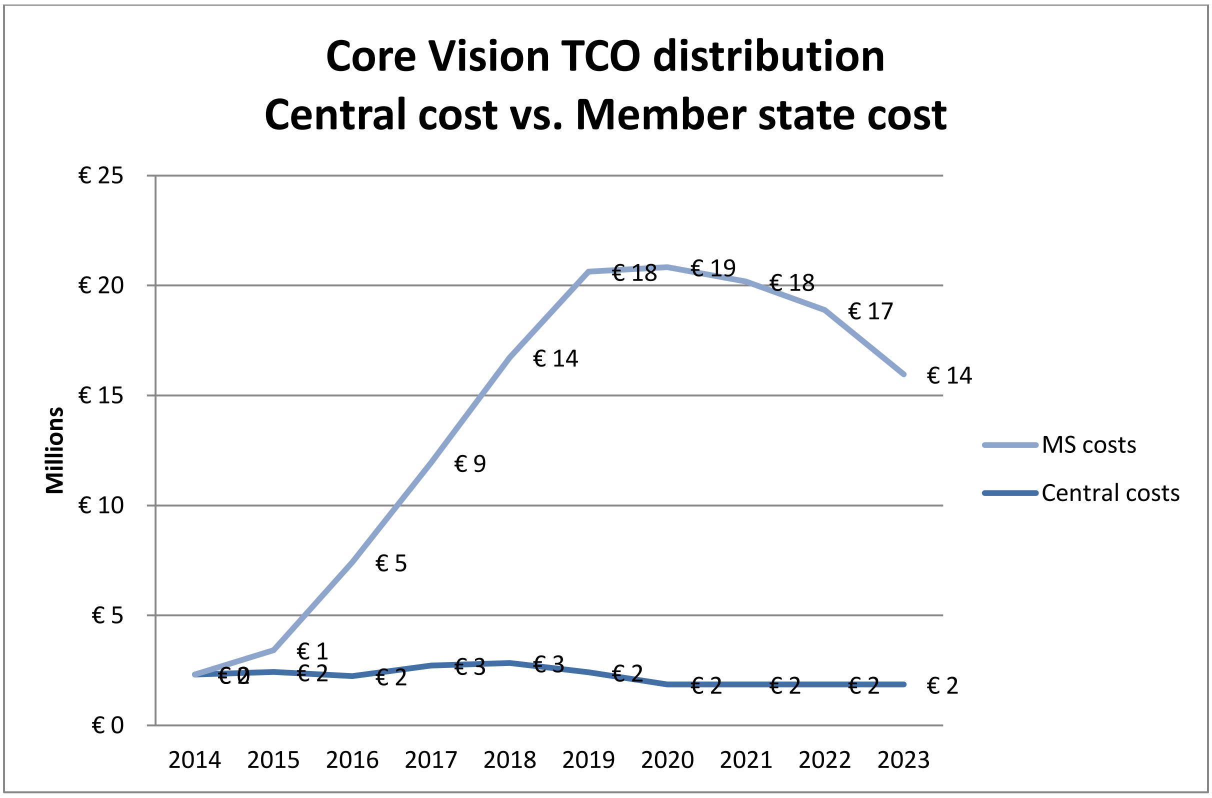


Figure 4iiii TCO Distribution of Central versus Member State Cost for Core Vision

Figure 11i Implementation timeline for Building Blocks for Visions other than the Hybrid Vision

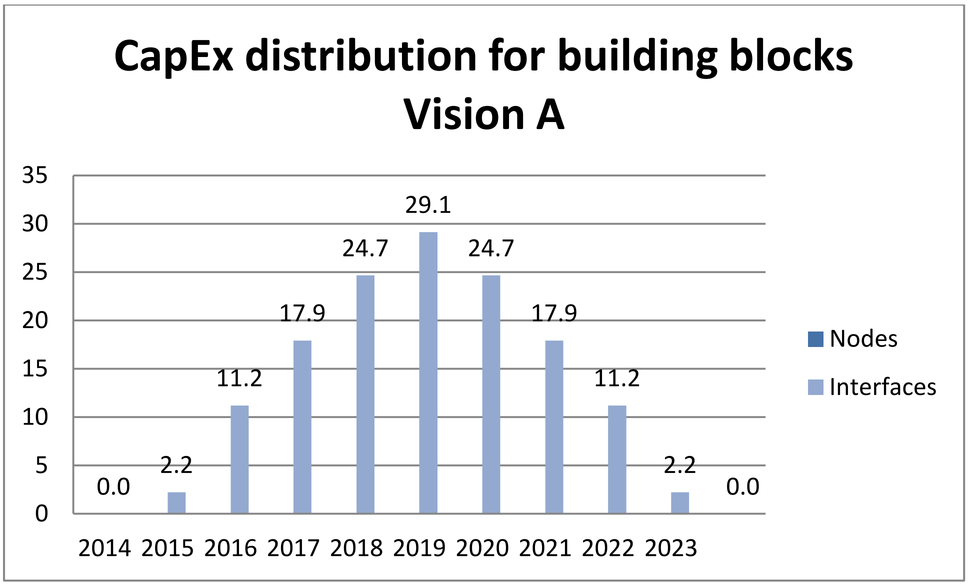


Figure 11i - Implementation timeline for Building Blocks in Vision A

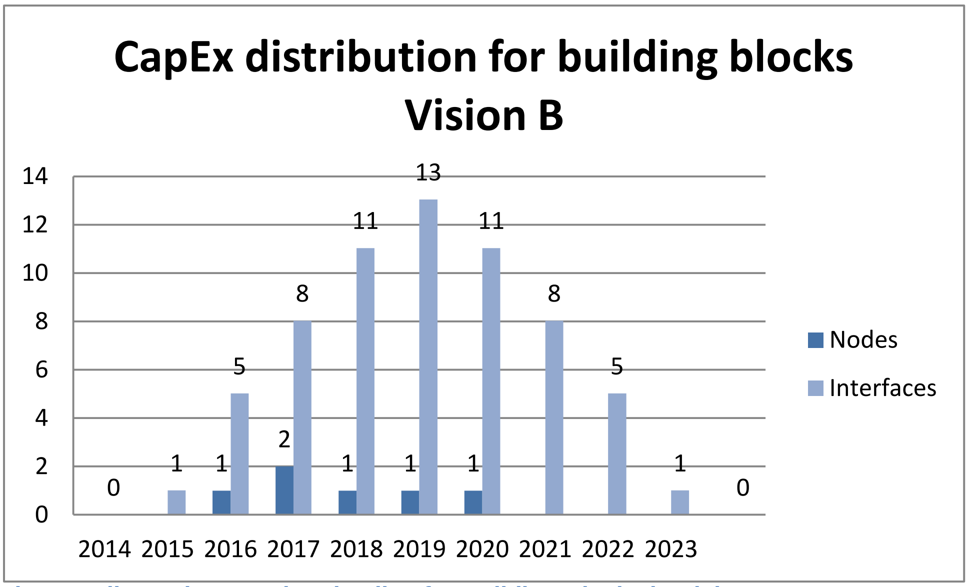


Figure 11ii - Implementation timeline for Building Blocks in Vision B

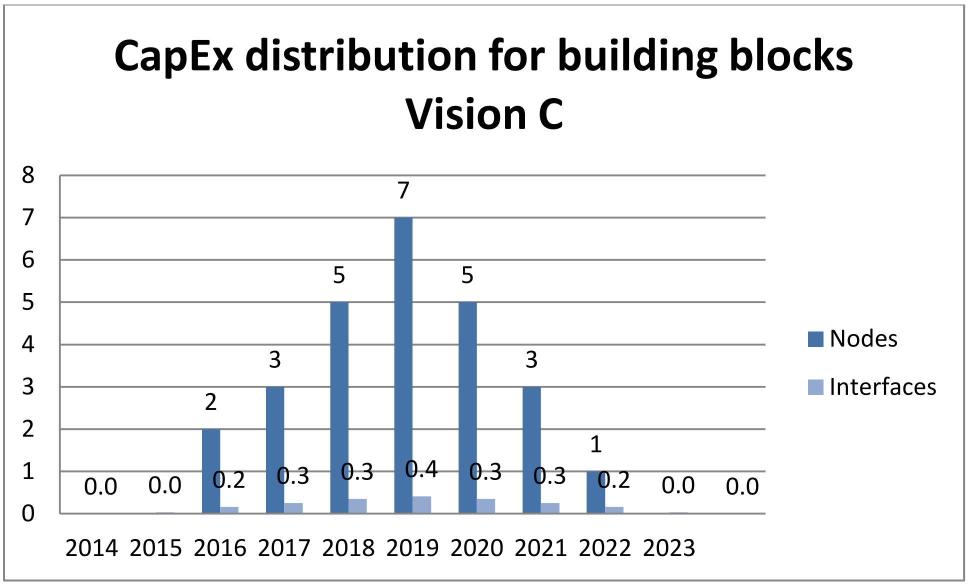


Figure 11iii - Implementation timeline for Building Blocks in Vision C

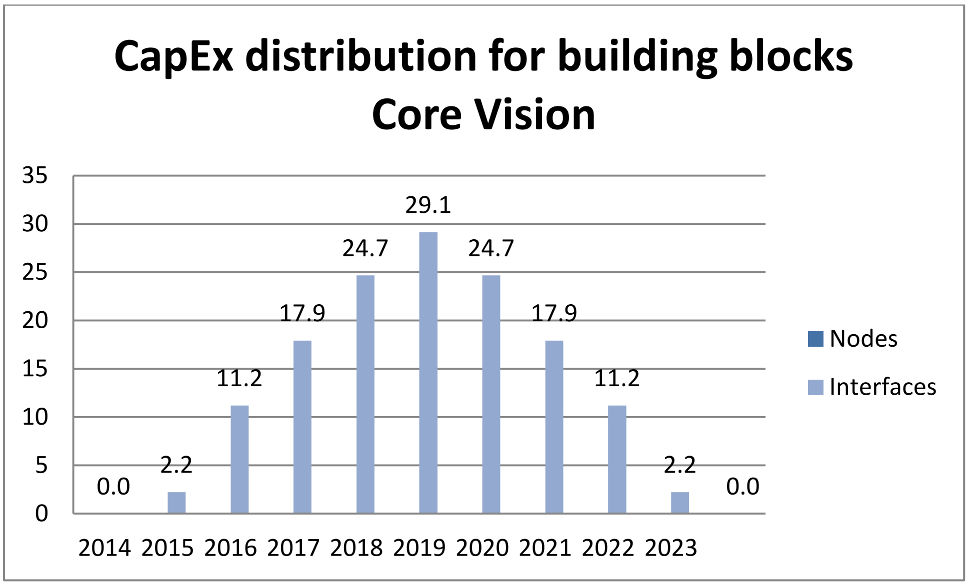


Figure 11iiii - Implementation timeline for Building Blocks in Core Vision

Additional tables

Total number of units		Units	Description
#	**MS Category 1**		
2 Interfaces	50%	1 Interface	Interface implemented to connect the national Node to CISE
6 Interfaces	50%	3 Interfaces	Interfaces implemented to connect the Nodes to CISE
#	**MS Category 2**		
49,2 Interfaces	No of Interfaces	4,1 Interfaces	It is assumed that this group of countries will implement a number of Interfaces. The average number of cross-sectorial systems (source: MS survey) is used
#	**MS Category 3**		
84 Interfaces	100%	7 Interfaces	It is assumed that 100% in this group will implement Interfaces connecting existing systems. It thus uses the average number of systems per MS (source: MS survey)
	Total Nodes	**0**	
	Interfaces	**141,2**	

Table 6 i – Calculation of number of Nodes and Interfaces for Core Vision

Total number of units		Units	Description
#	**MS Category 1**		
2 Interfaces	50%	1 Interface	Interface implemented to connect the national Node to CISE
6 Interfaces	50%	3 Interfaces	Interfaces implemented to connect the Nodes to CISE
#	**MS Category 2**		
49,2 Interfaces	No of Interfaces	4,1 Interfaces	It is assumed that this group of countries will implement a number of Interfaces. The average number of cross-sectorial systems (source: MS survey) is used
#	**MS Category 3**		
84 Interfaces	100%	7 Interfaces	It is assumed that 100%

			in this group will implement Interfaces connecting existing systems. It thus uses the average number of Maritime Surveillance IT systems per MS (source: MS survey)
	Total Nodes	**0**	
	Interfaces	**141,2**	

Table 6 ii – Calculation of number of Nodes and Interfaces for Vision A

Total number of units		**Units**	**Description**
#	**MS Category 1**		
2 Interfaces	50%	1 Interface	Interface implemented to connect the national Node to CISE
6 Interfaces	50%	3 Interfaces	Interfaces implemented to connect the Nodes to CISE
#	**MS Category 2**		
49,2 Interfaces	No of Interfaces	4,1 Interfaces	It is assumed that this group of countries will implement a number of Interfaces. The average number of cross-sectorial systems (source: MS survey) is used
#	**MS Category 3**		
6 Nodes	50%	1 Interface	It is assumed that 50% of countries in this category will implement one Node as the integration point with CISE and connect onto national systems through this Node
24,6 Interfaces	50%	1 Interface	It is assumed that the other 50% in this group will implement 1 Interface as coordinated connection point to CISE
	Total Nodes	**6**	
	Interfaces	**63,2**	

Table 6 iii – Calculation of number of Nodes and Interfaces for Vision B

Total number of units		**Units**	**Description**
#	**MS Category 1**		
2 Interfaces	50%	1 Interface	Interface implemented to connect the national

			Node to CISE
2 Interfaces	50%	1 Node	Interface implemented to connect the Node to CISE
#	**MS Category 2**		
12 Interfaces	100%	1 Node	It is assumed that this group of countries will implement a Node
#	**MS Category 3**		
12 Interfaces	100%	1 Node	It is assumed that 100% of countries in this category will implement one Node as the integration point with CISE and connect onto national systems through this Node
	Total Nodes	**26**	
	Interfaces	**2**	

Table 6 iv – Calculation of number of Nodes and Interfaces for Vision C

Any questions regarding this Report should be addressed to:

Kristian Billeskov
Engagement Manager
Gartner Belgium BVBA
Leonardo Da Vincilaan 11
Figueras Building
B-1935 Zaventem
Telephone: +45 2830 73 76
Facsimile: + 32 2 725 71 09
E-mail: kristian.billeskov@gartner.com

This Report was prepared for European Commission- Directorate General Maritime Affairs:

Olivier Fontaine
European Commission- Directorate General Maritime Affairs
DG MARE
Maritime Policy in the Mediterranean and Black Sea
Rue Joseph II
J-99 06/012
B-1049 BRUXELLES
Telephone: +32 2 2980544
Facsimile:
E-mail: olivier.fontaine@ec.europa.eu