Exchanging Systems Engineering data for teaming in a System of Systems and Services, IEEE SoSE conference – 20 June 2018

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A [business] teaming problem

- **Assuming that**
  - **A market / a service (or a set of services) and the date of Initial Operational Capability are identified**
- **The questions are**
  - **How to organize the system of systems (and services) to ensure that the service can be delivered in time?**
  - **Profitably for all partners ➔ teaming or not, with whom?**
- **With uncertainties and incomplete information**

(in particular) on potential partners abilities, strategies, maturity …

System engineering approach to help resolving the business problem

Approach:

- **Systems engineering helps <u>sharing</u> proper consistent information before committing to team, whilst <u>protecting</u> sensitive information.**

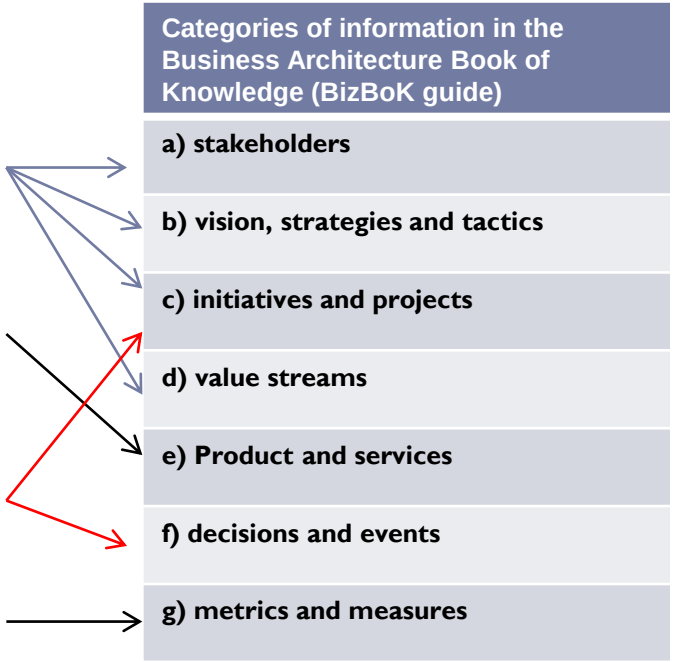
➔ **The principle of an information framework, currently under study within AFIS (French Chapter of INCOSE), is explained.**

A fictitious space launcher case is shortly presented to illustrate the approach.

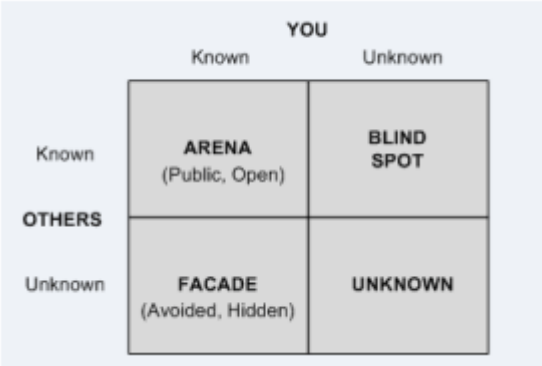
Categories of sensitive information

One doesn't share information when:

1. It is <u>strategic</u> : targeted market, product line approach, future products or future offered capability, intellectual property items
2. It is sensitive <u>technical information</u> : this includes System Engineering models and parameters,
3. Publicity on <u>schedule problems</u> may endanger the access to market (customers should better not know) → undisclosed <u>delays</u>
4. Disclosure of <u>uncertainties and risks</u> could endanger company image



Negative impact of not sharing information



Johari window

Impacts:

- **Lack of confidence of the partnership,**
- **Delay to gather known-unknown information,**
- **Insufficient knowledge of relevant information, potentially resulting in wrong assessment of the ability to deliver a capability or a service**

There is certain amount of information that each partner could disclose without endangering his strategy, activity, access to market.
This gap between what is not disclosed and what could be disclosed can be evaluated in terms of a **benefit/risk balance**

Architecting a SoS to create a Capability (1)

- **Notion of capability:**
  - Agreement on a desired capability would allow the SoS partners to jointly offer services to a community of users
  - Agreement is not mandatory in some cases
    - with service providers that offer services without consideration of what it is used for
    - With system providers that sell widely used systems in an open market (e.g. COTS)

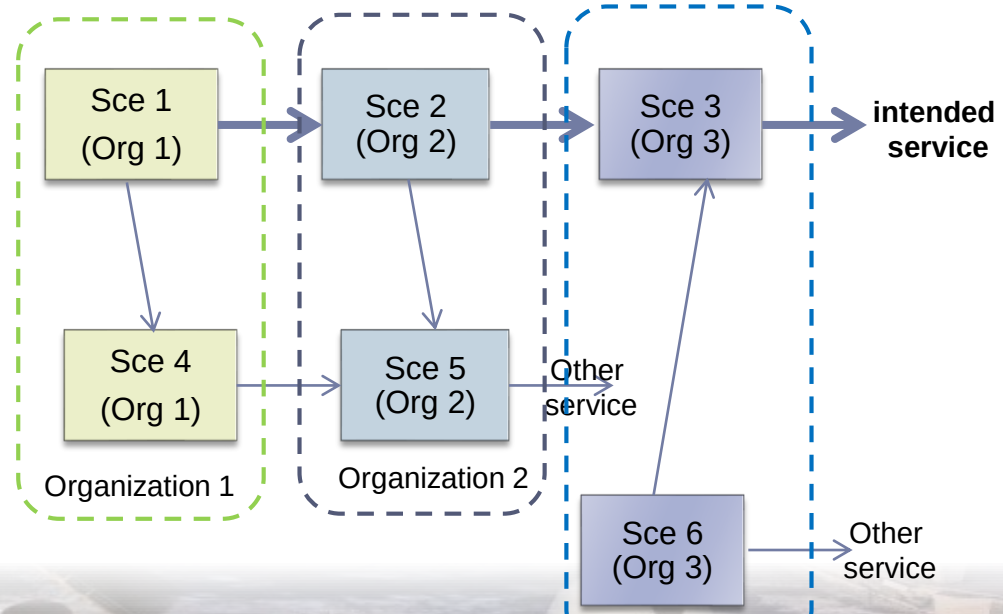
➔But teaming is the best assurance that the capability can be durably offered

➔Can be analyzed prior to decide the mode of governance

Architecting a SoS to create a Capability (2)

- **Agreement on high level architecture:**
- Notion of a **chain of services** (within a **network of services** ➔ VALUE NETWORK*)
- The ideal granularity is obtained when one can map a partner (Org_n) to a service (in the chain) : Service Oriented View

Often, potentially participating organizations are already delivering other services and build their systems for other purposes.



* Ref. S. Ben Hamida : Stakeholder Value Network

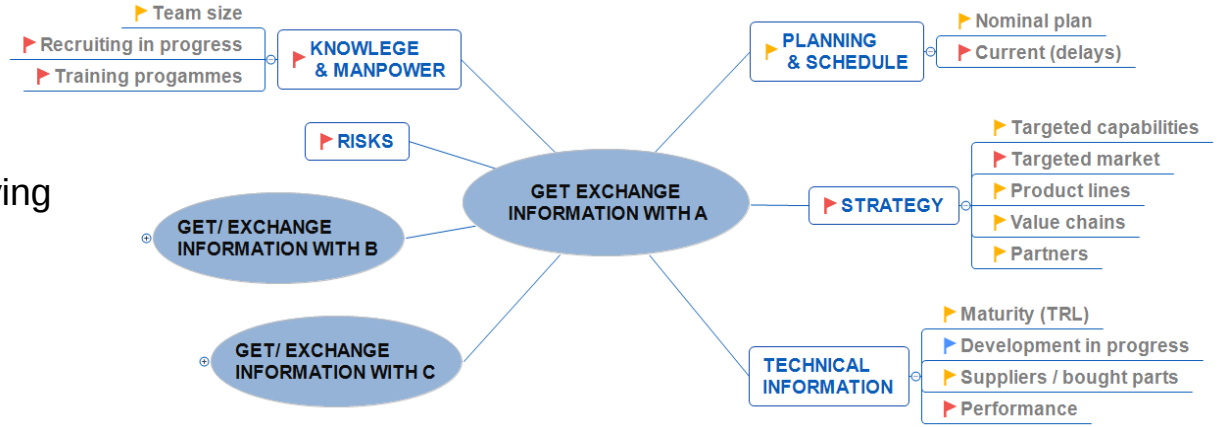
Process to reach an agreement

1. Value chain
2. Services
   - CONOPS
   - Functions
3. TRL
   - Interoperability
4. Timelines
   - Uncertainty
5. Risks

1. Establish a high-level **model of the value chain**, with explicit assumptions on the addressed market, and as much as possible with quantified values,
2. Identify the main **services** which have to be provided by the various **partners** and characterize the required **Quality of Service (QoS)** at high-level.
   Develop a **Concept of Operation** document to ensure common understanding of the intended services and supporting capabilities of the SoS.
   Build a high-level **functional model** which can be shared,
3. Identify in a collaborative way the **readiness** of the main components / service constituents and their **interoperability** features,
4. Identify the **main timelines for needed development, industrialization and deployment**, with explicit range of **uncertainty**,
5. Identify and quantify **risks**, in terms of likelihood and impact. Assess jointly the robustness.

Data and tagged confidence

- **Uncertainty representation**
  - From data owner point of view
  - From partner point of view (relying on transmitted / gathered information)➔ **confidence** tag



Systems engineering information can be **progressively disclosed** to other partners and finally shared as a common framework to support partnering discussions to define:

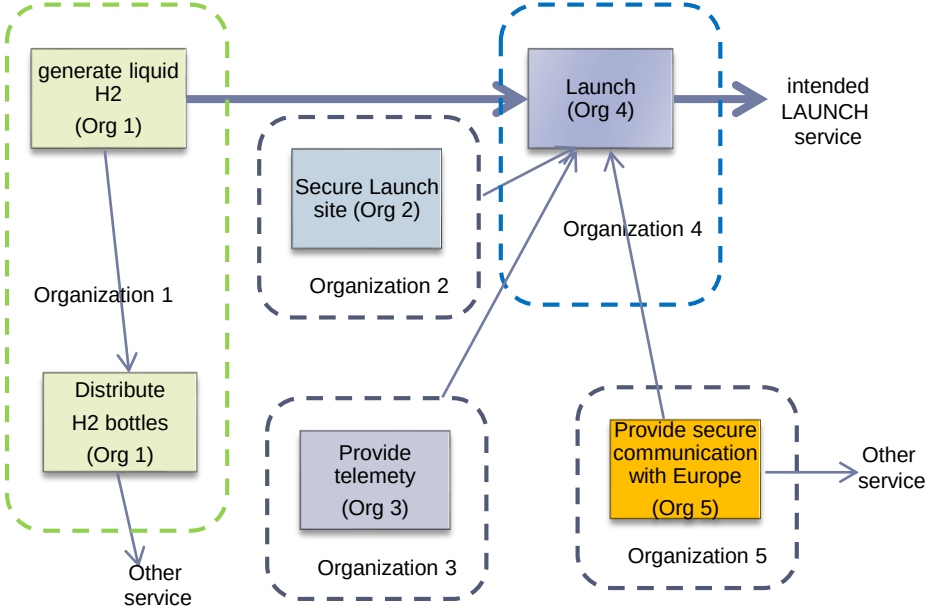
- allocation of responsibilities and workshare,
- business cases assumptions,
- and pricing policies

Launcher System example (1/2)

- The Launch Service (LS) provider first identifies the high-level service requirements: e.g. inject a satellite at a given orbital position and with a given velocity, with cost and performance requirements (accuracy, availability, response time).
- Along with the System of Interest (**launcher**), a **production system** also needs to be defined with services to be provided by external actors:
  - **Transport services** from Factory to Launch base, to convey parts,
  - Services to **secure the launch base** and surrounding installations (to be provided by private companies and by national authorities)
  - **Tracking services**, using cooperative and non-cooperative sensors to monitor the trajectory and demonstrate that the quality of injection
  - **Fueling** services
  - And many services offered by the region, consistently with its own development objectives (roads, hotels, harbor, airport…)
  - . …

Launcher System example (2/2)

- **Uncertain parameters**: number of launches per year, the advance notice time, the number of people needed to operate the various services …



Conclusion

1. To initiate teaming, some information must be shared: **SE should start before agreement**
2. **Limited knowledge** is a reality to be captured
3. A **SE framework** is a pragmatic to approach to de-dramatize the process to increase **mutual understanding** … and finally to reach an agreement
4. The **Value network** (based on the network of services) needs to be understood by all parties
5. **Uncertainties** should be identified by all partners
6. The shared model will be an efficient to organize and develop collaboration (**MBSE**)

➔… More work is still needed to progress on such a framework.

AFIS Association Française d'Ingénierie Système

INCOSE International Council on Systems Engineering

Thank you for your attention