

# Collaborative research project's Value chain analysis and design

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## Foreword

The purpose of this document is to propose a set of tools to facilitate the analysis and design of the business strategy of any ITEA project. The proposed approach makes possible to identify weaknesses and possible corrective actions: better coverage of developed technologies in larger markets, redefinition of business model, evolution of the project's purpose and / or consortium. It is therefore recommended to start the analysis & design of the “business design” in the upstream definition phases of projects.

## Introduction

The main objective for an ITEA project is to innovate for actual exploitation. Industry players have to explain how the project will serve their own economic interests (mainly producing more value for the company), which can only be accomplished if the project is realised. There is thus a confluence of individual interests materialised by the proposal of a project. Unfortunately, the confluence of business individual interests is seldom explained. Some partners often explain their business individual interests with no assumptions on how other participants will interact at the business level with them to help achieving it. In the past, this has led to large business crashes. E.g. a few years ago, the media community put a huge amount of effort to define a system solution for mobile TV (standardisation, computing solutions, software, encryption) and a lot of SMEs invested on this new promising market. But when the commercial discussions started, the Telcos explained to the media companies they would have to pay for the transport of their contents while the media companies were expecting the Telcos to pay for having access to their contents on their networks. There was no agreement on the value chain organisation! The result was that the solution was not deployed and several SMEs became bankrupt. But a lack of shared understanding of the value chain is not the only issue; sometimes business models are not viable because even the customer identity does not appear so clearly.

Some guidance has to be put in place to mitigate these issues; this is the purpose of that document through the concept of value chain analysis. Value chain analysis is introduced here to solve the business consistency issue and help engineer an overall project's business case from the inception to the exploitation phase including steering the ITEA project itself. Formalising a value chain helps to explain the causal business links between the partners' own interests and the shared objective of the project. Value chain analysis also includes key actors involved in serving the customers or the end users even when they don't belong to the project per se in order to clarify to whom to deliver the business value and articulate the proposed value proposition that makes sense only to its recipients. In the mobile TV market, a value chain analysis done at the beginning of the innovation process would have shown business model inconsistencies between the Telcos and the media companies and would have stressed the need to solve the issue before investing massively in R&D.

As innovation requires more and more composite technological solutions implying several partners' participation, one cannot accept not understanding how the business will be organised as it has a potentially significant impact on the solution, furthermore sometimes enabling new businesses constructions.

Value chain analysis encompasses different concerns when analysing potential business:

- How the value is generated by progressive transformation from actors to actors.
- How actors are rewarded from value transfer.
- How the environment may hinder or facilitate value creation.

The next section is organised according to that structure.

## Value chain analysis

### Value chain analysis objectives

A project is considered as a precursor of future businesses; partners are collaborating together to prototype future business relationships which need to be established or re-enforced to create value for business participants. Therefore, we need to design what is the project's shared vision of what these future business relationships will be and test their soundness, consistency and strength without forgetting actors outside the consortium that will influence the relationship with the customers and the end users. It is essential to understand that value chain analysis and representation does not intend to describe how the project's partners collaborate during the project execution. Instead it represents:

- A shared vision on how the participants will execute business once the project is completed.
- The intellectual assets which must be transferred in order to enable the new business configuration to be set up.

We will be interested in three different concerns that are essential to analysing the business potential:

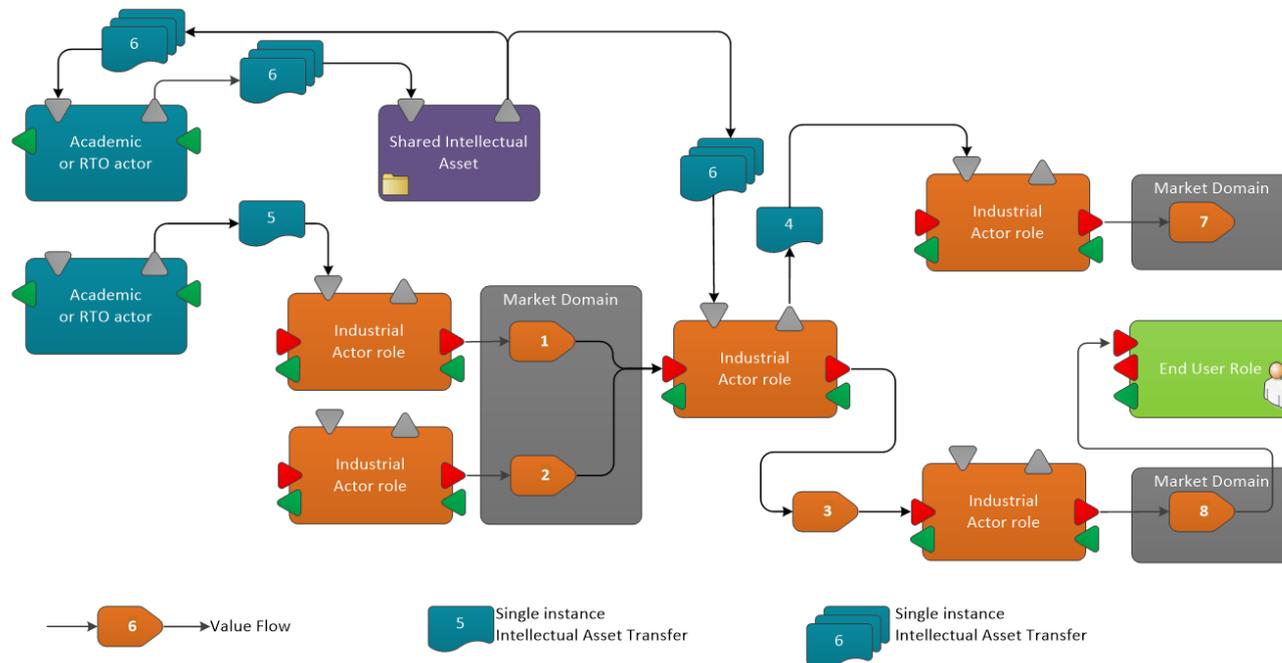
- Value creation: How the project's integrated solution is built by progressive aggregation of values flows from business participants. This will foster the generator and the receiver of the value flow to work on contract agreements value flows.
- Cash reward: How value chain actors are rewarded for value delivery. This will help the generator and the receiver of the cash streams to work a pricing policy which is acceptable for the parties.
- Influencers: These are the actors and factors that allow or prohibit a value offer to a specific market. This will help make the business potential analysis, with consideration of real world constraints, more realistic.

For the sake of clarification, we use "Value Chain" in that document to mean an overarching concept encompassing the two perspectives: value flow representation and cash reward. Analysing the environment, the actors and factors are part of "Value chain analysis", the activity which tries to demonstrate that the value chain is realistic by considering real world constraints.

### Value flows representation

A value flow diagram is a graph orientated towards one or more customers and end users operating in the same business domain and represents how value is created by progressive aggregation of values flows from business participants.

The following figure is a value flow representation containing all the notation elements that are discussed afterwards<sup>1</sup>.



*Figure 1 Value flow we must represent a customer which can be different from the end users*

A value flow diagram is represented as a directed graph (here from left to right) where economic actors collaborate together in order to produce some kind of good or service. It is key to representing the customers and end users that may provide invaluable information on market size and segmentation. Economic actors can be either business or academic actors that may contribute to the value chain through patent transfer or open source repository development necessary to deliver the expected goods or services. Academic actors are not the key actors of the value chain in the analysis of the potential of a business; but their role may be central to enable a business actor to become capable to deliver.

Economic actors consume input value flows and transform them into output value flows. A value flow is an exchange of goods or services between a producer and a consumer of that value. Figure 2 shows an example of value flow transformation. In car manufacturing, plates of steel enter in the value creation process run by car manufacturers. Steel plates are transformed into cars which is the output value flow. Steel plates become part of cars.

<sup>1</sup> Icons used in the value chain representation in PowerPoint version are available in the ITEA Call 2022 binder.



Figure 2 Car manufacturer Value flow transformation

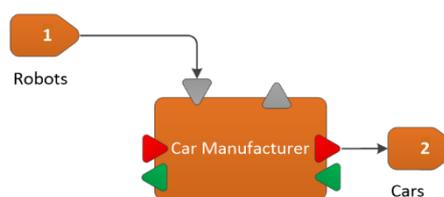
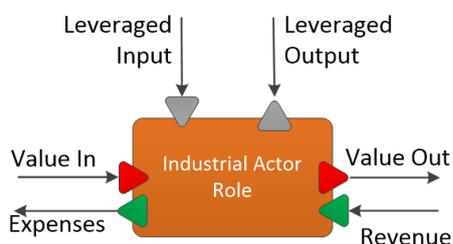


Figure 3 Robots as a leverage value flow in car manufacturing

A second kind of value transfer exists: The leverage value flow. A leverage value flow is a value transfer towards an economic or an academic actor that has a leverage effect on the value transformation process of the receiver. It participates in the value transformation process without becoming part of it (here arrows on the incoming triangle of the Actor role). The leverage value flow may have two different impacts: Either it can improve the efficiency of the output value production process without changing the nature of the value flow so generating more incoming cash streams, or it can be an enabler of a value shift. By value shift we mean generating a new kind of value flow, different from the one that the economic actor has been able to produce so far. Figure 3 shows that robots are a leverage value flow in the car manufacturing business. Robots do not become part of cars but add value in the cars whereby using robots in the manufacturing process we can expect higher quality cars, or cheaper cars; in other words, generating more value for money.

The notation elements are more systemically described in the following text:

#### Industrial actor



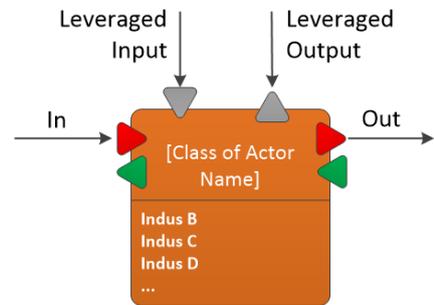
*An industrial actor is an entity role that consumes one or more input value flows (left input arrow) and produces one or more output value flows or intellectual assets (right output arrow) in a specific market. By role, we mean that the industrial entity is reduced to its interaction in a specific market. E.g. Thales sells railway signalling systems and satellites, which are two different markets and thus correspond to two different business roles.*

*An industrial actor activity can benefit from additional contributions involved in the value creation process, in the form of leveraged value flows or intellectual assets that have a leverage effect on its value creation process (vertical inbound arrow). These are called leveraged inputs. The value entering from that leveraged input entry is not integrated into the outgoing value stream; it helps make the transformation of input value flows into output value flows. For example: Academic knowledge, design environments / simulation tools helping to define products, manufacturing machines, and open-source code are all input values which improve the value created. It may also occur that an industrial actor also produces output leverage value flows, values which are not core elements of its business model. For example, a patent which is transferred to a third party.*

An industrial actor leverages its production process with revenues and expenses. No value flow is exchanged between actors without counterpart in the form of revenues or expenses. Therefore, the revenue flows may be important to capture to clarify the business case for value delivery.

Class of actors

A class of actors is a facility provided to simplify the value flow diagrams. A class of actors identifies a set of actors roles which play a similar role in a value chain: All the actors part of the class of actor receive all the incoming value and revenue flows and intellectual assets and produce outputs that may be different but on a single market description.



The class of actors has a generic name. The name is written into brackets and italic; a second quadrant is defined where all the names of the actual actors corresponding to the class of actors are listed.

Value flow

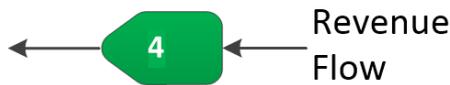
A value flow is a flow of products or services. Value flows are different from revenue flows that may follow a different path than value flows. How revenue flows are captured will be described in the next section.



A value flow is an exchange of goods or services between a producer and a consumer of that value. Goods and services are produced in unbounded multiple instances. For example, cars leaving a production line, video-on-demand movies etc.

Revenue Flow

A revenue flow is a flow of currency which is a counterpart of a value flow.



Currency exchanges may be recurring or not. Non-recurring exchange of currency occurs, for example, for patent acquisition. Recurring exchange of currency may occur for reward of value flows. For example, annual

subscription fees for a service. Composite currency flows may exist, for example, when there is an initial licence fee plus an annual renewal licence fee.

Market domain

Industrial actors deliver value in a given business domain or target their offer for a target business domain.

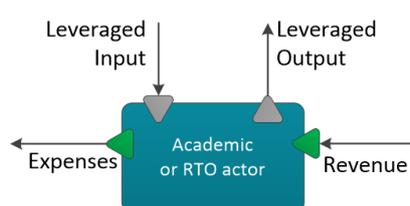


A market domain is an area where suppliers and customer actors complete value flow transfers. They are represented according to the left-hand side formalism.

*A market domain is where the competition operates value flow transfers toward our targeted customers. If the R&D project intends to deliver an incremental or disruptive value proposition into a market domain, it is essential that the disruptive value proposition is articulated in the proposal. There will be a chapter dedicated on market analysis in the next sections.*

### Academic actor

Academic actors' fundamental goal is not to deliver products and services into a market; it is to deliver intellectual assets to economic actors that are more efficient at creating new kinds of values to markets (what we call innovation) or at improving existing value flows. An intellectual asset is discrete compared to a value flow: academic actors transfer intellectual assets non-recurrently or incrementally, while value flows are continuous (repetitive) exchanges. Representing academic actors in the value chain clarifies their catalytic role in the value chain: if the intellectual asset is not transferred, economic actors are not able to provide the value stream corresponding to the promises of the project.



*An academic actor is similar in every respect to an industrial actor except that it produces and consumes only leverage value. There is no value flow production in any dedicated business market that is ruled by competition. The leverage value takes the form of intellectual property or intellectual assets.*

*Of course, this is a reduced definition of academics and RTO. E.g. It is often the case that RTOs sell access to some prototyping infrastructure for industrial experimentation. This is a transitional situation necessary to enable a technology transfer at a later stage. Remember that we are interested in the targeted value chain definition; a transitional situation may occur during a project but should not last.*



Single Instance Intellectual Asset Transfert

*A transfer of intellectual property corresponds to a non-recurrent transfer of intellectual asset like some knowledge corresponding to patents, property rights etc.*

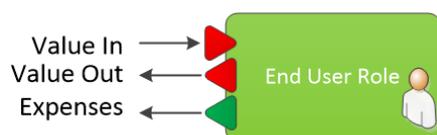


Multiple Instance Intellectual Asset Transfert

*This representation is adopted when several instances of the same intellectual asset are transferred like open-source code updates.*

### End users

End users are individuals, consuming products and services available in the public market.

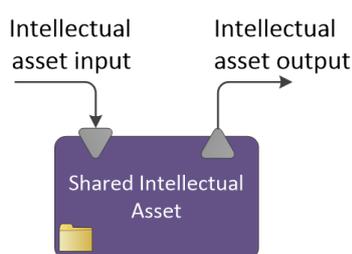


*An end user lives in the public sphere, is a consumer of value flows, can generate currency flows (typically when paying for goods or services) and may be also able to generate value flows. E.g. collecting data from end-user experience generates a value flow.*

*By their very nature, economic actors at the start of the value chain (left-hand side of Figure 1) produce the most generic technologies in the value flow while at the end (right side of the figure) we find vertical domain actors (automotive, energy, health, etc.) producing the least generic technologies and applications which are the closest to the social sphere.*

### Shared intellectual assets

**Figure 1** also represents a type of role corresponding to the management and sharing of intellectual property assets (typically corresponding to the open source model). This type of entity does not produce value on its own; contributors who exchange intellectual assets with this intellectual storage facility generate value through the use they make of shared technology.



*A shared intellectual assets repository receives and makes available an intellectual value to other actors, whether industrial or academic. This value may or may not be the materialisation of accumulated knowledge.*

*The extension of these accumulated intellectual assets is produced by increments of any actor using the existing content (outgoing arrow) and storing an extension or modification to the repository (incoming arrow).*

*An actor may, of course, simply be a consumer of an intellectual asset without contributing to its improvement.*

### Example:

Figure 4 represents an example of a (theoretical) value flow targeting the improvement of electricity production in the wind energy sector. It should be noted that the represented value flow is only a small part of the real value chain.

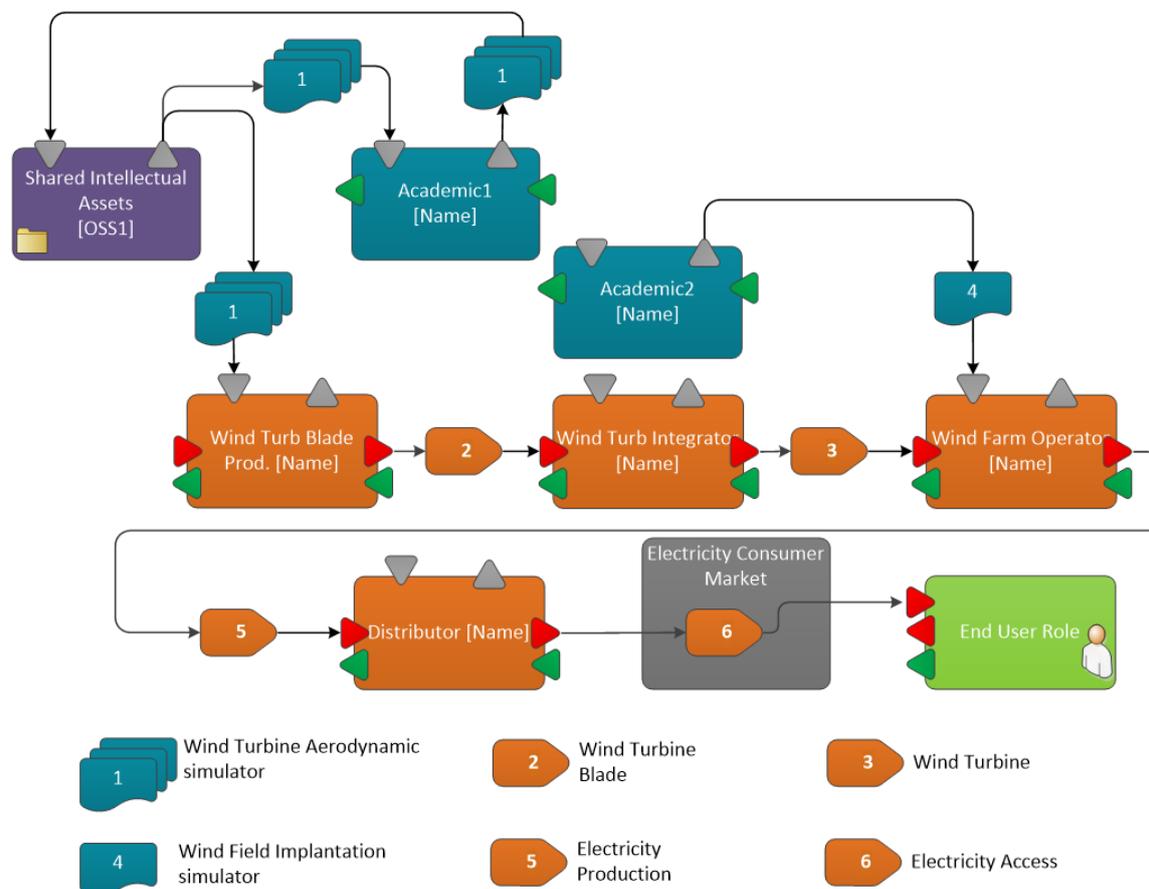


Figure 4 Theoretical example of an electricity production value chain.

Academic1 maintains an OSS repository “OSS1”. The content of this repository, which is a Wind Turbine aerodynamic simulator, is used by the Wind Turbine Blade producer industrial actor as a leverage technology. Academic1 regularly updates the aerodynamic simulator, thus creating updates which are pushed to the Wind Blade Producer. In that example there is only one contributor to the shared asset but in general there may be several contributors to shared asset repositories.

Academic2 makes a one-off transfer of a wind field implantation simulator to a wind farm operator. Once the transfer is completed, Academic2 doesn't own anymore the property of the Wind field simulator. There may be other patterns existing such as the granting of a licence for a limited period of time to its receiver for exclusive or non-exclusive use. One should represent all these situations the same way while the textual description of the value flow should clarify the details whenever possible.

The wind turbine blade producer produces a flow of wind turbine blades which is consumed by the wind turbine integrator. The wind turbine integrator produces a flow of wind turbines.

The wind turbine blade producer and wind turbine integrator operate within the wind turbine manufacturing market.

The wind turbine flow is consumed by the wind farm operator that installs and operates the wind farms. It produces electricity to the electricity distribution market. In order to deploy more efficient installations, it has acquired the property of the wind field implantation simulator. This simulator is a leveraged value transfer making its activity more productive.

The distributor actor operates in the electricity distribution market. The distributor transfers a flow of electricity access to the consumer market.

It is also interesting to stress that this value chain may accept other variants:

- There are some cases where the distribution is not the customer of the electricity producer but the provider and in this case the end user is the customer of the electricity production when his first contact is the distributor.
- We can also imagine having another actor between the distributor and the end-user which actually would be the final customer when the end users are not at all a customer (E.g. Think about the social departments of cities supporting electricity access for some of the population).

## External environment

Delivering value to customers is not only a question of balance between a value proposition and pricing. There are other factors that may have a decisive impact on the capability of a new offer to generate new deals with potential customers in a market domain. These factors are external to the actors involved in the transaction, but they may rule the business. These factors need to be identified as they may be powerful enough to deny or facilitate a business relationship between business actors. They are four types of external environment factors:

- Influencers
- Professional syndicates
- Standardisation organisations
- Regulation and certification authorities

The **Figure 5** suggests a representation for the factors that apply to a market domain.

Influencers are business actors such as large integrators that impose rules on their market domain, such as AIRBUS that defines the rules for procurement with which their subcontractors and sub-sub-contractors need to comply. It is important to be aware about these constraints before talking business with their sub-contractors.

Professional syndicates are professional organisations in direct touch with the professions; they strive to protect the interests of the members of their respective professional branch or branch of activity. They have the power to impose constraints on a specific business ecosystem in which the customer to which a value proposition is intended to be delivered is located.

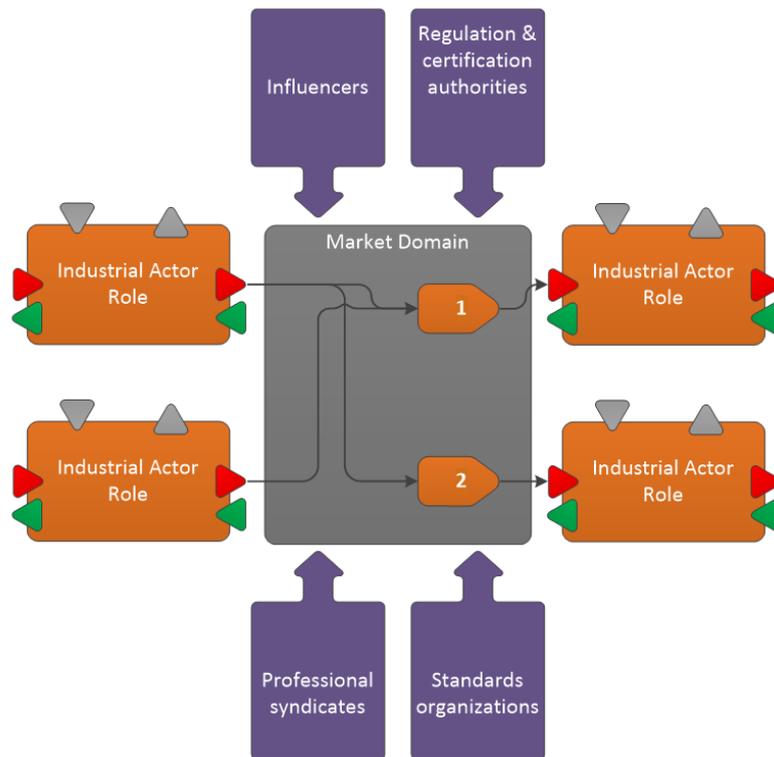


Figure 5 Environment constraints

Standardisation organisations are another kind of environment constraint or opportunity. The customer maybe part of it or even the supplier of a value proposition may be part of it. Standardisation organisations define standards but do not monitor their application. Still, it is important to understand:

- who is a part of the standardisation organisations to follow where standards are heading;
- if the value proposition discussed needs to comply with the standard and needs to remain compliant with it in the long term;
- who can help in maintaining the standard in a way that is favourable for the value proposition supplier.

Regulation and certification authorities are slightly different from standardisation authorities. They are in charge of certifying that constraints and rules are fulfilled by products and services. Regulation and certification authorities behave as barriers for new actors entering existing market. One should not neglect the importance of those organisations disabling new entrants to existing markets.

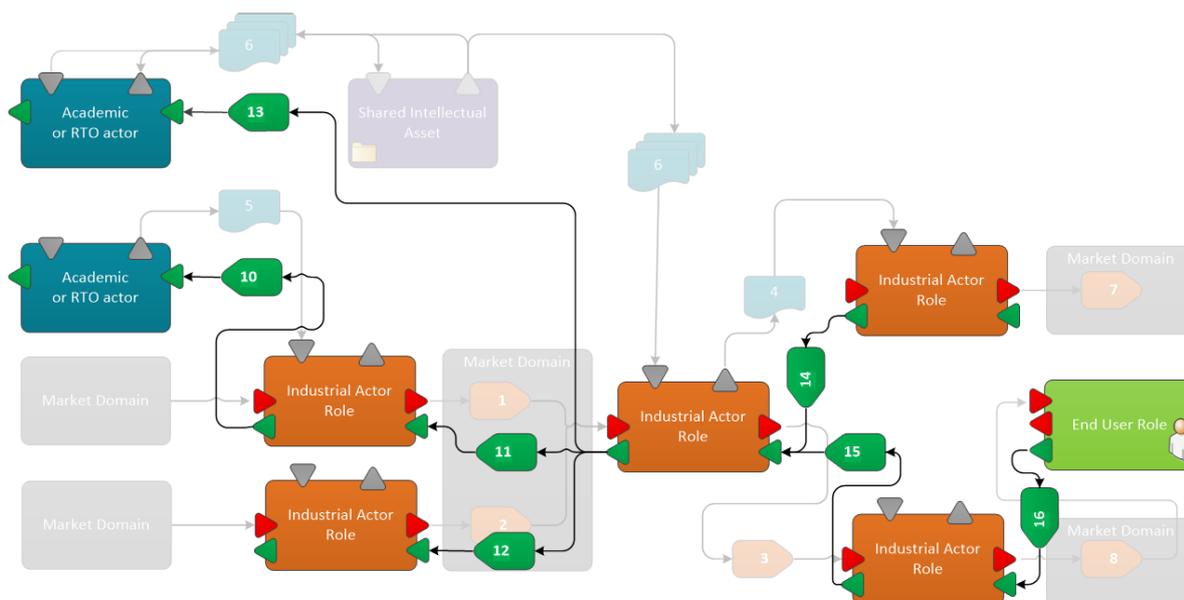
These four types of constraints that may apply to new business entrants are not independent of each other. Influencers often take a role in the definition of standards; they interact with certification authorities and professional syndicates. In a project's proposal it is therefore necessary to identify all the actors, links and rules that may have an impact on the business. Once this is achieved, it is necessary to describe the partner strategy to overcome the potential issues or to use this environment as a business facilitator, for example by participating in the elaboration of standards. The exploitation and dissemination section of a proposal are good places to highlight the strategy for overcoming the potential issues.

There is no need to analyse the external environment for each actor of the value chain. However, there is a need to perform the exercise for the disruptive value flows of the project: only the value flows which exhibit a kind of value proposition that may be disruptive in a market domain. It is seldom that there are several outgoing disruptive value propositions from a research project. The project's overall technology concept is usually the one that requires attention.

### Revenue Flow representation

As already stated, cash streams representation describes how value chain actors will be rewarded for value delivery. This will help generators and receivers of the cash streams to work a pricing policy which is acceptable for the parties and answer the question: Are all value flow receivers willing to pay for the proposed value proposition?

Starting cash streams representation from a value flow is straightforward. **Figure 6** shows the cash streams perspective derived from value flow described in **Figure 1**. Basically, circulating the value flows in their opposite way reveals the cash streams.



*Figure 6 Some revenue flow perspective*

However, there may be several variants for the above figure depending on participant's strategies.

- It is not mandatory for the industrial actor to fund academic or RTOs actor for the development and maintenance of shared intellectual assets. The development of shared intellectual assets may involve more sophisticated funding models so then they should be represented.
- It is often the case that industrial actors or end-users are not willing to pay for the value which is delivered to them. However, value providers are still delivering their value to them in exchange for some other value. Think, for example, of the provision of the Google document suite delivered free of charge to individuals. Accesses to user data or to user experience are two examples of the value that may be provided by end-users in exchange of the incoming value. In that case, the value generated from the end-user toward Google should be represented in the value flow diagram.

Representing the cash streams forces the business actors to ask themselves if there is a business case for their offer and often this can end up with the redesign of their business model, thus impacting in turn the value flow perspective and the products/services architectures. Then one should think about the cash stream perspective and the value flow perspective as two sides of the business between them, so one should iterate until both perspectives become balanced.

### Standard representations

In this section we go through standard representation.

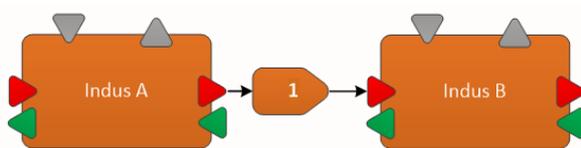


Figure 7

Figure 7 is the most common and simple case: Indus A is delivering a value flow to Indus B.

The Value flow is part of the standard business of Indus A. Indus B integrates the incoming value flow in its outgoing value flows.

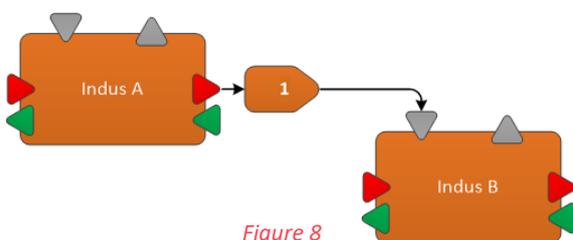


Figure 8

Figure 8 is a variation of the previous case. The value flow generated by Indus A is an enabling technology used by Indus B to support its production process. In the automotive domain, one example could be robots used by the manufacturing company to manufacture cars.

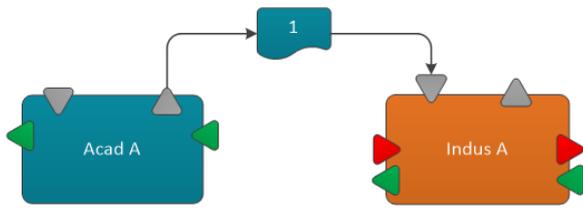


Figure 9

Figure 9 is a common business relationship between an academic actor and an industrial one: An academic actor transfers in one shot an intellectual property asset to the industrial which acquires the property of the asset. E.g. It may be the case of report a patent a source code elaborated by the academic who loses the property of the asset.

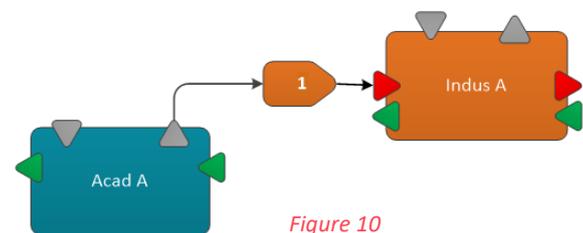


Figure 10

Figure 10 is another common business relationship between an academic actor and an industrial one: An academic actor grants a license to an industrial actor for integrating an intellectual property in a product/ services produced by the industrial actor.

A variation of this case is when the value flow is delivered to the leverage input entry of the industrial actor (no figure for that situation).

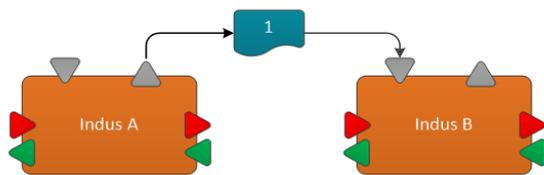


Figure 11

Figure 11 is more uncommon but may happen: An industrial actor transfers in one shot an intellectual property asset to another industrial actor which acquires the property of the asset.

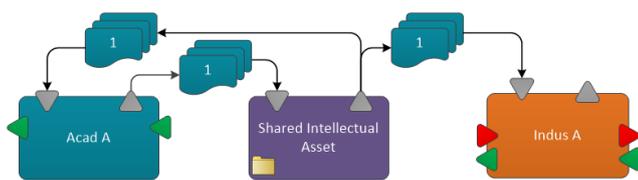


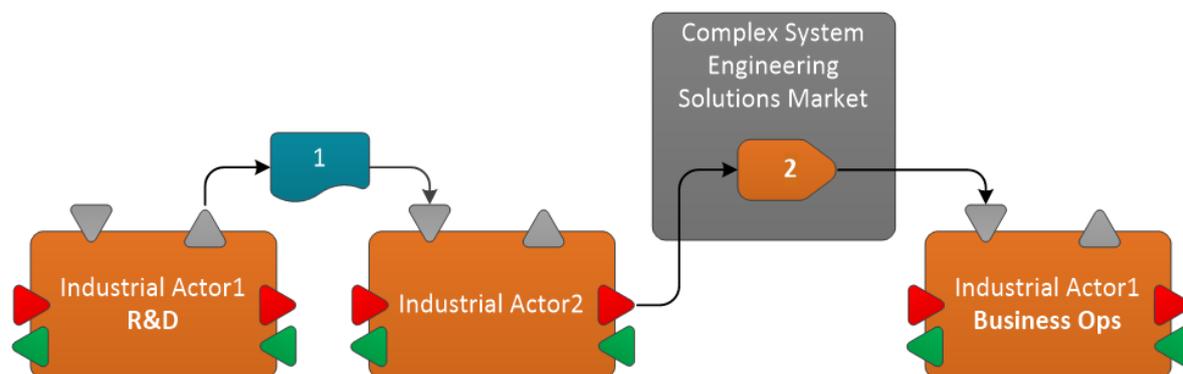
Figure 12

Figure 12 is part of the open source series. The academic actor contributes to the development and maintenance of an open source repository for a technology. The industrial actor uses snapshots of the source code to integrate and possibly modify it to generate an enabling technology for its manufacturing process. One can notice that it does not share any change made to the source code to the shared repository.

One can notice that it does not share any change made to the source code to the shared repository.

## Multirole business actor

There is a possibility for a value flow to have the same actor at different stages of value production process. [Figure 13](#) represents how this situation may be represented.



*Figure 13 Multirole business actor*

In this figure we can see that the Industrial Actor1 intervenes at two different stages of the value chain. There is nothing wrong with this as the value chain represents an industrial role within the value flow. Usually these roles correspond to different sub-organisations within a business actor. There may be several roles played by the same industrial actor which means that it can be involved in different markets, delivering different value flows. In the above figure, the R&D department transfers some intellectual property (e.g. a process, a technology prototype or a patent) to a second business actor that builds an offer from that input. That second offer is an industrial grade solution that can be procured by the business units of Actor 1. Since this was not the case with the intellectual property issued from the R&D department, there is a great business case for Actor1 as a whole to go that way. He has spent a limited effort (R&D) in the development of a solution and finally gets access to the industrial implementation of the solution at a reasonable price. Of course, this is possible as Actor2 is selling the industrial grade solution in a sufficiently large market that contains Actor1 Business Unit to make the deal viable.

Note: It makes sense to make such decomposition because an external value flow transit occurred toward an external actor. It would not have been necessary to decompose Industrial Actor1 into its different departments if it had not occurred.

## Dealing with class of actors

A class of actors is used when several actors play a similar role in a value chain. In research projects, this corresponds often to the situation where several use cases are handled to test an innovative technology in similar contexts to check the independence of the technology from a specific potential user. The class of actors aggregates all the project's Use Case providers in one single Class of Actors. These actors all are consuming the same input value flows and intellectual assets. These actors may use these input value flows and intellectual assets for similar or different purposes, so they may or

may not address the same targeted market. Figure 14 represents an example on how we represent such kind of situation.

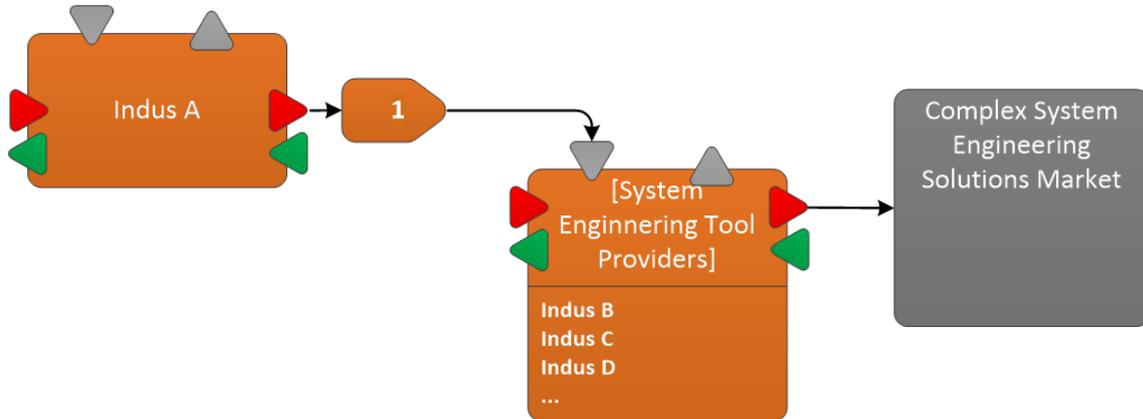


Figure 14 Set of actors playing an identical role in a value chain

It is important to note that all the input flows are destined to all the actors which belong to the class. Also, the value flows which are leaving the class of actors target the same market defined in a generic way. If this is not the case, it is preferable to split the class of actors in several classes. With that representation, it is not recommended to represent the individual value flow outgoing from the different actors of the class to the different markets as there is no way to state which actor is delivering which value flow. In that case it is better to complement the value flow diagram with another detailed one.

The following Figure 15 is an example of how we complement the Figure 14 by a detailed and local description of the value flows of the business actors from the class of actors.

- The generic targeted market splits into specific markets
- The different value flows outgoing from the actors are identified specifically for each actor from the class of actors

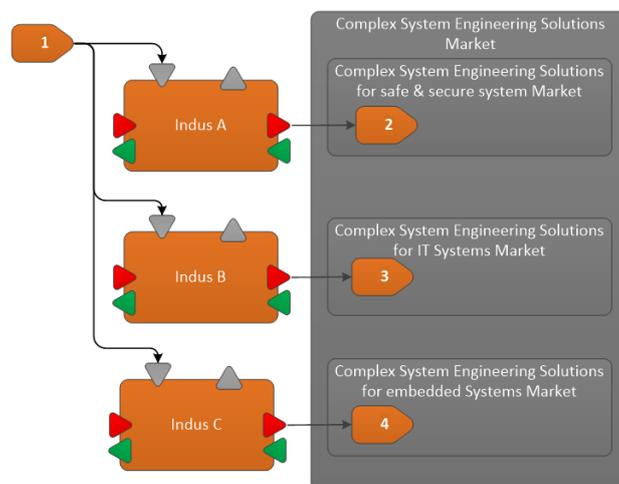


Figure 15 Complementing the class of actors diagram with detailed representation of how their inner actors are doing business