Cloud Computing in Europe

Appendix 3

H-CLOUD Analysis Approach

20th April 2020

h-cloud.eu

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Important Notice: Working Document

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CONTENTS

EXECUTIVE SUMMARY

This briefing paper is quite different to the other briefing papers that support the Green paper. This briefing paper is about the project itself and the thinking behind the approach in the green paper. It is about the process, rather than the content. The purpose of this briefing paper is to explain:

1) The detailed thinking behind of the deployment model
2) The wider thinking and ideas that went on, but that was too early, or detailed, for the Green paper.
3) How these pieces provide the basis for the direction of travel towards the Strategic Research, Innovation and deployment Agenda, (SRIDA), and its associated programme and scorecard.

The models in this paper are designed to be generative. This explanation is provided so they can be developed further by the readers to obtain richer insights.

Section two expands on the demand supply landscape model. It is merely a starting point for the development of the strategy maps as a frame for the SRIDA, were planned in the original H-CLOUD paper. It explains how the model can be developed into the strategy maps, strategic themes, programmes and measures for the SRIA.

Section three explains the choice of the demand side scenarios, why and how they were chosen.

Section four expands “deployment”. Deployment as adoption and implementation are expanded to include operation, maintenance and end of life. It is also expanded across the layers of the demand supply model.

Section five explains the evolution of the demand side framework. It provides some deeper thinking about the deployment framework that was not in the original green paper. Areas that may be worth exploration later. Section six explains the reasoning for the model used in the supply side.

Section 7 asks questions about validating the challenges and proposed strategies. These include:

- How do we validate the challenges and the underlying diagnoses of each challenge?
- If we treat any proposed strategies as a hypothesis, how do we test them?
- Given strategy is about choice: What do we choose to do, and not to do? How to choose?
- How do we identify those with the greatest leverage and the greatest potential for success?
- How do we create a discussion around the challenges, diagnosis, strategies and potential actions?

1 INTRODUCTION

This briefing paper is quite different to the other briefing papers that support the Green paper. The other briefing papers are about the content of the project (cloud computing, edge, green ICT, federation, demand side scenarios, etc.) In contrast this briefing paper is about the project itself and the thinking behind the approach in the green paper. It is about the process, rather than the content.

In contrast to the other briefing papers, this briefing paper is about the underlying thinking and process of the project. The other briefing papers are about the content.

The purpose of this briefing paper is three-fold:

1) To expand the explanation of the deployment model used in the green paper, so there is a richer understanding of the thinking behind it
2) To set out some of the wider thinking and ideas that occurred during the development and application of the framework, but that was too early, or detailed, for the Green paper.
3) To explain how these pieces, put in place during the Green paper development, provide a basis for the future work and to explain the direction of travel towards the Strategic Research, Innovation and deployment Agenda, (SRIDA), and its associated programme and scorecard.

The thinking and models described in this paper are designed to be generative. This explanation of the landscape model, the deployment framework and the analysis of types of deployment at different levels, are described so they can be developed further by the readers to develop their thinking and help to understand the thinking of others: to build on these frameworks and models, for clearer analysis and greater insight.

The models and thinking in this paper are designed to be generative, so they can be developed further by the readers and so they explain the thinking of others.

So, this paper has three main sections:

Section two introduces the overall model of the layers of the landscape. This expands on the explanation in the green paper and explains a little of its evolution and underlying approach. It also explains how the overall landscape demand and supply model is merely a starting point for the development of the strategy maps as a frame for the SRI(D)A that were planned in the original H-CLOUD paper. It explains how this supply demand model can be developed into the strategy maps, strategic themes, programmes and measures for the SRIA.

the landscape demand and supply model was merely a starting point for the development of the strategy maps as a frame for the SRIDA.

Section three explains the choice of the demand side scenarios. It explains why and how they were chosen and how they can be further developed in the project.

Section four expands what we mean by “deployment”. In the green paper, “deployment” was expanded to “adoption” and “implementation”. Distinctions were made between adoption and implementation in the demand side, and how supply side players think differently about these two ideas. Adoption and implementation are expanded to include operation, maintenance and end of life, taking a fuller asset management lifecycle perspective and linking the aspects of deployment with the challenges of green ICT. It is also expanded further across the layers of the demand supply model.

Section five explains the evolution of the demand side framework and how the various aspects of the two main dimensions (Organisational breadth) and complexity, emerged. It also expands on some richer thinking about the framework that was held back from the original green paper for simplicity's sake. Areas that may be worth further exploration later.

Section five describes the deployment challenges. This is an expansion of the explanation in the published green paper. It also explores an extension to the deployment framework. This extension

addresses, not simply the challenges of “deployment” within any of the boxes of the deployment framework but opens up the discussion about how an organisation might move between the boxes. For instance, how an individual organisation might participate in cross industry collaboration. This being distinct from the challenges of adoption and implementation amongst cooperating organisations. Such thinking was beyond the scope of the initial green paper.

Section 7 asks questions about validating the challenges and proposed strategies. These include:

- How do we validate the challenges and check that the underlying diagnoses of each challenge is correct?
- If we treat any proposed strategies as a hypothesis, how do we test them?
- Given strategy is about choice: What to do and what not to do, how do we make choices from amongst the strategy?
- How do we identify those with the greatest leverage and the greatest potential for success?
- How do we create a discussion around the challenges, diagnosis, strategies and potential actions?

2 OUR APPROACH: A DEMAND SIDE AND SUPPLY SIDE ANALYSIS OF THE DEPLOYMENT CHALLENGES

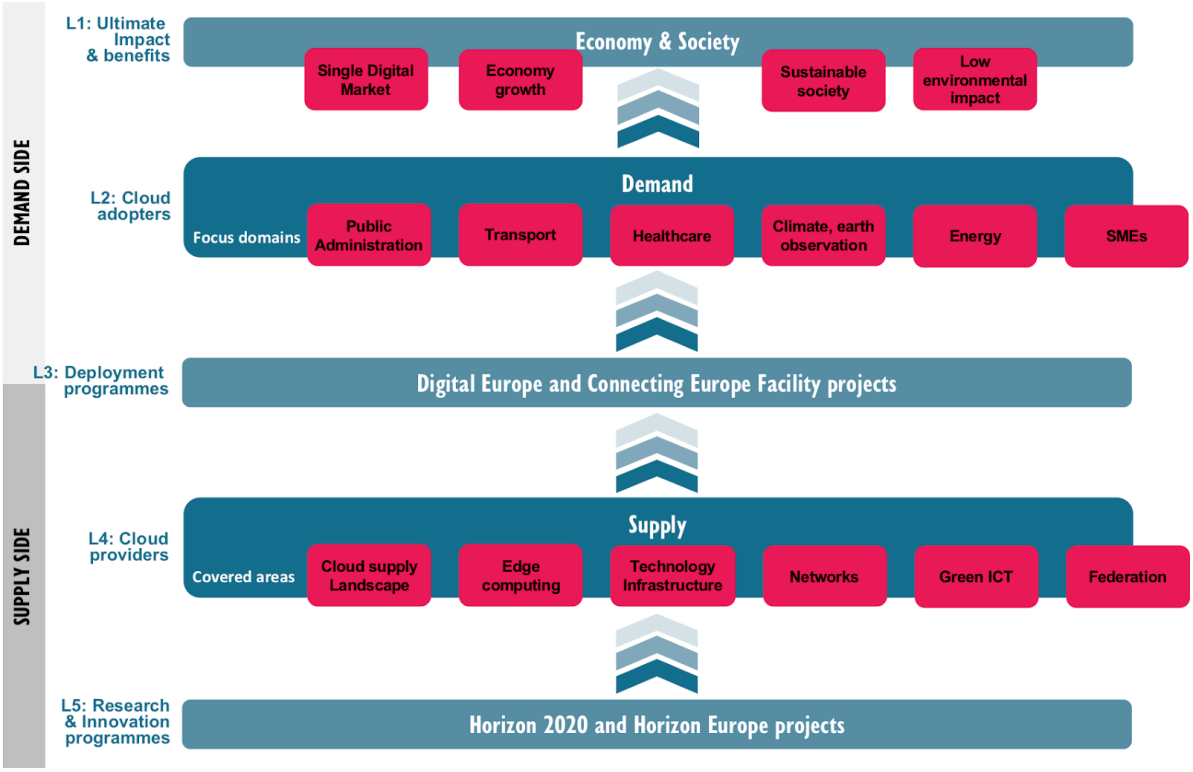
This section describes the overall demand side and supply side model being used. It explains how this demand supply model is only the basis of a much richer analysis designed to eventually develop the strategy maps and strategic themes, programmes and KPIs for the SRIDA.

2.1 The overall demand supply landscape model

To tackle the potentially wide and complex scope of this document and the EC's questions, the project decided to adopt a view of demand side and supply side. This is consistent with the deployment landscape model we showed the EC at the kick-off meeting (see slide below).

To tackle the potentially wide and complex scope of this document and the EC's questions, we decided to adopt a view of demand side and supply side.

The top of this slide (Level 1) shows the ultimate beneficiaries and outcomes. This layer relies on Level 2, the deployment and exploitation of digital and cloud technologies across industry and the public sector. We have called this part "The demand side".



This deployment layer relies on the supply side, which includes the landscape of cloud computing and the range of technology and resource providers that enable that deployment. Beneath this layer lies the Research and Innovation programmes and projects.

The demand side scenarios are designed to expose the variety of deployment issues.

In this paper we have expanded this model.

2.2 The landscape and strategy maps: the underlying approach, model development and direction

It was always the intention of the H-CLOUD project to use strategy maps and the strategy mapping approach to develop the analysis of the landscape and to frame and structure the Strategic Research and innovation Agenda. This approach is based on the work of Excitant Ltd, and outlined in “Strategy Mapping for Learning organizations”, by Phil Jones.

It must be understood that the model of the landscape is not a strategy map. Rather, it is only the first step in moving towards a strategy map. A strategy map is developed in layers, or phases.

This is a landscape model. It is not yet a strategy map. There are phases of development to be followed until a strategy map can be developed.

The first phase is to develop the underlying structure of the model. In this case the four levels (or layers) of the demand supply model. This creates an underlying cause and effect relationship. Having this underlying cause and effect relationship correct is fundamental to the further phases.

The second stage is to place upon this core cause and effect model, the principles parts of the landscape. In this case for the demand side we have choses the deployment programmes of the EC, alongside the demand scenarios that were chosen for the demand side analysis. The clearer one is at this stage of the components and players, the easier later phases will be. This is sometimes referred to as “the operating model”.

If you have a clear operating model of the landscape, it is then possible to overlay the challenges on that model. In the case of the analysis in the green paper it was clear that the variety of the challenges in both the demand and supply side required a richer picture of that layer of the cause and effect model. Hence the demand side challenges being categorised by the deployment framework and the supply side challenges being summarised in a richer picture of the supply side players.

Once there is a clear operating model, the challenges can be overlaid, and the challenges diagnosed to develop strategies to address them, as a set.

This is typical. It merely highlights that the challenges are often of a different structure and naturally group together differently to the way the landscape is viewed. However, it would be easy to overlay the challenges onto the landscape, were the structures of the demand side and the supply side suitably refined. The green paper stopped short of this mapping.

2.3 Moving from challenges to strategic themes

At this stage the challenges start to hint at the potential structure of the strategy. Rather, it suggests a number of strategic themes that might link layers of the landscape. Strategic themes are orthogonal to the layers of the model. They cross the layers, and each has a cause and effect model with clear drivers of change across those layers. For instance, in the supply side there are clearly themes of challenges associated with the providers of IaaS, PaaS and SaaS, and separate themes associated with edge computing, with network capacity and the landscape of technology providers. Each of these has different effects on aspects of the demand side layer.

The strategy for deployment will have strategic themes. These are orthogonal to the layers of the model. The identification and choice of these strategic themes is fundamental to good analysis and ultimately effective implementation.

Likewise, the demand side deployment framework suggests that there may be demand side themes (to be the subject of a more detailed analysis) of:

- Simple deployment challenges,
- data protection and security,

- data federation across industries,
- the deployment of complex edge and AI technologies,
- highly collaborative deployments such as smart cities

Note these are not necessarily themes extracted from the axes of the deployment model, but consistent themes exposed across the model.

Only at this stage of having identified “Strategic themes” is it sensible to start exploring strategies to resolve the challenges in those themes. A fuller analysis will adopt a “Good Strategy, Bad strategy” approach and seek a clear diagnosis of the underlying reasons for each challenge, before starting to suggest specific strategies that should address that strategic theme.

At this point you can start to create the strategy map, with a clear strategy that has a cause and effect relationship changing the objectives and outcomes across the layers of the strategy map, positioned on the underlying cause and effect model and operating (landscape model).

Only once you have this “strategy map” can you sensibly look at programmes of change and specific initiatives within those programmes. In this case there may be programmes of change within the players or strategic themes) in each layer of the landscape. These programmes of change can then be aligned with the strategic themes on the strategy map.

Ultimately, once you have the strategies, described in strategic themes, it is possible to overlay the programmes of change and the measures to track and manage those strategic themes as they ripple through the underlying cause and effect model.

Of course, these themed programmes can be the programmes of change ultimately set out in the Strategic Research and Innovation (and deployment) Agenda (SRIDA)

The final phase of overlay on a strategy map is to identify measures of progress at each layer and within each strategic theme. These can then be brought together to create a “balanced scorecard” of KPIs that can be used to track the progress of the strategies and programmes across the layers of the landscape.

2.4 Developing the strategy maps and strategic themes to address deployment and the SRIDA

It is normal in these sorts of exercises to develop a cascade of strategy maps. The high level one, cascades, usually by strategic theme, into more detailed strategy maps that expand the challenges, strategies and programmes of change for that theme. These can then be owned by separate parties who call contribute to and manage their part of the overall strategy.

Fundamental to this is identifying the correct, in the sense of most appropriate, set of strategic themes. In part this is also about choosing what layer of the landscape to have those strategic themes pivot around. For instance, the EC initially focussed on edge, green and federation, which are clearly pivoting on the supply side of the landscape. An alternative would be to use, say, industry themes and within each theme, have specific technology sub strategies. Choosing how best to cascade and structure the set of strategy maps is a matter of judgement and expertise. A whole chapter of Strategy Mapping for Learning organizations is devoted to examples of these cascades, each which serves a different purpose.

Fundamental to developing the correct cascade of strategy maps is identifying the most appropriate set of strategic themes.

Finally, it is important to remember that these strategy maps are a means to an end. Their purpose is to picture and capture a strategy so it can be learnt from and managed. The important part is to use them to manage the programmes of change and recognise when to refine and adapt the programmes or even the, higher level strategies, as the programmes are implemented and develop.

The purpose of strategy maps is to capture the strategy so it can be learnt from and managed.

3 THE DEMAND SIDE SCENARIOS AND DEPLOYMENT ANALYSIS

For the demand side analysis, we wanted to expose the diversity of deployment challenges that would illuminate the supply side and the cloud, edge, green and other issues. We therefore created a set of demand side scenarios. We choose ones that, as a set, would expose a variety of demand side issues. For the purposes of this discussion, we defined the demand looking at Digital Europe Programme (DEP) priorities. We choose:

We choose a limited number of stretching demand side scenarios (from the DEP programme) to explore the wider cloud, edge, green ICT and federation issues.

- Public Administration,
- Transport,
- Energy,
- Healthcare and
- Climate

since these sectors were explicitly referenced as priorities for federated cloud in the draft orientation for the Digital Europe Programme. To provide a horizontal dimension of demand, we also considered the needs of small- and medium-size enterprises (SMEs).

We have clear links from the demand side scenarios chosen and the various EC initiatives.

This section explains the thinking behind those choices.

3.1 How did we choose the Demand side scenarios?

The question was how to create a sensible set and manage the complexity. The criteria we choose was:

- Individually, they test and illuminate things about the Cloud computing landscape in general, and specifically for their sector
- Collectively, they provide different lenses on the landscapes, to highlight different aspects.
- They stretch and expose issues in the current models or landscape of cloud computing
- To choose scenarios that they clearly were related to the EC programmes. This is explained in the Green paper.
- The final criterion was having some expertise in the H-CLOUD project that could develop the scenario.

The challenge with these, was how to avoid making these scenarios superficial and bland? We need enough substance to make them substantial tests, but not to create a lot of work that would have been impossible to manage. Also, it was important that there was minimal duplication amongst the scenarios. In part the choice was determined by looking at the demand scenarios from two sides:

The challenge was to represent the complexity in the demand side with just a few scenarios yet expose the breadth of challenges across the complex landscape

1) In this domain (Industry/demand sector) what are the characteristics we are seeing for future computing?
2) Given what we know about the cloud landscape, and technologies, and the EC policies, etc., what do we think this domain's example might highlight?

3.2 Each demand scenario is a test case, to be developed and refined

So, each demand scenario was developed as a briefing paper and summarised in the Green paper. It needs to be understood that each domain scenario is effectively a test case: a test case chosen to provide a lens and illuminate cloud issues. Each scenario is far from exhaustive and can easily be refined and developed later as the H-CLOUD project develops and more knowledge and experience of

the domain specific issues is gathered. This thinking led to the chosen sectors and the briefing papers behind the summaries in the green paper.

It was this set of scenarios that we used to highlight the variety of challenges and then position the challenges in the deployment framework. The framework allows us to expose specific issues from each demand side, to identify issues in the broader supply side, and to go deeper into the research and innovation programmes.

In doing so we have concentrated on identifying issues within the scope of the focus areas set for us by the EC, namely, cloud, edge, green and federation. These demand scenarios are not exhaustive. They are a starting point: we are happy that they are built on and expanded as the project develops.

These demand scenarios are not exhaustive. Others could be added. These exemplify the diverse demands side deployment challenges.

4 ADOPTION, IMPLEMENTATION, OPERATION AND MAINTENANCE, AT DIFFERENT LEVELS

The EC deliberately described our challenge as one of "Deployment". This section expands the meaning of that idea for different layers of the demand and supply model. In the Green Paper this "deployment" was clearly seen as two separate pieces: adoption and implementation. It was also clear that these happened in various ways at various levels of the demand/supply landscape model.

This section also expands the idea to operation, maintenance and decommissioning, which were not explicitly highlighted in the same way in the Green Paper.

4.1 EC deployment and richer distinctions across the landscape.

In EC terms, deployment is above the research programmes, particularly the Digital Europe and CEF-2 programmes. At the EC kick off meeting, they referred to the H-CLOUD project having to address Research and innovation ideas as in "Research, innovation and deployment" and described the originally scoped SRIA, as SRIAD. In other words, the deployment of the research and innovation.

This caused some confusion of language. However, in this wider demand/supply model, demand side and supply side players can be outside the deployment programmes of the EC. These commercial, public administration or industry players each have their own deployment perspective.

To avoid confusion with the EC's specific use of deployment, the project decided to use "adoption" and "implementation".

To get around this specific EC use of deployment, on the demand side, the Green paper initially focused on the two steps of "Adoption and implementation" where

- **Adoption** addresses the questions: "Is this right for our organisation, and what stops or enables us to consider taking it on?"
- **Implementation** addresses the question, "Having decided to adopt this solution, how do we make it work in our organisation, and make sure we and our stakeholders/clients can use it to our mutual benefit?"

So the green paper talks about the challenges of adoption and implementation in the demand side.

4.2 Beyond adoption and implementation: Operation maintenance and decommissioning

Looking through the use cases and supply side briefing papers, there is even more to this. Deploying edge technology creates operational challenges. The technology also requires maintenance. Eventually assets require decommissioning. This is beyond adoption and implementation. It is making sure the technology continues to function and has an appropriate end of life. This makes the analysis more consistent with the lifecycle delivery activities of ISO55000: 2014 for the management of assets of any kind. Clearly ICT equipment, and edge technologies fall into the class of Assets.

Beyond "adoption" and "implementation" are operations maintenance and end of life.

The supply side analysis does highlight aspects of operation, maintenance and end of life, for instance:

- Operation of edge technology and sensors at remote locations
- The effects of network reliability and growth in data volume from assets at the edge
- Upgrading software versions for widely distributed intelligent and smart assets.
- Maintaining security across widely distributed assets.

- Within the Green ICT briefing paper: choosing assets with an inherently long lifecycle, and how assets are ultimately recycled or disposed of.

However, to keep things simple, the green paper identified separate demand side adoption and implementation challenges, and classified them all under the broad, EC, heading of deployment. However, it should strictly also include maintenance and operation and their end of life. This is a potential area for further research or work.

4.3 Supply side adoption and implementation: a different perspective

For the supply side, the Green paper took these two of adoption and implementation but recognised that they were quite different sets of thinking for these supply side organisations. Supply side organisations are developing, selling and marketing solutions and resources. Therefore, adoption and implementation take on different meanings. Adoption is about whether to choose a technology that can be sold. "Implementation" is much more about how to create a value proposition with that technology and help clients take on and then how to sell and help clients implement that technology. The adoption and implementation questions for the supply side mirror the questions on the demand side.

To avoid confusion with the EC's specific use of deployment, the project decided to use "adoption" and "implementation".

The implementation question becomes, "How do we best offer these services to the end users, to help them adopt and implement their solutions." And "How do we create a value proposition around this offering".

From the adoption perspective, each player is making decisions about the technology and infrastructure underpinnings that support the specific offering and value proposition. Underpinning both questions is the economic sustainability foundational one, "Can we create sustainable income streams from these investments?".

The demand side looks at its supply side options when they are making their decisions. The demand side players consider their long-term technology architecture framework, how to retain flexibility and avoid being locked into a dead-end technology. They want solutions and value. They want simple, reliable, commodity offerings in some areas, and sophisticated solutions in others, that will give them advantage and a potential competitive edge.

Each supply side player will ask these questions in different ways, depending on:

Each supply side player will ask these questions in different ways depending on their market position, technology directions and other long term implications of their choices.

- Its own position in the market (structure of its market segment, the potential for associations and affiliations, its strength and bargaining power).
- The range of approaches it can adopt (e.g. open source/proprietary, the rate of change of the technology options, emerging trends, the choices it and its competitors make, the architectural direction it has chosen to take, the standards it has adopted).
- The longer term social, environmental and economic implications of its choices

Supporting the supply side players, EC research and innovation programmes are developing ideas and solutions that could be adopted, brought to market and implemented in client organisations, either on the supply side, or the demand side. They will also consider the proprietary and openness of solutions and how they can protect or expand their market, given these choices. The way EC projects licence and

Against this background, demand side players are choosing what technologies they adopt and are building solutions with those technologies in the hope of solving their organizational challenges. So, the supply side of the Green paper explains both the structure

Against this Supply Side complexity, demand side players are trying to choose technologies and build solutions in the hope of solving their organizational challenges.

and nature of these supply side players, the implications for the supply side players and the consequences for adoption, implementation, operation and maintenance, for the demand side.

4.4 Research and innovation projects: Adoption and implementation questions

Though it was not covered in the Green paper, we can expand the idea of adoption and implementation to the Research and innovation projects.

Adoption would ask questions about the choices of projects, the choices of technologies adopted by those projects and the reasoning behind those choices. For instance anecdotal evidence suggests projects choose innovative technologies that allow the project to produce research papers. An example is the choice of research infrastructures and tools. Such choices may act against for or against a future adoption or deployment of the ideas or technologies within that project. Adoption might also extend to project participants, choosing that that will assist in later deployment.

Implementation may be about the choices the project makes along the way, for instance its choice of technology. Just as with the supply side, how a research or innovation projects "Markets" its results and insights will determine how easily its insights are adopted and used.

The implications of adoption, implementation and maintenance questions for the research and innovation programmes should be explored and validated more explicitly.

The implications of adoption, implementation and maintenance questions for the research and innovation programmes should be explored and validated more explicitly.

5 THE EVOLUTION OF THE DEPLOYMENT FRAMEWORK: FROM COMPLEXITY TO STRUCTURE

This section expands on the description of the deployment framework that was used to analyse each demand scenario and identify distinct types of challenge at different organisational breadths and different types of deployment sophistication.

While the deployment framework has been developed to generate insights into the challenges of deploying IT solutions to the cloud, it is not limited to cloud-based implementations and could be applied to any application of information and communication technology (ICT).

5.1 The evolution of this framework: breaking through the complexity

Starting with the demand side it was clear we needed a way to break through the complexity and breadth of this challenge. Therefore, the simplest way was to cut the problem down into distinct pieces of manageable size. The way chosen to do that was create a series of “demand side scenarios”. The plan was that these would act as a set of challenges to the supply side and to the research programmes. If we chose them well, they would highlight the issues across the range of challenges (or hopefully at least the main ones). (See appendix for the demand side scenario criteria)

When the members of the Advisory Board were briefed, each made a comment to the effect, “This is extremely complex”, “You are taking on a lot” and “Good luck with making sense of all that!”. It was clear we had a significant challenge to break down the complexity into manageable pieces.

This section provides the background to that thinking as the scenarios exposed differences amongst the examples within them.

5.2 Deployment was not a single challenge, but a variety of distinct challenges

It quickly became clear that “deployment” was not one single challenge, but a variety of distinct deployment challenges. By examining the challenges from the demand side scenarios, we were able to position the major recommendations from those scenarios into these quite different deployment types. This gives us a framework to look at specific deployment challenges in specific situations.

It was quickly realised that deployment was not one single thing. There were many variations with differing challenges. We needed a framework to hold and discuss the range of deployment variations.

Two useful classifications of demand side deployment emerged (which are explained in the following two sections):

1) The degree of sophistication of the deployment
2) The breadth of organisational reach of the deployment

When we looked at the demand scenarios, through the lens of these classes of deployment challenges we find three things

1) Various examples from the demand scenarios can be placed in each of these boxes.
2) There are specific deployment challenges inside the different categories. Some are specific to the complexity of deployment. Some are specific to that sector’s specific situation.
3) There are several challenges that are common to several of the categories.

5.3 Varying degrees of deployment sophistication

The degrees of sophistication are straightforward, ranging from simple to complex. They fall into three broad categories:

A. Relatively simple deployment and migration:

Our first dimension is the degree of sophistication of the cloud deployment:
1) Relatively simple migration,
2) Complex data security and protection.
3) Sophisticated cloud and edge exploitation.

   a. Individual applications moving to the cloud. Usually a simple cost justification.
   b. Multi-cloud or hybrid-cloud application and integration: usually an efficiency issue. Could be across a company or within an organisation's supply chain or customer reach.

B. Deployments requiring high data security and data protection.
   a. This can be in the nature of the data being handled itself.
   b. It can extend to external data, where data is brought together from multiple (external) sources (say climate research and insurance)
   c. The extent to which the data is distributed (i.e. data has been gathered and stored in multiple system and locations, perhaps operated by different organizations)

C. Deployments of more sophisticated edge and cloud technology. This can be
   a. Sophisticated technology (e.g. edge, AI or whatever).
   b. Potentially a competitive move, either defensively or aggressively.
   c. Combinations of technology and data deployments.

Although Category B might seem to be just a compliance issue, this analysis focuses on the complexity of the implementations required to achieve that compliance.

5.3.1 Type A: Relatively simple deployments and migrations to the cloud

Type A deployments are, in general, well known problems that have been solved in multiple cases. Individual applications moving to the cloud, is a 'commodity problem'. Many smaller organisations may struggle to apply the technology however, it is a well-travelled path. More complex organisations tackling multi-cloud and hybrid cloud deployment, Level 1b, is again a relatively common challenge and well understood. Both may require specialist skills, but the problems, solutions and skills needed are well understood. Larger organisations failing to solve these issues may fall behind competitors. This level of problem may be a significant part of an organisation's ICT challenge. However, it is relatively straight forward. Plenty of advice and process consulting (buying consultancy services from a supplier with a track record in this area) is available to address these issues.

5.3.2 Type B: Sophisticated data protection and security challenges

As cloud and edge deployment expands data security and data protection and privacy become increasingly important and complicated.

Type B deployments are more sophisticated with data protection and security issues. They present a different challenge. As deployments move from internal systems to the cloud, or data is collected at the edge, it becomes increasingly important to ensure the security of the systems and the privacy and protection of the data those systems contain. Data protection has two main themes: access restriction (restricted, confidential, secret, etc.) and usage restriction (public, personal, private, sensitive, etc,). As deployments get more sophisticated the potential for unauthorised access, hacking or even simple movement of data where it should not be, becomes important. Security becomes paramount. Directive 2016/1148 (the NIS Directive) of 6 July 2016[1] applies. More effort is required in the design of

[1] The NIS Directive concerns the measures necessary to achieve a high common level of security of network and information systems across the Union" and a link to: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016L1148&from=EN

applications and cloud use. As more parties are involved, mixing data sources, the complexity of this challenge increases.

5.3.3 Type C: Sophisticated deployments of cloud technology

As whole sectors of organisations get involved, the complexity of a deployment increases in challenge and complexity.

Type C deployments are the more sophisticated the application of sophisticated cloud enabled technology, (Level 3) the more complex the challenge. This is where potential differentiation and competitive exploitation lie, as well as wider benefits for industry and the wider population. Across a sector, the extent to which players implement such technology, will vary. It will depend on their business and services. Level 3 has distinct issues relative to those in level 1 (simple migration) and level 2 (Data protection). Whilst this more sophisticated application may be only a relatively small part of that organisation's challenge, it is the area where lies the most potential leverage and opportunity for their customers and the organisation's future success. The more sophisticated deployment challenges will require access to more sophisticated and specialist skills and knowledge.

Of course, there is overlap across these broad deployment sophistication challenges. Simple deployment needs data protection and security. More sophisticated applications also have to be very conscious of data protection and security. However, for our analysis, recognising these broad deployment sophistication categories helps us to break down the problem into component parts.

However, this is not the whole story. A further dimension of deployment challenge became apparent in our analysis.

5.4 The variety of organisational breadth at which deployment may occur

The second dimension is the organisational breadth of the deployment. 1) Relatively simple organisations, 2) Larger and more complex organisations and their ecosystem, 3) whole sectors covering multiple organisations, and finally to deployments involving multiple sector coordination.

The various levels of sophistication of deployment can occur at quite different levels, sizes and complexity. Each level introduces a new level of complexity to the deployment challenge. For instance, deployment in a single large organisation, is a different level of challenge to deployment across a whole sector of many organisations. Deployment of an application for a smaller organisation, is quite different to the much wider challenge of deployment across a smart city that involves the coordination of many parties from potentially many sectors.

We have identified broadly four main levels of organisational deployment challenge (In increasing degree of complexity and breadth):

1) Deployment of a technology in a smaller simpler organisation.
2) Deployment in a more complex organisation in a sector or industry (e.g. a motor company, utility or public administration organisation. This includes potentially that organisation's supply chain.
3) Deployment across an industry: So, extending a use across the utility sector, or energy sector. (This can include deployment of public administration applications across countries.
4) Deployment involving multiple industries or sectors. For instance, smart cities require multiple players, being coordinated.

Note that levels one and two avoid the simplistic description of SMEs vs larger corporate categorisation. Some smaller organisations can be quite complex, whilst others are far simpler. Both would be classed as SMEs on size alone, but that does not describe their deployment complexity. Likewise, some 'larger' organisations can be relatively simple in deployment terms. So, this

categorisation has chosen the approach of 'Smaller and simpler' vs 'larger and more complex' organisations, to distinguish the different levels of challenges.

5.4.1 Level 1: Smaller, or simpler, organisations

As the demand scenarios came in, it was started to become clear that there were a whole variety of different challenges across them.

The first obvious category came from scenarios that described relatively simple cloud implementation problems. They described small SMEs trying to adopt standard cloud applications and the problems they faced. This was across commercial and public administration examples. The EC had made it clear this was a well-researched and known problem and not something we should worry about. However, it was important not simply to throw them away, but find a box to place them in. So, these were classified as "Simple, single organisations, with relatively simple cloud adoption and implementation challenges.

However, amongst these smaller organisations, were two other interesting types of smaller organisations. Some were supply side technology organisations who were exploiting, developing and selling sophisticated cloud technologies. The others were smaller organisations in the demand side who were exploiting more sophisticated cloud technologies for their operational needs, or even for competitive advantage. Clearly, this sub-set of "Sophisticated" smaller organisations, needed to be separate from the simpler, more naïve ones.

The final piece of this was that the categorisation "SME" was not suitable. SME is a description of size and turnover. What we were looking at was a question of size and complexity. Some SMEs are quite complex organisations, which the designation SME does not reflect. So, the category was changed to "Smaller simpler organisations" to reflect this.

The categorisation "SME" was not suitable. SME is a description of size and turnover. What we were looking at was a question of size and complexity.

This gave us this initial categorisation.

Level 1, the deployment of a technology to a single smaller and simpler organisation, is a relatively self-contained problem. This still applies even if the level of sophistication is made more complex through data security challenges or the deployment of more advanced and sophisticated applications. The challenge is still relatively self-contained.

Again, this challenge works at various levels. Simpler application deployment may still require complex integration across parties. Data security and privacy challenges arise from multiple sources. The most sophisticated applications (edge, learning, AI, etc,) not only work individually, but as a set. This is the highest level of deployment challenge and sophistication.

5.4.2 Larger and more complex organisations, with relatively straightforward cloud deployment challenges

Clearly, this level of challenge was quite different to that of a larger corporate, with multiple lines of business, a complex supply chain, operating in multiple countries. Here the conversation was much more about hybrid and multi-cloud adoption and the complexity, not of how to start using cloud, but making choosing solutions and architectures that would work, managing interoperability, multiple different suppliers and solutions. (The IDC multi-cloud and hybrid-cloud slide pack illustrated this problem).

This was also the area where the hyperscalers (AWS, and the other large players) and the larger SaaS providers (i.e. SAP, Salesforce) dominated the market. They provided the simple solution, that was easy to implement, and for which there were often plenty of solutions providers and consultancies that had experience. This highlighted two aspects of this category:

1) The availability of "process consultants", that is consultancies who have a proven track record in the implementation of such applications or technology. Solving this is a "Common problem".

2) Avoiding sustainable competitive disadvantage (A common cause, amongst others, being locked into a technology that has gone down a dead end.)

The “Sustainable competitive disadvantage piece is important. In a rapidly evolving technology world, with multiple choices over technology, it is easy to choose a technology that looks ideal, only to find that it ends up a dead end. Others have become the de-facto standard. The Technology has not provided sustainable competitive advantage, nor has it provided simple efficiency. On the contrary, having that technology has “hamstrung” the organisation, locked it into a dead end and would make the organisation less efficient, rather than enabling efficiency and effectiveness. This is why expressions like “No one got fired for buying IBM” were common in the industry. Nowadays, the equivalent would be, “No one got fired for using AWS”.

Process consulting means that a solutions provider demonstrates they have a track record of successful implementations. They should be able to roll in an experienced team of specialists, at relatively middle to low rates, that can provide assurance that they can implement the solution in this particular organisation’s circumstances. Again, they are a safe choice for the organisation.

The complexity of this sort of organisational challenges should not be underestimated. These organisations have existing legacy systems, multiple lines of business, multiple customer sets, having ‘one version of the truth’ are all underlying indicators of the complexity that these organisations face. They have complex supply chains where suppliers are integrated into their core systems. They have multiple customer facing systems from distribution networks, where communities and customers interact with the organisation. Architecting solutions, migrating systems and creating new ones, are not simple problems. They are at least “Complicated”. They can be solved in a variety of ways. Solutions can be found, and many have spent lots of time and money addressing them. (Having been IT Strategy Manager of a large insurance company I have seen this first hand).

These sorts of deployments improve efficiency and effectiveness. They allow an organisation to keep up in their industry. They are the necessary changes and evolution that an organisation has to make, over time to renew systems and maintain a degree of competitiveness in their market, or cost efficiency and service in a public administration of charitable sector. In the technology maturity curve (see Geoffrey Moore’s *Crossing the Chasm*) most of these applications are in the early or late adopters’ category.

5.4.3 Level 2 Larger organisations: More sophisticated applications

However, larger organisations are also seeking a competitive edge and to exploit newer technology. Effectively operating at the leading edge of the technology (for example before ‘the chasm’, or as a relatively early adopter). The migration of standard lines of business to the cloud is different from the more sophisticated exploitation of advanced cloud, edge, AI, blockchain (or whatever) technology. This is not to underplay the complexity of the mainstream application of cloud technology. It is to highlight the quite different challenges of choice, skills, implementation and breaking new ground when making technology adoption choices and when implementing this type of technology.

The edge briefing paper highlights how organisations are faced with a dilemma over edge technology standards, networks, technology choices and return on investment questions, before they even reach the challenge of implementation and exploitation.

Clearly the framework has to expand upwards to accommodate this organisational breadth.

Level 2 is the deployment challenge faced by larger, more complex, organisations with multiple partners, channels, suppliers and customer groups. It is the complexity of the organisation and its applications that increases the complexity of the challenge. That challenge becomes even more complex as the organisation’s reach extends across countries (e.g. vehicle manufacturers) or across different applications (e.g. public admin organisations with multiple services). In these types of organisations, even relatively simple migrations of applications to the cloud can be a challenge. This challenge increases as data security and protection comes into play. Deployment of sophisticated solutions across a whole supply chain of across multiple countries and customers increase the complexity of the challenge.

5.4.4 Level 3: Cross industry collaboration

Further analysis of the demand scenarios identified situations where the players in an industry were collaborating.

A simple example of this is where a set of utility providers across a country decide to share data on the state of their assets, or energy providers start to share data about energy distribution and consumption.

Deployment in a larger complex organisation can involve a whole supply chain and deployment for customers across multiple countries.

More complex cases included sharing data across parts of the healthcare ecosystem, so that primary care and secondary care started to collaborate and share patient information with social service provision.

There were several aspects to this:

1) The collaboration amongst the primary players in the industry
2) the collaboration amongst the set of suppliers to that industry, to support the primary players,
3) Collaboration between related parts of a wider ecosystem (e.g. healthcare or transport).

There were cases where the consistency of all data was required. Situations where only parts of the overall data across an industry needed to be shared. Situations where guarantees around anonymity of the data was required in parts of the industry as data was transferred for richer analysis.

This is clearly a level of collaboration, complexity and organisational breadth beyond that found in a single organisation.

Level 3 are deployments that reach across multiple players, typically in the same sector. For example, extending a public administration service across multiple countries, or between quite different aspects of public administration (say tax and health). Another example would be an industry seeking to gain benefits from cross industry integration, say utilities sharing asset data, or the coordinating across the transport sector (see demand scenarios for more detailed examples). As the degree of sophistication of these deployments increases so does the complexity. Even deploying simple applications across multiple different players in a single sector can be a challenge.

As whole sectors of organisations get involved, the complexity of a deployment increases in challenge and complexity.

The data sharing and security problems are compounded by typically organisations having different definitions of data, leading to data consistency and standardisation challenges. Deployment of sophisticated edge and AI technology adds yet another level when faced with multiple integrations to heterogeneous existing networks and applications.

5.4.5 Level 4: Collaboration across industries: the smart city examples

The final level of organisational breadth was highlighted in the public administration and transport briefing papers. The public administration paper referred to smart city implementations where the local authority would act as a coordinator across a range of players from different industries. This was no longer collaboration within a single industry, rather it was collaboration and coordination across quite distinct industries.

At level 4, typified by the challenge of deployment in a smart city, the challenge is even wider. Such deployments typically involve the coordination and integration of multiple players, from different sectors, deploying multiple applications across multiple locations. These applications need integrating to become a whole smart city view.

In situations like Smart Cities, the deployment challenge is coordinating players from multiple sectors.

5.5 The deployment framework: Combining sophistication and breadth of organisational challenge

If we combine these two perspectives on deployment, we can see both simple cases and more interesting and challenging ones. Clearly there are quite different challenges across this set of quite different deployments.

This led to the overall framework as shown below, and the same framework with examples included as shown opposite.

Combining these two views on deployment, the sophistication of the deployment and the organisational scope, we create a range of diverse deployment situations with quite different challenges in each combination.

Organisational challenge (Breadth)	Deployment sophistication		
	A: Relatively simple cloud deployments	B: High Data protection and security needs	C: Sophisticated deployment of more advance technology
Level 4: Cross sector coordination. Involving multiple organisations and sectors			
Level 3: Multiple organisations collaborating across the same sector			
Level 2: Single larger, more complex organisations, including their customer networks and supply chains			
Level 1: Single, simpler, smaller organisations			

5.6 Examples of increasing deployment sophistication and organisational challenge.

Table: Examples of Deployment sophistication and level of organisational challenge combined.

Organisational challenge (Breadth)	Deployment sophistication		
	A: Relatively simple cloud deployments	B: High Data protection and security needs	C: Sophisticated deployment of more advance technology
Level 4: Cross sector coordination. Involving multiple organisations and sectors	Multiple sectors and players, deploying simpler applications and prototypes as spot solutions. (e.g. trials of individual Smart city applications)	Integration of personal data across a smart city from multiple sources. Security challenge of multiple applications	The integrated application of solutions involving the coordination of multiple sectors and players. Eg aspirational Smart Cities.
Level 3: Multiple organisations collaborating across the same sector	Sectors seeking coordination and cooperation and pooling insights across mainstream applications. Sectors looking for insights and sharing consistent (non-personal) data across the sector. (e.g. energy, utilities sharing asset data).	Sectors with vast data sets looking for shared insights across sector (e.g. environment, health, media) **Public sector cross border or cross entity collaboration**. Sharing data held across separate entities (e.g. personal data, police bodies, etc.)	**Sectors applying a sophisticated coordinated response to challenges.** e.g. transport addressing environmental impact across parts of the sector, or large-scale edge and AI deployments
Level 2: Single larger, more complex organisations, including their customer networks and supply chains	**Larger & more complex Organisations seeking efficiencies and staying up to date.** Eg Creating multi-clouds & hybrid cloud solutions as they migrate parts of suite of applications to cloud for efficiency. Challenges of data security and integration across applications.	Larger organisations managing data protection and security across multiple in house and cloud deployments. Eg Commercial organisations protecting customer data. Eg Public-administration omni-channel services. Mobile apps gathering data from the edge.	**Organisations seeking a sustainable competitive edge.** Eg Organisations adding sophisticated & specialist applications such as Edge with AI to manage processes or gather insights for long term modelling. Includes use of insights from external data sources, added alongside their core applications.
Level 1: single, simpler smaller organisations	**Smaller organisations seeking efficiencies:** Eg SMEs migrating core administration, sales & servicing systems to the cloud. (e.g. Accounts, CRM, etc.) for efficiency gains	Smaller organisations protecting sensitive data and ensuring security. Smaller organisations sharing and using other sources of personal data	**Smaller organisations creating or using innovative technology for competitiveness or as offering**. Eg. Innovative SMEs creating sophisticated AI solutions, or using large data sets for insights product development offering.

5.7 Deployment framework and benefits

We have summarised the extent of examples, the benefits and the main challenges in the table below. This includes both the opportunity for exploitation and the risks involved, particularly with data protection and security.

Organisational challenge (Breadth)	Deployment sophistication		
	A: Relatively simple cloud deployments	B: High Data protection and security needs	C: Sophisticated deployment of more advance technology
Level 4: Cross sector coordination	Few examples. New area. Much to learn. Still a challenge. Necessary step to 4B. Increasing integration complexity even for more basic applications.	Enormous opportunity for synergy and insights. Comes with commensurate increase in risk.	Even fewer examples. Definite challenge, but potentially the greatest opportunity.
Level 3: Multiple orgs, same sector	Many sector examples exist. Problems & barriers at simpler levels are specific to sectors (e.g. Public Admin)	Increasing opportunity for synergy across a sector, with accompanying risk. Data security and protection issues compound as a variety of heterogeneous organisations cooperate.	Large opportunity across individual industries. Challenges with data sharing and technology compatibility and interoperability. Important step towards 4B
Level 2: Single larger org & supply chain	Known & common problem. Plenty of services and experience in this area. High opportunity for increase efficiency, but with multiple services comes increased complexity to be managed.	Necessary application of data protection and security. Known problems and well proven solutions. Requires increasing care as complexity increases. Security & data protection, could be considered more of a risk than an opportunity for many organisations.	Multiple examples around and emerging. High opportunities in players and industries. Uneven uptake across industries. Specialist skills brought in and then developed internally
Level 1: Single small/med size org.	Well known problem Commodity consulting and services	Necessary provision. Well known problem Commodity consulting and services. Requires care with data security and protection	Potential opportunity for smaller niche players with specialist opportunities. Skills and training needed. Specific barriers for smaller organisations.

This is the framework we used to examine the demand scenario deployment challenges and gain insights into the EC's specific questions in section 3.

5.8 A further deployment challenge: how to increase sophistication and breadth

There is a second, more subtle, deployment challenge in this matrix. That is, the challenge of moving from one square, to the other. In the various demand scenarios, we also saw a second deployment challenge. The challenge of helping organisations and sectors move up through, and across, this set of deployment challenges. For instance, this is not about how a sector might exploit edge technology, but how a sector is mobilised to work together so it can exploit edge technology as a coordinated sector. This is summarised in the table below, where the highlighted text shows the movement challenges. We ignored this issue for our initial analysis, as an unnecessary level of detail at this stage. For simplicity, the framework also ignores the distinction between the challenges of data protection and security and sophisticated deployments. However, for the Green paper, this extra level of detail was unnecessary.

	Moving deployment through the stages of sophistication		
Deployment challenge	A: Relatively simple	→	B: Relatively sophisticated
Level 4: Cross sector coordination	Multiple sectors and players, deploying simpler applications (prototypes as spot solutions.	How to move from simple prototypes and limited roll-outs to full integrated, and universal adption?	The integrated application of solutions involving the coordination of multiple sectors and players.
↑	Bringing sectors together for cross-sector data sharing and efficiencies (e.g. Health & demographics, or transport and energy)		Bringing sophisticated sector solutions together for cross sector synergies (e.g. which sectors to involve in smart cities)
Level 3: Multiple orgs, same sector	Sectors seeking coordination and cooperation and pooling insights: Public sector cross border or cross entity collaboration.	How to encourage sectors to adopt more sophisticated solutions as a sector	Sectors applying a sophisticated coordinated response to challenges. Sectors with vast data sets looking for shared insights across sector
↑	How to move from individual effectiveness, to cross industry compatibility and interworking?		Making sophisticated solution an industry wide movement.
Level 2: Single larger org & supply chain	Larger & more complex Organisations seeking efficiencies and staying up to date	How to help larger organisations move to testing, developing and exploiting more sophisticated solutions	Organisations seeking a sustainable competitive edge
↑	Helping smaller orgs grow their technology as they grow		Helping smaller orgs to grow and move to more sophisticated application and value
Level 1: Single small/med size org.	Smaller organisations seeking efficiencies:	Help smaller organisations identify, take and exploit more sophisticated	Smaller organisations creating or using innovative technology for competitiveness or as offering

		opportunities	

6 NOTES IN THE SUPPLY SIDE FRAMEWORK

For the supply side it was appropriate to take a different approach. This was for two reasons:

1) The EC specifically asked about Edge, Green ICT and Federation, so these topics deserved elaboration based on the briefing papers.
2) The landscape analysis, technical infrastructure analysis and other supply side briefing papers, set out a set out a wide diverse ecosystem.

Therefore, it made sense to analyse the supply side by showing this ecosystem as a diagram and placing the variety of challenges on a simplified version of that diagram. This part of the market is illustrated in the figures below. The green paper also highlights how “adoption” and “implementation” and quite different questions for suppliers rather than end users. Issues of maintenance also apply for suppliers in a different way, considering how they offer upgrades, version control and migration to new architectures as the products develop. The supply side's different perspective on adoption and deployment questions is covered in section…

The supply side players and components included:

- The European supply side cloud ecosystem (cloud services, cloud suppliers, the edge market and emerging standards)
- The edge computing landscape, and barriers to adoption and implementation
- The networking component: that part that connects everything else.
- The cloud infrastructure and technology landscape
- The implications of green ICT
- The potential for federation and other mechanisms of cooperation.

Figure: the diversity of players and components in the supply side cloud landscape

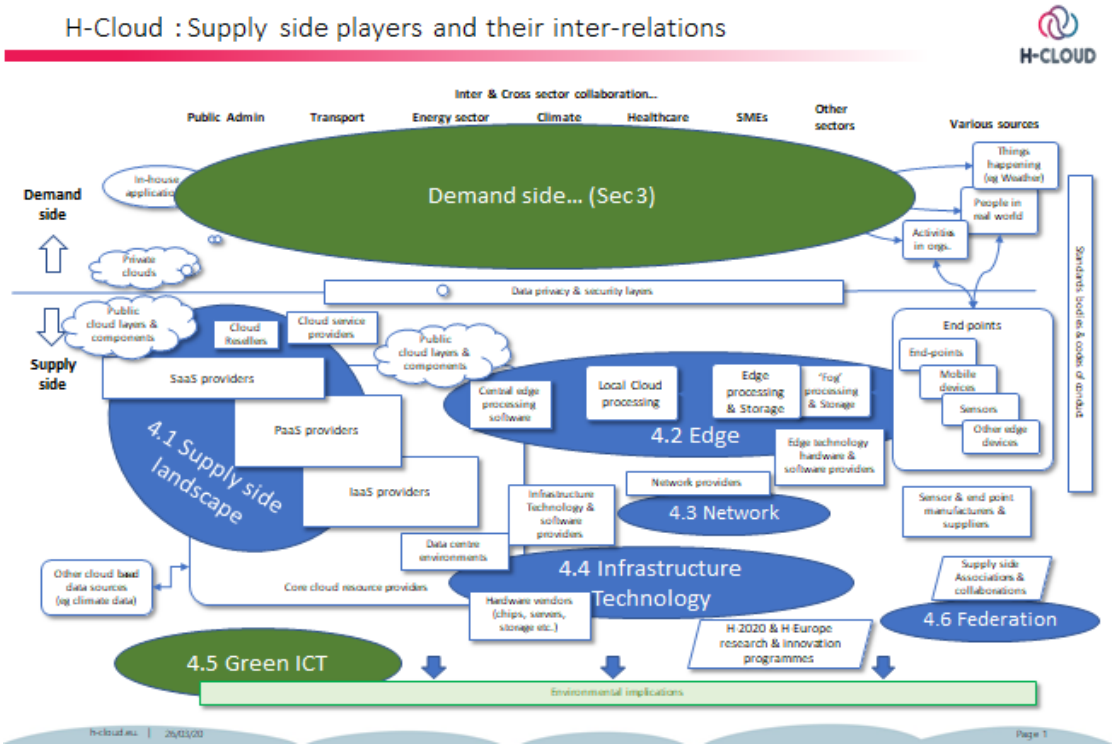
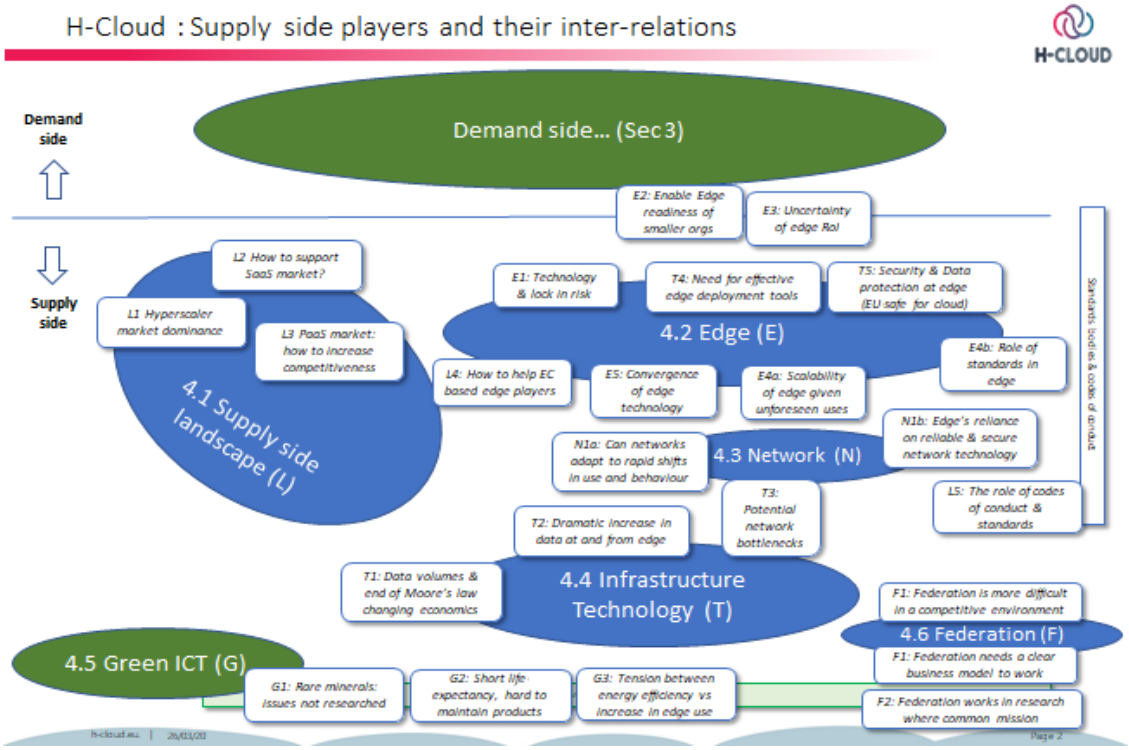


Figure: Supply side challenges located on the supply side map



7 DIAGNOSING THE UNDERLYING CAUSES AND STRATEGY CHOICE

7.1 Strategy as a hypothesis to be tested

One of the core principles of strategy development is to develop a hypothesis about the strategy and test it. This is because it is easy to 'come up with a strategy" to address a particular challenge or situation. However, it is better to treat that idea as a hypothesis, and text it, rather than leaping to action, only to find out 12 months later that the strategy was based on sand.

7.2 Diagnosing the underlying causes behind a problem or situation

Fundamental to this approach is to diagnose the underlying reasons and causes of challenges or how things will change. The clarity of the diagnosis is vital, because different diagnoses of frames of a challenge or problem are likely to lead to quite different strategies and policies to address them. This is the principle explained in "Good Strategy, Bad Strategy" by Richard Rumelt.

1) Understand the situation and its underlying causes,
2) Develop an overall policy or strategy to address the underlying causes,
3) Develop actions coherent with that strategy that will address the underlying issues
4) Continue to test the strategy as it is implemented.

Both the "Strategy as a hypothesis" approach and the "Diagnosis of the underlying causes" before strategy or policy formulation, are consistent. They both say, "Check your understanding of what is going on and test whether the underlying cause is what you think, before you leap to strategies, let alone actions.

An example of this in the green paper, is the lack of take up of Edge processing. (A similar analysis can be done on other challenges in other topics. This example simply best illustrated the situation). Across that briefing paper the underlying causes (challenges) include:

1) Difficulty in making a business case
2) The lack of emerging standards
3) Immaturity of the technology
4) The challenge of collecting sensitive data.
5) Solution complexity.
6) The challenge of maintaining edge devices
7) The security of edge and end-point devices
8) Lack of collaboration between industries towards single solutions.
9) Lack of support for cloud research towards technical readiness, and/or interoperability, and/or automated management
10) Lack of promotion of "public" shareable edge solutions
11) And others…

Each of these may be true, to a greater or lesser extent. However, given the wide breadth of these diagnoses, it would make sense to test them with the wider communities, in specific industries before devoting time to investment to address them.

The most intractable situation amongst a management team or a group of players is where two parties consider the diagnosis quite different. Neither can agree. So, both either go off implementing their solution, or alternatively neither are implemented. Getting agreement to the underlying diagnosis, so people frame the problem in a similar way, is fundamental to successful decision making and successful strategy formulation, development and implementation.

Strategy is about choice: what to do and what not to do. It is also about leverage, where do we get the greatest "bang for our buck". This leads to the question, addressing which amongst these would create the greatest amount of leverage? And what should we choose to address and choose not to

address. Clearly the answer to the latter depends on where you sit in the layers of the landscape. The EC has tools of policy and investment in research and innovation programmes. Supply side players have choices about how they address the issue. Individual industries will make choices, as individual organisations in that industry, or perhaps as an industry as a whole. So the diagnosis and the strategies to address these challenges, can differ with the layers and perspectives as well as the power available to those players.

7.3 Implications for the H-CLOUD process and consultation

In the H-CLOUD green paper, the individual briefing papers have developed challenges, which are summarised in the green paper. Some of those briefing papers have gone further to suggest recommendations or policies and even work programmes to address the identified challenge.

In the consultation process, the project has the opportunity to take a step back and test the underlying findings behind these challenges with the experts and players in the landscape. If their knowledge suggests the findings are incorrect, that may lead to different challenges. If their diagnosis of the situation is different, it might lead to different perspectives on the challenges. Both could lead to quite different approaches to the development of potential strategies to approach the challenges, and quite different actions (work programmes) resulting from them.

Therefore, it makes sense that the consultation process of the green paper, discussion paper, is that it creates a discussion about both the challenges, and their underlying causes. This should happen, before the conversation jumps to solutions. It also provides a way to test the underlying hypotheses within the green paper, and therefore gain engagement of the community the project wishes to engage.

7.4 Conclusion

The green paper is a discussion paper. It was designed to create a way to unpack the complexity of the challenges, address the specific issues that the EC raised, and to put those issues in a context so they could be analysed. The paper has successfully identified a set of challenges that can be discussed by the experts and players in the community.

This section suggests that the focus of that discussion should not, yet, be on solutions. It should start by testing the hypotheses, seeing if they are recognised, building upon them and exploring the underlying causes. From this, potential strategies (hypotheses) can be developed and tested in that community. Some approaches may result in community players taking actions themselves, individually or collectively. Other challenges may lead to the need for research programmes and investments.

Regardless, having clarity over the underlying causes is fundamental. Then, strategies can be tested and implemented and refined and learnt from (or discarded when it is realised that they are no longer working or things have changed). Strategy becomes a genuine learning process.