Output-based regulation

Fields of innovation for energy-grid operators?

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Arthur D Little

Content

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Executive summary

The regulatory environment in Europe is pushing network utilities to face new challenges that will heavily impact their operations. Regulators all over Europe are watching the tariff mechanism introduced in Great Britain, named RIIO, which is based on incentives, with interest. Many have plans to introduce similar output-based methodologies already under way.

Aside from output-based regulation, an innovative methodology for grid operators to evaluate projects is cost-benefit analysis (CBA). CBA differs from traditional approaches, such as DCF and others based only on the financial perspective, as it considers and estimates a larger amount of costs and benefits originating from projects. Examples include economic, environmental and welfare effects with direct and indirect impact on stakeholders.

Given a new regulation that presses network operators to deliver sustainable outcomes, new challenges arise, and network operators will face this huge cultural and operational shift and need to rethink their business models. In the new scenario, in which innovation also plays a strategic role in success, Arthur D. Little helps companies using digital competences and solutions that ensure greater control of data flows, enable exploiting of all informative potential in asset management, and overcome limits of infrastructural assets typical of network utilities.

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1. Moving towards output-based regulation

In theory, tariff setting should balance three elements: stakeholder protection, economic efficiency and system sustainability. In practice, tariffs are aligned with the end results regulators strive to achieve. In almost all cases, tariffs are designed to favor investment remuneration, mainly to entice operators to develop the network. Otherwise, national regulatory authorities ("NRAs") push grid operators to seek operational excellence, setting tariffs with the aim of transferring more benefits to the end user issuing the operational-excellence targets.

Tariff regulation schemes across Europe vary widely. However, mainstream regulatory methodologies fall under the following categories:

- Cost plus
- Rate of return
- Revenue cap
- Price cap
- Outputs & incentives

Initially, network price regulation was derived from input-based schemes such as **cost-plus** and **rate-of-return** methodologies, which indirectly caused grid operators to over-invest in their networks without paying sufficient attention to network efficiency, or to increase costs in order to maximize profit. The internal inefficiencies brought by the application of these

Figure 1: Moving towards regulation based on outputs

- Price regulation is based on four basic elements: cost, investment, capital and the costs of the capital
- The new trend is the involvement of a fifth element – the quality factor, which is often very difficult to reflect in regulated prices
- Under incentive methods the activity of the regulated subject is usually viewed as a whole, and specific strategies can be selected

Level of motivation to improve efficiency by additionally granted profits

Cost plus	Rate of return	Revenue cap	Price cap	Output based
■ Price is determined annually according to planned costs increased by a legitimate profit ■ Unplanned costs causing increases/ decreases are fully projected into prices ■ Regulated entity is motivated to only increase the component used for profit calculation (expenses, assets/ equity)	■ Based on return on capital ■ Prices determined for the whole regulatory period ■ Profit determined by the amount of invested capital and the costs of capital ■ Projected costs for the regulatory period are added to legitimate profit ■ Surplus/deficit will be balanced at the end of the regulatory period	■ Related to price cap, but price is determined on the basis of the same components annually ■ Most components are constant for the given period ■ If subject reaches higher profit within the allowed revenues, this profit is fully granted to this subject	■ Determination of max. prices valid for the regulatory period ■ Price is escalated and based on allowable costs, profit and capital ■ Comparisons over time or with other entities to determine some components of the initial price ■ Method does not reflect a change in amount of volumes transferred	■ Revenues calculated according to the achieved outputs ■ Regulated targets defined in advance ■ Extended regulatory period enables companies to achieve regulated targets ■ Parameters set up according to company business plans ■ Revenues allocated fairly between current and future customers

Source: Arthur D Little Analysis

principles has been the main reason to move towards different methodologies, as well as alternative and more advanced regulatory principles such as price- and revenue-cap methods.

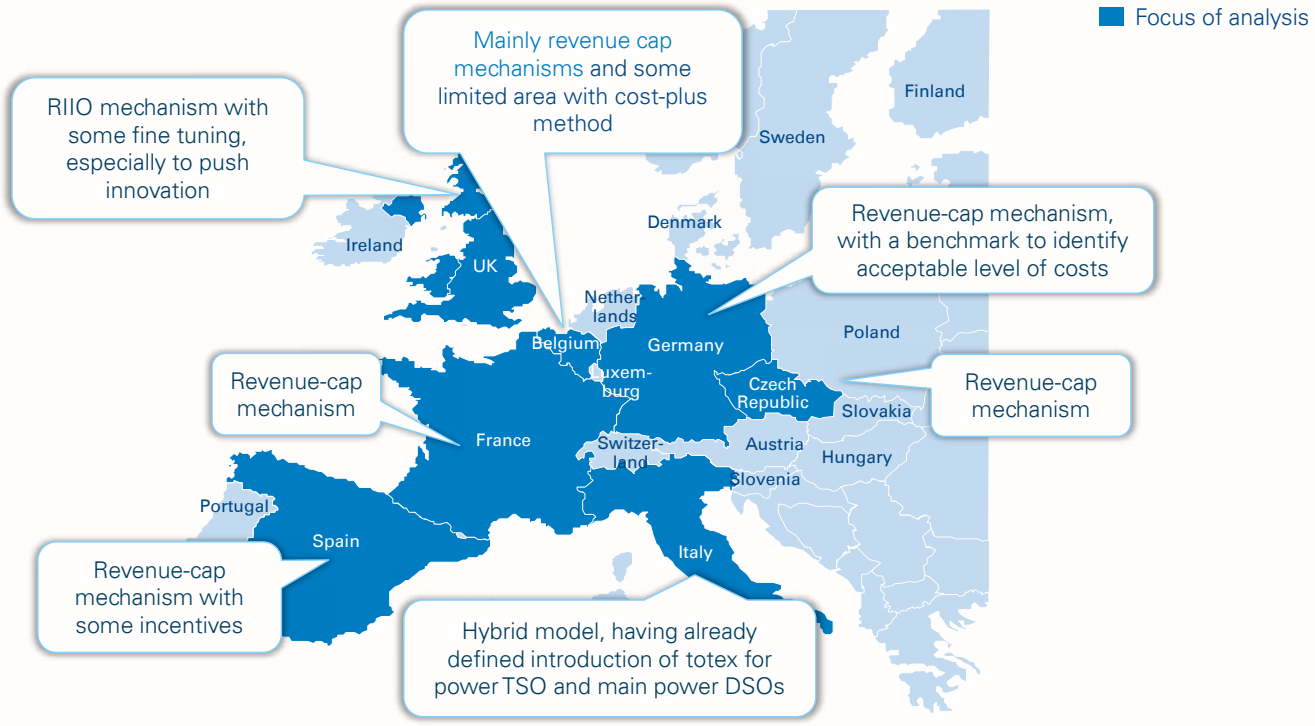
Both **revenue cap** and **price cap** differ according to the variables regulated by the NRA. Inflation-adjusted revenue is the topic of revenue cap-type regulation; price-cap mechanisms set prices and the way such prices are indexed to inflation. NRAs use corrective mechanisms – most notably, x-factors to account for required efficiency gains – to focus operators' attention on specific topics.

The last evolutionary step of regulatory framework lies in the introduction of **output-based** mechanisms and relative incentives on the achievement of specific objectives. These kinds of mechanisms are applied in almost all European countries, but refer only to rewards/penalties systems based on quality of service, except for the UK, in which output-based regulation is fully implemented.

However, there exists an additional evolution: with the ever-increasing efficiency gains component that constituted part of revenue- and price-cap regulations, operators and NRAs generated a situation in which operators were held accountable for certain levels of service and given lower and lower allowances to sustain them. Also for this reason, attention is shifting towards regulatory models that focus on maximizing the outcomes generated with currently allowed expenditure amounts.

Different tariff schemes are in place among European countries, but almost all are still input based (as illustrated in the box below), with the exception of the UK, which, in the last years, has openly moved towards an output-based regulatory mechanism.

Figure 2: Overview of grid tariff mechanisms in Europe



Source: Arthur D Little Analysis

Regulatory framework in Europe

Belgium

In Belgium the applied distribution tariff depends on regional authorities: CWaPe and Brugel apply cost-plus methods already put in place by CREG. Conversely, VREG has instated a revenue-cap regulation model, with certain defined non-controllable costs remaining as a pass-through.

Tariffs are established for two-year set intervals. For TSO, CREG defines a fair-return mechanism based on remuneration of RAB, with some tariff incentives, such as those linked to the progress of construction work for major projects mainly associated with interconnection capabilities, for power TSO.

The current tariff period lasts four years, starting from 2016.

Czech Republic

All distribution and transmission tariffs are set by ERO (Czech's NRA) according to a revenue-cap methodology, with regulatory periods usually lasting five years.

Capital costs are remunerated via cost reimbursement (depreciation and rate of return on RAB), while an incentive method is defined for operating costs. (Before the regulatory period, a fixed cost base is set, and then annually escalated for inflation minus an efficiency factor set by ERO, whereas the compound escalation factor cannot be lower than zero.)

The TSO is obliged to process a ten-year development plan for the transmission system. The DSO does not have this obligation; however, on request of ERO, regulated entities must present ongoing or planned investments.

France

The French NRA, CRE, uses revenue cap- based methodologies to regulate tariffs, but it also includes cost reimbursement elements and incentives (e.g., smart-meter extra-remuneration for good performance in terms of costs, deadlines and quality of service), as well as an efficiency requirement on opex.

Regulatory periods last four years for distribution and five years for transmission regulations. Within the realm of RAB remuneration, it is to be noted that WACC regulation was rendered moot with regard to energy distribution following a deliberation dated November 28th, 2012.

Subsequent amendments made by the regulator include a system of capital charges, which takes into account the modifications imposed by the legal determination on the matter.

Germany

The German model places a revenue cap and acknowledges two types of cost: permanently non-controllable costs, which are fully reimbursed and not subject to incentives, and generally controllable costs. Within this cluster, the regulator identifies efficient and inefficient costs through a benchmarking exercise within comparable companies. The acceptable level of costs identified is adjusted according to several parameters to account for the operator's actual size. This is in order to obtain an efficiency coefficient to determine how many costs are accepted as efficient, while the rest is accounted as inefficient and the operator must strive to eliminate them.

The German model does not formally hinge on WACC calculation, as it operates directly through cost-of-equity calculations. Its regulatory periods last five years.

Italy

Italy proposes a hybrid model, with elements of a price-cap mechanism applied to opex, while capex is partially reimbursed and partially remunerated by WACC (nominal pre-tax). Regulatory periods currently follow different structures: a 4+4 year framework is in place for electricity transmission and distribution, while four and six years are respectively in place for gas transmission and distribution.

The Italian model includes, on the one hand, both input- and (to some extent) output-based incentives, mostly related to a system that rewards and penalizes operators according to specific service-quality parameters. However, it also includes extra-remuneration on certain categories of "smart" investments. The Italian NRA is already contemplating the opportunity to invest heavily in an outcome-based tariff methodology.

Spain

In Spain, the CNMC sets a range of highly customized regulations, whether we refer to gas or energy, transmission or distribution, with some common elements: A revenue-cap mechanism, even if applied with some differences, and no use of standard WACC methodologies to remunerate RAB.

The gas distribution tariff follows a revenue-cap method and, in addition, remuneration is based on totex.

On the other hand, the power transmission and distribution tariff follows a mix of revenue cap with incentives on availability (transmission) and quality of service (distribution).

Still missing are incentives on customer satisfaction, connection terms and environmental impact. Regulatory periods, for both gas and electricity, last six years.

2. RIIO – A novel regulatory approach to maximizing output for end users

In 2010 the UK evolved its revenue-based methodology (RPI-X) to a new format of tariff regulation scheme based on **incentives**. This methodology goes by the acronym "RIIO" – Revenues = Incentives + Innovations + Outputs. The regulator determined that the long-term challenges, uncertainties and huge investment requirements of developing a sustainable, low-carbon, smart energy system would require a revised mechanism.

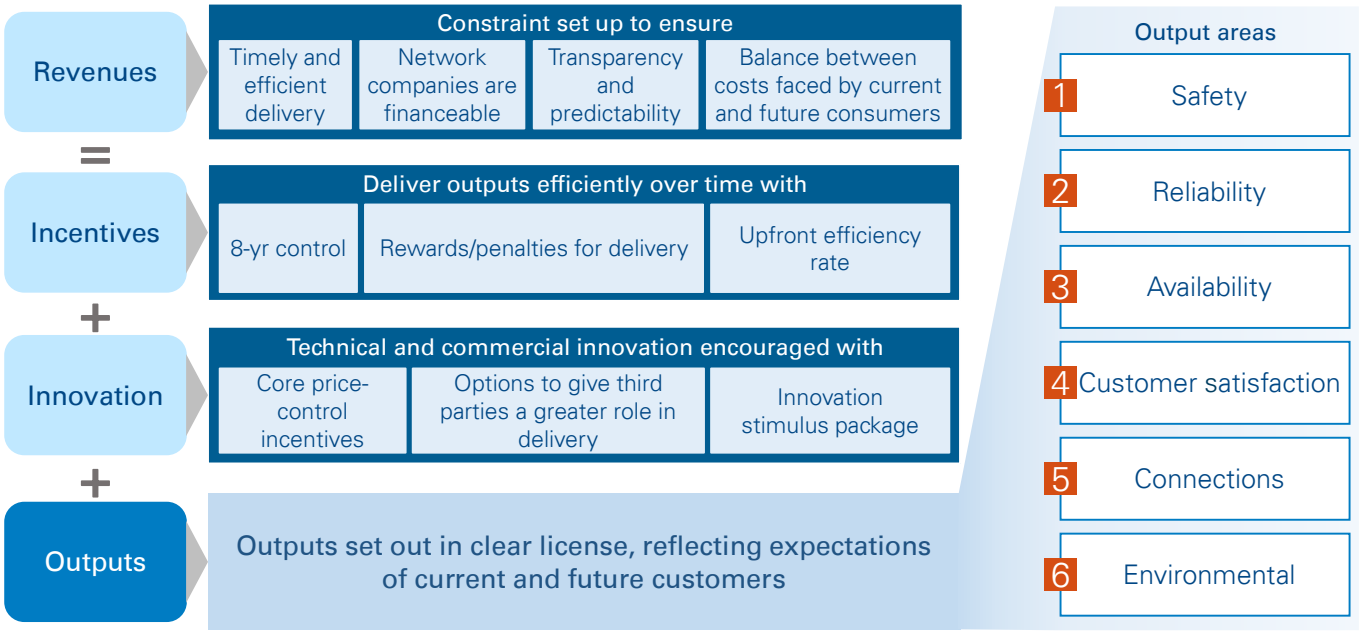
First implemented in 2013, RIIO is designed to encourage network companies to:

- Put stakeholders at the heart of their decision-making processes
- Invest efficiently to ensure continued safe and reliable services
- Innovate to reduce network costs for current and future consumers
- Play a full role in delivering a low-carbon economy and wider environmental objectives

Revenue allowances continue to be set in advance, with similar goals to previously in terms of transparency and predictability. However, the regulatory period has been extended to eight years, with annual reporting and interim reviews, which allows greater certainty for investors and more effective delivery of projects. Operators are evaluated based on a set of qualitative categories, and may then be rewarded or penalized according to their performances in these fields. Such rewards and penalties update the set revenues automatically every two years. Specific attention must be paid to balancing the investment cost burden between the consumers of today and those of the future. Output incentives have also been adjusted to better support evolving customer needs. The key development – the additional "I" – is that companies are incentivized on targeted and efficient innovation, with funding available via competitive processes and innovation management entering regulatory performance frameworks.

The elements that compose *Revenues* in the RIIO mechanism are designed to interact as follows:

Figure 3: RIIO Framework



Source: Arthur D Little analysis on "Ofgem RIIO: A new way to regulate energy networks, Final decision, Oct 2010"

- **Incentives** encourage operators to deliver results efficiently, as agreed ex-ante over the eight-year time frame, by rewarding or penalizing them according to their actual performances;
- **Innovation** is encouraged to meet targets and stimulated via core price-control incentives, innovation stimulus packages and the prospect of competition from third parties in delivery;
- **Outputs** targets are negotiated between each operator and the regulator, and include a range of output areas, such as safety, reliability, availability, customer satisfaction, connections and environment.

In summary, each operator must submit to Ofgem[1] a detailed, eight-year business plan addressing the regulator's requirements; following review, Ofgem decides the level of scrutiny to adopt, either offering early acceptance of the plan with no changes ("fast-track"), or requesting modifications and a second submission. The "fast-tracking" of a high-quality business plan (even though some areas for improvement may still exist) provides an effective revenue bonus to the operator and more time for planning and implementation. There are also potential reputational benefits if combined with high performance levels, which leads to reduced regulatory scrutiny in the longer term. The standard process, which has been termed "slow-tracking," is for business plans to be pushed back to operators for revision, with specific points to address. Other stakeholders are also able to respond to the business plans through public consultation. Once the plan is accepted and the regulatory period begins, the operator will then be evaluated on the categories highlighted above, and incentives or penalties will be awarded according to the operator's performance.

Each operator is subject to specific conditions because it is free to choose, among a set of alternatives, how best to address the general guidelines set by the regulator, as relevant to its specific network. This is made possible by the fact that there are only a handful of transmission and distribution operators in the UK,[2] a concentrated structure that does not apply to all countries. Other countries considering implementing RIIO-inspired, totex-based regulation are doing so within the context of their own markets: for example, in Italy, where there are numerous DSOs, the totex approach will be directed only to the national electricity TSO and the five biggest DSOs in the country, while smaller players will continue to be subject to the existing regulatory framework with some similar evolution.

With RIIO, the regulator focuses on maximizing benefits to end users, which can be expressed as achieving the best value for money for consumers both today and in the future, with the impact on gas and electricity bills as a key measure. Operators need to be as cost-efficient as possible, and the use of totex as a cost valuation methodology supports this: in essence, totex treats opex and capex in the same way (i.e., neither is treated, or remunerated, more advantageously than the other), which allows operators to plan their network expenditure considering minimization of whole-life cost value[3]. In addition, increasing the regulatory period to eight years allows operators to reap the benefits of their investments in efficiency improvements over a reasonable period of time. After this the efficiency benefits will be shared with consumers at the beginning of the following regulatory period.

Considering other European regulation mechanisms, RIIO definitively represents an innovative approach of output-based regulation for grid operators, even if regulators need to fine-tune some mechanisms of implementation in order to avoid unequal treatment of operators and thus disadvantage to consumers. Fast-tracking of business plans within RIIO has been criticized for possibly leading to higher costs for consumers due to the prospect of the light-touch approach, which creates larger revenue allowances than for slow-tracked companies challenged more by the regulator. Plus, there tend to be improvements in assessment and benchmarking methodologies through the slow-track process as more information becomes available and further analysis is carried out. This can lead to fast-track companies working to weaker efficiency measures. It follows, of course, that over time benchmarking models will improve, but regulators need to be wary of the possibility of unequal treatment of operators, and thus disadvantage to consumers. Finally, it is considered that implementation of innovation has been inefficient or insufficient until now.

RIIO is considered a successful case for implementing an innovative tariff grid mechanism, and most NRAs are looking at it as an example of future evolution regarding local regulation. Arthur D. Little strongly believes that analyzing key success factors, as well as related issues of RIIO and implications for UK grid operators' business models, is becoming more and more relevant to understanding and anticipating regulation progress and impact on network companies.

1 UK NRA.

2 1 and 2 transmission operators for gas and electricity, respectively, while 4 and 6 are the gas and electricity distribution groups, controlling all 8 and 14 DNOs in the country.

3 Totex was introduced in British regulation with DPCR5 (electricity distribution network's price control for the period 2010–2015) and cemented with actual RIIO regulations implemented for electricity and gas transmission in 2013, and for gas distribution in 2014 (electricity distribution was set to switch to RIIO at the end of DPCR5, in 2016). Even the water regulator started implementing totex methodologies with PR14, effective April 2015 (http://utilityweek.co.uk/news/the-topic-totex/1196702#.WCQ3SMczXIU).

3. Cost-benefit analysis and social ROI ("SROI") – a further step towards output-based regulation

In a context in which NRAs are moving towards output-based regulation, which presses operators to deliver sustainable outcomes, Arthur D. Little has tested how the methodology of cost-benefit analysis ("CBA") can help operators to evaluate, identify and prioritize projects to propose to the NRA and implement in their business plans.

The CBA[4] differs from traditional evaluation mechanisms (such as DCF and other approaches based only on a financial perspective) in that it considers all costs and benefits, with direct and indirect impact on involved stakeholders, which originate from projects and are not only related to economic aspects, but also include environmental and welfare effects. Giving a monetary value to each impact, CBA seems to be aligned with core principles of RIIO, and, in general, to output-based regulation mechanisms. It evaluates the project by considering the outcome from different stakeholders' perspectives, not just impact on costs and revenues for the company. Moreover, as we have noticed while supporting operators in business planning by applying this methodology, the evaluation of all potential benefits originating from a project should encourage innovative solutions that could produce positive effects on environmental and welfare aspects that are not considered in the traditional financial evaluation's methods.

As operators would include in their business plans only projects that showed benefits in the long term for stakeholders – primarily customers – considering different output areas (e.g., in RIIO: safety, reliability, availability, customer satisfaction, connections, environmental), CBA can be a valuable approach to demonstrate this. Having identified the technical solution, an operator can demonstrate the benefits for its main stakeholders by applying principles of CBA. One practical solution consists of the introduction of an indicator that evaluates project-valorizing benefits and costs – financial, welfare and environmental – throughout its life: the **social return on investment** ("SROI").

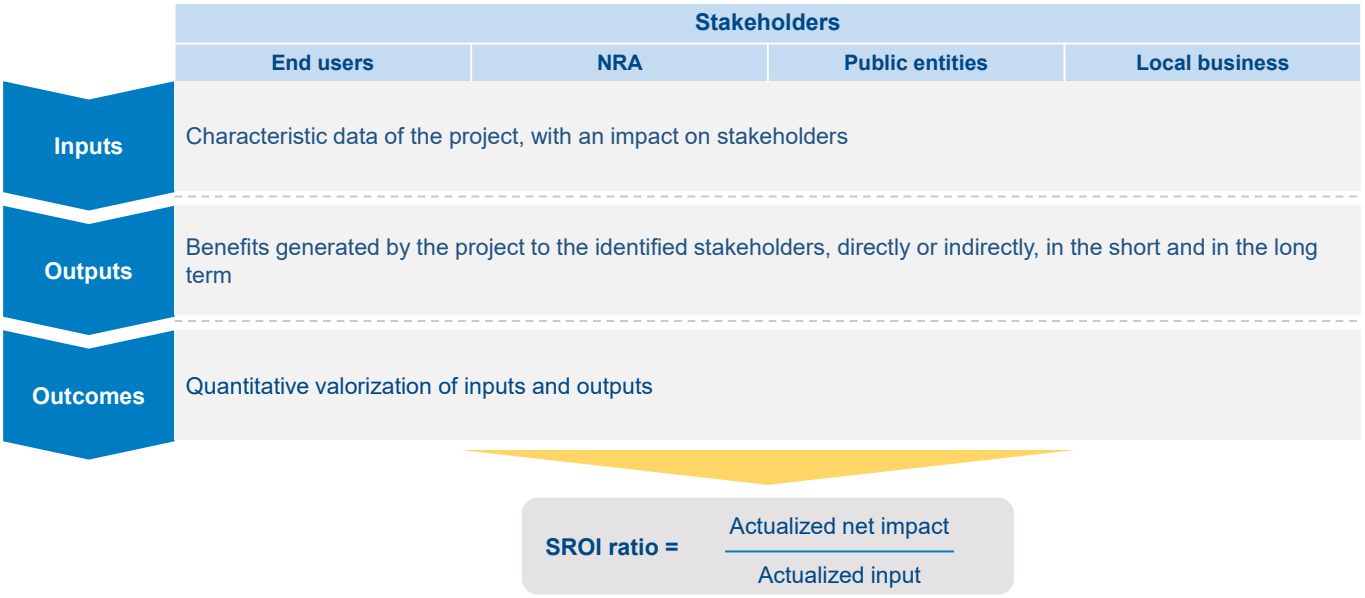
Arthur D. Little has supported several operators in introducing SROI as a KPI of projects' balanced scorecards. In particular, when we work with a company to build up a tool according to specific context, to calculate the SROI index we focus on drawing all potential quantitative impact originating from a technical project, based on a framework that considers the following elements:

- **Stakeholders:** Identification of all actors affected by the project, directly or indirectly. In case of energy-grid operators' projects, customers (citizens, small and large businesses), NRAs and other authorities involved are the main stakeholders to be taken into consideration when implementing the SROI analysis;
- **Input:** Specific data on the project, technical parameters, and capex and opex (in line with totex approach) that impact stakeholders, for example, with an effect on a network tariff;
- **Output:** Benefits generated from the project to the identified stakeholders, directly or indirectly, in the short and long terms. Some examples include: network extension to new customers, connection of off-grid areas, encouraging switching to more convenient energy sources, efficiency and reliability of the network, increase in quality of the service in terms of safety and availability, improving of welfare and environmental impact due to new energy-efficiency services and technology innovation;
- **Outcome:** Quantitative valorization of inputs and outputs, also considering the effect on satellite activities, such as impact on occupancy and other related businesses (EPC, local subcontractor companies, etc).

The aim is to summarize in a quantitative indicator (SROI) the trade-off between costs and benefits related to the technical project through calculation of the related net present value.

4 CBA is explicitly required, among other elements, as a basis for decision-making on the co financing of major projects included in operational programs of the European Regional Development Fund and the Cohesion Fund – source "Guide to Cost-Benefit Analysis of Investment Projects," December 2014

Figure 4: Framework of Social ROI index



Source: Arthur D Little analysis on "Ofgem RIIO: A new way to regulate energy networks, Final decision, Oct 2010"

If SROI is greater than one, the technical project presents more benefits than costs for stakeholders; otherwise, it requires costs that are not justified by the positive effects generated. Only projects that show SROI greater than one should be included in companies' business plans.

Through the introduction of SROI methodology and CBA approaches in general, the operators' decision-making criteria shifts from a financial perspective to valuation of all impact on stakeholders, in line with the purpose of the output-based regulation mechanism.

4. Implications for operators of the growing outcomes focus – Innovation as a key success factor for business models

The way this peculiar regulation evolved – as well as the way operators adapted their businesses in response to it – is of great interest to regulators and utilities alike. RIIO spearheads a novel regulatory attempt at maximizing output for end users, while operators' responses not only show a path to cope with similar changes in regulations, but also highlight opportunities for improvement in companies' operations.

Arthur D. Little has identified a number of crucial issues that grid operators must face to succeed in an output-based regulatory framework, such as:

- How to distinguish, case by case, the most convenient and remunerative solution to address asset management issues as an equilibrium of new investments and maintenance expenses – also considering the totex regime;
- How to exploit all the potential know-how coming from asset management, and to also apply CBA principles;
- How project management practices would evolve in response to stricter and increasing requirements to adhere to business plans and timely delivery, according to a path agreed with the NRA.

In our experience, identification of proper solutions to exploit all informative potential coming from asset management must consider some common peculiarities of infrastructural assets, such as those that constitute the utility's network:

- Infrastructure systems (most notably those originally under public control) have not historically been subject to the same pressures to optimize as other commercial industries have (e.g., manufacturing companies);
- Asset information systems and data sets might not yet be integrated into a single architecture, and real-time condition data may not be included in the system. The resulting lack of accessible information at the right time, in the right place, is a major barrier to efficiency improvement;
- Although whole-life costing is being put into place (i.e., evaluating total costs over the lifetime of the asset), in practice it is often poorly applied because of grey areas around key assumptions and fragmented responsibilities internally;
- Implementation of optimization techniques such as condition-based monitoring and predictive maintenance often gets stuck at the pilot stage.

The profound change introduced by output-based regulation requires grid operators to assess the level of maturity of asset management processes and tools. Arthur D. Little summarizes the impact on different tools in the figure below.

Innovation will then become crucial to addressing regulatory adaptation, should RIIO-type regulations be implemented. Regulatory modifications to come are consistent with outcome-centered, totex-based methodologies. This means operators will have to improve sector-wide efficiency by affecting capex and opex distribution and innovation.

Then, **Arthur D. Little believes the challenge for grid operators will be to push more disruptive and radical innovative instruments in a number of areas:**

- **Asset management database:** A number of technological solutions (smart grids, smart metering, etc.) demand higher computational capabilities and greater control of company information flows, both economic and technical. It's crucial, then, to assess the availability and quality of data needed for asset management and the effective ICT systems integration;

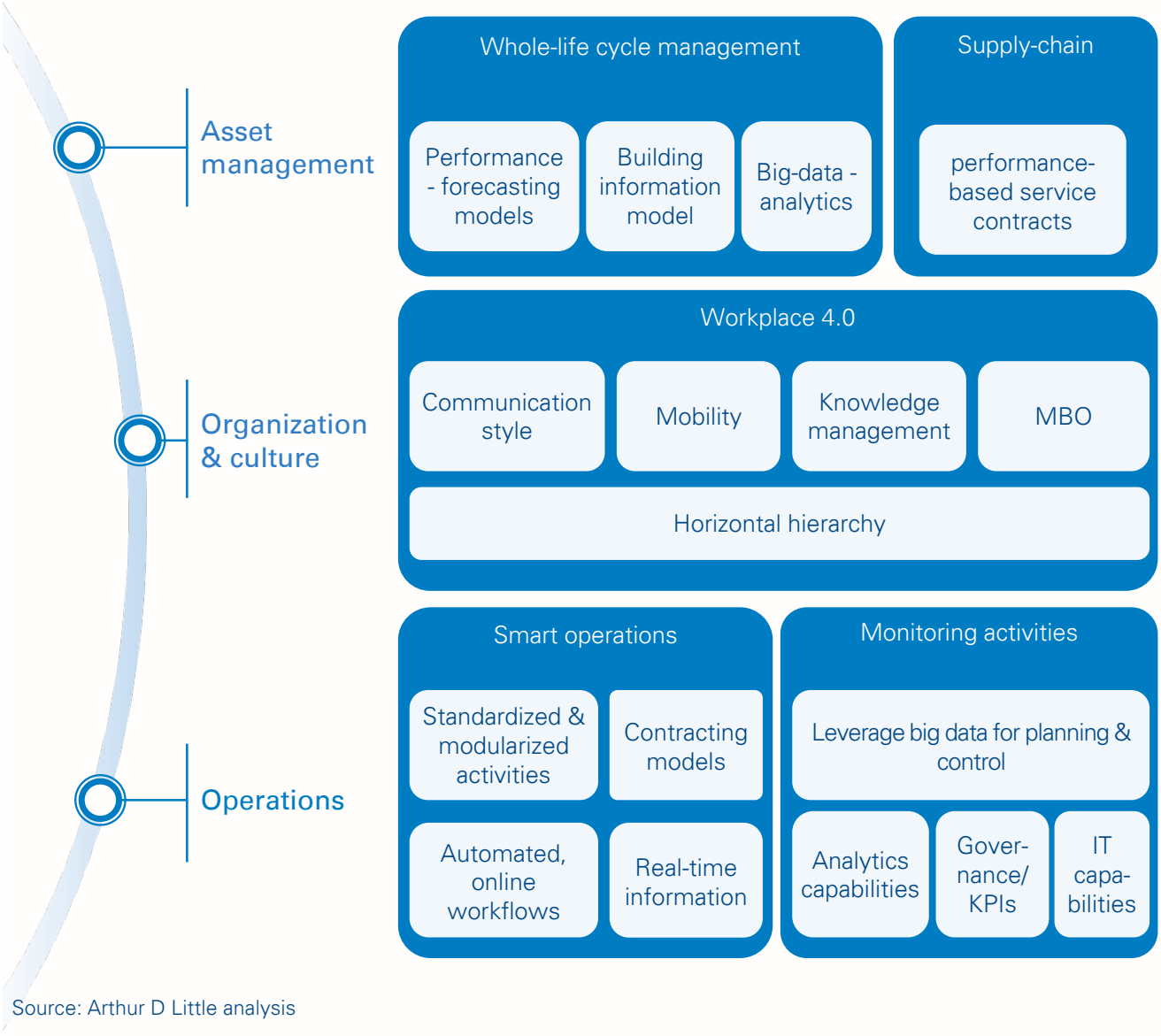
Figure 5: Asset management maturity grid

Degree of Maturity	Asset management database	Organization		Monitoring & reporting
		Activities	Roles	
+	▪ Complete coverage of assets ▪ Monthly updates ▪ Complete information (costs, expected lifetime, reliability...)	▪ Updated activities ▪ Full documentation ▪ In line with strategy ▪ Full respect of investment prioritization	▪ Clear roles ▪ Management and ownership of roles ▪ Extensive training	▪ Full quantitative and qualitative evaluation ▪ Full audit and checks ▪ Regular reporting, KPIs and scorecards
	▪ Complete coverage of assets ▪ Quarterly updates ▪ Basic information	▪ Updated activities ▪ Formalized ▪ Active understanding ▪ Weakly harmonized and with the strategy/investment prioritization	▪ Clear roles ▪ Formalized and assigned ▪ Basic training	▪ Partial quantitative and qualitative evaluation ▪ Partial audit ▪ Reporting, KPIs and scorecards
	▪ Complete coverage of assets ▪ Yearly updates ▪ Basic information	▪ Regular updates ▪ Partially formalized ▪ General understanding ▪ Weakly harmonized and with the strategy/investment prioritization	▪ Clear roles ▪ Assignment of top-level roles ▪ No training	▪ Only qualitative evaluation ▪ Limited checks and controls ▪ Yearly updates
	▪ Partial coverage of assets ▪ Yearly updates ▪ Part of basic information	▪ Ad hoc updates ▪ Partially formalized ▪ Understanding of concepts ▪ Not harmonized with the strategy ▪ Unclear prioritization criteria	▪ Top-level communication ▪ Unclear assignment ▪ No training	▪ Only qualitative evaluation ▪ No audit or checks ▪ Irregular updates
	▪ Fragmented coverage ▪ Ad hoc updates ▪ Part of basic information	▪ No updates ▪ Not formalized ▪ Low understanding ▪ Not harmonized with the strategy ▪ Nonexistent prioritization criteria	▪ Basic awareness ▪ Unclear assignment ▪ No training	▪ Basic evaluation ▪ No audit or checks ▪ Irregular updates
–	▪ Records don't exist	▪ Process doesn't exist	▪ No awareness about AM processes	▪ Monitoring does not exist

Source: Arthur D Little analysis

- **Organization and processes:** Internal processes have to evolve to allow effective solutions to be reached in the most efficient manner. Suppliers' and contractors' performances will become even more impactful to the overall project lifecycle, not only from a make or buy perspective, but also from an integration perspective;
- **Change management:** An "output-based" mentality will become necessary to cope with output-based regulation. Cultural changes are not only difficult to achieve, but also need to be correctly undertaken over a long period; the future workplace will differ from today's, especially with communication styles, mobility/connectivity, and knowledge sharing. Examples include assignment-based team structures, connectivity solutions to enhance remote work and communications, and access to cloud-based databases;
- **Monitoring and reporting:** Output-based regulation pushes operators to improve asset knowledge and management of related data, including reporting. A complete set of KPIs (input and output) is critical to correctly evaluate projects and measure achievement of targets and lag indicators. Processes and tools for performance measurement and control become key success factors within business models of grid operators. This means for the introduction of capability assessment methodologies in line with big-data analytics structures, a number of technological solutions (smart grids, smart metering, etc.) demand higher computational capabilities and greater control of company information flows. Monitoring practices need to be updated from both a hardware and a software perspective to track real-time operative performances and swiftly identify critical areas for improvement.

Figure 6: Asset management – Fields for innovation



Source: Arthur D Little analysis

Notes

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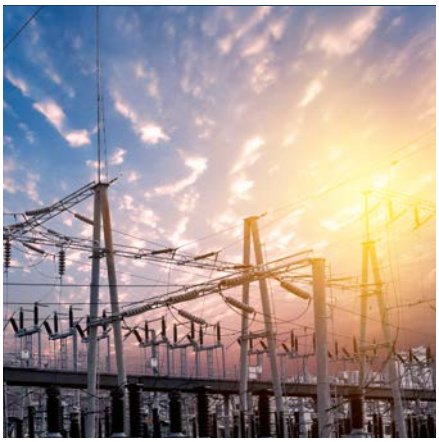

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Arthur D. Little

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