

A Framework for Assessment and Implementation of Product-Service Systems Strategies: Learning From an Action Research in the Health-Care Sector.

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Abstract: - Product-Service Systems (PSS) are new business strategies moving and extending the product value towards its functional usage and related required services. From a theoretical point of view the PSS concept is known since a decade and many Authors reported reasonable possible success factors: higher profits over the entire life-cycle, diminished environmental burden, and localization of required services. Many researchers reported very interesting experiments in large enterprises, typically specialized in functional goods production, while only few researches have been performed for small and medium enterprises (SME). From the flexibility point of view, SMEs seem to be facilitated in approaching a PSS business strategy, thanks to the rapid re-organization of their value-chain/supply-chain (VC/SC), but, on the other hand, requiring a structured, and interrelated approach in order to assess and implement such a strategy.

This paper presents the learning from an action research (AR) in the health-care sector. AR has been used in order to experience a PSS initiative and therefore define, develop, and test a complete framework for assessing and implementing PSS strategies. Reflection on the story in the light of the experience and the theory is presented, as well as extrapolation to a broader context and articulation of usable knowledge.

Key-Words: - Business strategy, Product-service systems, Small-medium enterprises, Action Research, Health-care.

1 Introduction to Product-Service Systems

New business models propositions based on a greater focus on after sale services and on integration with products required to provide services according to a wide systemic view have been proposed in the last decade. These business models have been translated into different strategies. One of these strategies is Product-Service Systems (PSS).

PSS can be thought of as a market proposition that extends the traditional value of a product by incorporating additional related services [1], [2]. A complete state-of-the-art on PSS can be found in Baines *et al.* [3].

The concept of PSS has been discussed in the literature for over a decade [4], [5], [6], [7], [8], however the use of such strategy, in the industrial context, appears limited. PSS concept and

terminology have been conceived from Academic Industrial Sustainability Community, but industrial organizations are not still correctly informed about them and often the same concept is better known as global service or servicization. Organizations undergoing fundamental PSS change are concerned about change and inertia key processes; hence, even if this strategy promises extremely interesting benefits, its practical adoption is really low. PSS is a potentially valuable concept for manufacturers based in developed economies with products at their maturity stage searching for new market niches and business consolidation. The adoption of a PSS based competitive strategy, which uses deeply product, process and customer knowledge to lead a more sustainable consumption/production paradigm, over all the life cycle stages, seems to be very interesting, not only for large functional goods manufacturers, but also for small and medium enterprises (SMEs). Unfortunately, PSS is, today, mainly a prescriptive

improvement strategy, for which qualitative and quantitative analysis tools have not really addressed [9]. Existing designing methodologies [10], [11], do not include or consider frameworks for PSS analysis, verification, and definition, in order to guide and facilitate the transition from the conceptual level to the practical level [12]. This is particularly true for SMEs not able to analyse the critical factors and the risks related to a new PSS strategy. Traditional manufacturing business models cannot be changed instantaneously through a revolution in innovating both product and services; they need to act small changes and obtain few, but increasing, benefits from the business point of view in order to become PSS providers. A high degree of coherence between PSS concepts (production and services integration), and internal capabilities (production management and service delivery) of the organizations, is a necessary condition for which a PSS strategy can be successfully implemented. PSS implementation is, indeed, a complex cross-functional problem, for which traditional manufacturers, especially from the organizational point of view, are not ready, typically facing PSS barriers during the first implementation steps [13]. Risks or issues associated with social, economic, and environmental aspects permeate all the designing, testing, manufacturing, operating, supporting, and disposing phases of the analyzed products and services [14]. Internal and external capabilities play a fundamental role: internally, in terms of designing skills required to develop and innovate products and services, and externally in developing and maintaining a supply network to provide the PSS services as well as transferring the meaning of PSS value to market end-users. A PSS proposition could, unfortunately and rapidly, convert in a failure when promises exceed changing ability and adaptability or when market dynamics have not been correctly investigated. SMEs do not always have the managerial competences and resources to manage such change and implement strategies PSS based. As a consequence of that, they need specific support, which relies in the development of frameworks and related guidelines for managing PSS projects.

For these reasons action research has been used in order to experience a PSS initiative and therefore define, develop, and test a complete framework for evaluating PSS strategies. This paper is organized as follows. In the next section the research methodology is presented and the research question formalized. The action research experience is then presented, by highlighting the context, purpose and process of implementation. Further, a framework for

PSS evaluation is presented as extrapolation to a broader context and articulation of usable knowledge. Such framework constitutes the answer to the research question investigated. Finally, conclusions are drawn based on reflection on the story in the light of the experience and the theory.

2 Context, Research Question Formulation and Research Methodology

This paper presents the learning from an AR research in the health-care sector. Particularly, the authors acted as action researchers together with the key members of the client organization. In this section, context, research question formulation and research methodology are presented.

Context and Research Question Formulation

A Product-Service System (PSS) could be considered a new business proposition competing on a traditional Product-Oriented (PO) market, usually assumed to be in an equilibrium state at a given time [15]. A PSS proposition can be or not successful, depending on some factors. Evaluating a PSS strategy it requires to analyze both the internal and external environment of a company (this is due to fact that PSS is strongly context-to-use). Analyzing the external environment of a company for evaluating PSS transition it means to understand and evaluate the impact of a PSS initiative on all business stakeholders, such as governments, investors, supplier, employers, competitors, etc...

In this action research, we'll consider the external analysis of the business as given, and we'll focus therefore on investigating how to manage the internal one.

As a consequence of that, our research question (RQ) can be formulated:

RQ: "Which analyses should be carried out in order to assess and implement PSS strategies?"

Research Methodology

This kind of research can be characterized as being exploratory in nature and longitudinal; the project took 1 year to complete. During this extended period of study the authors supported the company involved in the project from its inception, participating with the enterprise owners and managers in the strategy definition, processes design, and above all, in the PSS framework design and implementation. Formal project management methods and a variety of data collection techniques were also utilized during this process, e.g. direct

observation, surveys, interviews and customer oriented focus groups, as well as; direct participation in meetings, marketing activities and product development projects.

This kind of approach differs from the conventional case study methodology which typically relies on data gathered from key informants by interview or survey to provide a window on reality in that it allows researchers to gain a deeper knowledge of the case and its dynamics.

From this point of view our work might be further classified as action research as defined by Benbasat et al. [16] since in this approach “The action researcher is not an independent observer, but becomes a participant, and the process of change becomes the subject of research”. Westbrook [17] emphasizes the importance of this approach in building theory in complex situations, arguing that “the grounded, iterative, interventionist nature of action research ensures closeness to the full range of variables in setting where those variables may not all emerge at once” and that “action research requires us to be creative, because, it is usually conducted to develop a new approach to or solution to a situation for which there is no existing prescription”. Gummesson [18] highlights ten major characteristics of AR:

1. Action researcher not limit to observe but take action;
2. AR involves two goals: problem solving and contribute to science;
3. AR require cooperation between the researchers and the client personnel;
4. AR aims at developing holistic understanding and recognition of complexity;
5. AR is fundamentally about the comprehension and investigation of change;
6. Ethical issues have to be understood since the close cooperation between the researchers and the client personnel;
7. AR includes all types of data gathering methods;
8. The action researcher should have a pre-understanding of the company business and environment;
9. AR should be conducted in real time, even if retrospective is admitted;
10. The AR paradigm requires its own quality criteria for evaluation.

Coughlan and Coughlan [19] suggest the issues a AR paper should formally deal with:

- purpose and rational of the research;
- context;

- methodology and methods of inquiry;
- story and outcomes;
- self-reflection and learning of the action researcher;
- reflection on the story in the light of the experience and theory;
- extrapolation to a broader context and articulation of usable knowledge.

This paper is structured so as to respect such reporting methodology

3 The Action Research Experience

The company is an Italian SME operating in the national and international market of non-woven materials for medical and extra-medical applications. It is a family owned business, which relies its competitiveness on flexibility, quality and propensity to innovation. The company is very open to changes: e.g., it did not hesitate to outsource part of its manufacturing in the late 90's, benefiting therefore of far-east labor costs.

The main products of the company are surgical kits based on non-woven materials, that are used in hospitals by nurses and surgeons during operations. Companies competing on a traditional PO market limit their VCs (all operations that deliver the product to the customer) before the surgery room (SO) (Figure 1), while PSS offers the possibility of expanding the VC after the SO, with the development of product-related services. As a consequence of that, company potential VC extend its operations before and after the SO (e.g. all operations of used product collection, recycling and disposal).

This leads to the goal of this action research.

Motivations of the Project

Because of the enhancement of competitiveness, hospitals always more demanding in terms of product flexibility and logistic services, and the necessity of anticipating market trends, the company decides to develop a new competitive strategy. As a consequence of that, a team composed by internal decision makers such as company owners, external consultants and academics was established for identifying the desired new competitive strategy. This project resulted in the definition of a new business model, called “global service”, which relies definitely on some basic PSS principles.

Development of the “Global Service” Project

Phase 1 – Market Analysis and Competitors Benchmarking

First, the project team decides to research the characteristics of market demand (hospitals requests) and to benchmark the offer of competitors. The first activity resulted that hospitals were reducing the number of their supplier in favor of unique provider of products and services: e.g., if before an hospital had one supplier for surgical kits and other suppliers for services related like warehouse management and disposal of products; nowadays the tendency is to identify a unique provider of all these products and solutions. Moreover, hospitals remarked also the wish of outsourcing some of their product-associated internal activities, like the advanced labeling of products. Regarding the benchmarking of competitors, these research resulted that larger market player are extended their supply chains so as to enlarge their offer of products and related services.

Phase 2 – Verification of Phase 1 through Field Tests

In order to verify the information highlighted in the Phase 1, the project team decided to carry out a survey into two important Italian hospitals that are historical clients of the company. As a consequence of that, a questionnaire together with semi-structured interviews was carried out in order to identify hospital expectation in terms of products, services and future needs.

This research remarked a number of increasing expectations regarding the products, like the desire of more personalized surgical kits, and particularly regarding services, like: warehouse and orders management, recycling management and disposal management.

Phase 3 – Definition of Possible PSS Strategies

According to the needs identified in the previous phases, the project team developed three different “global service” scenarios, which corresponded to three different levels of PSS strategies with increasing services.

In the first scenario, namely Global Service A, the company performs the following activities related to product and service (S) delivery:

1. Marketing;
2. Pre-sale consulting (S);
3. Order Management;
4. Manufacturing;
5. Packing and Product Delivery;
6. Customer Training (S).

It is possible to remark that services 2. and 6. extend the company traditional VC.

In the second scenario, namely Global Service B, an additional service is added:

7. New Product (NP) customer warehouse management (MGT) (S);

Finally, in the third scenario, namely Global Service C, the company extends its VC after the SO, by offering the following services:

8. Used Product (UP) customer warehouse management (S);
9. Reverse logistic of UP and packing (S);
10. Packing disposal/recycling (S);
11. UP disposal/recycling (S).

Figure 2 summarizes the evolution of the company value chain in correspondence of the three different level of Global Service achieved.

The definition of the different scenarios involved the analysis of various managerial issues, like: definition of the new company value chains, definition of the new company supply chains, analysis of risk and costs in the different scenarios, development of a model for PSS proposal to customers. The investigation of the above aspects lead to the result that not all the competences and resources needed to implement the PSS strategies identified were available inside the company and therefore a consequent phase of partner selection was needed. The implementation of PSS strategies highlighted therefore the need of expanding previous value and supply chain, with the involvement of new partners in the business models. Figure 3 highlights the evolution of the SC in correspondence of the different VC associated to the various level of GS. E.g., it is important to note in GS B the need of an informatics system between the PSS provider and the final client, and the need of an additional partner in GS C.

The remarks above permit to state that increasing level of PSS increase the system complexity.

At the same time, it is important to underline that in this evolution, the company implementing the PSS strategy (the provider) acts as lead actor in the new value/supply chain.

4 Learning from AR and Presentation of a Framework for PSS Strategy Assessment and Implementation

Coherently with the research methodology employed (action research), the expertise developed in the project previously described together with the knowledge available from the literature, lead the authors to develop a framework for PSS evaluation for answering the RQ investigated. Such result

constitutes the extrapolation of the learning from AR to build usable knowledge.

Learning from Action Research

This story from Italy probably does not differ from some other similar stories from other places in the world. We can assert that the actual activities of small and medium enterprises, operating in traditional markets, confines them at the edges of a highly competitive context, characterized by increasing competitiveness versus large players, more demanding customers. The restricted dimension of SMEs and their dynamism, however, allow them to manage change and develop responsibly PSS strategies with customized products and services. So that, adopting a business model, such as PSS, can let SMEs challenge the main competitors and impose them in a niche market by providing high quality products and integrated services. In such a way, PSS can become the leverage to rethink the business model in order to innovate and transform an old business into a new one [13]. Action research revealed the complexity of PSS initiatives, confirming therefore the theoretical evidence that SMEs need to be supported in the assessment/implementation of PSS strategies with the development of specific frameworks and guidelines. Moreover, the specific action research revealed interesting insights as the increase of system complexity with PSS strategies associated to the evolution of both VC and SC.

The general learning, and the authors involvement in the problem solving of the specific AR lead the authors to develop a framework for PSS assessment and implementation, which is further presented.

The ADVP Framework for PSS Assessment and Implementation

The framework proposed for PSS assessment and implementation assumes the acronym of ADVP, since its main components are Analysis, Development, Verification, and Proposal. The framework presented in Figure 4 is further detailed described.

Analysis

The analysis phase represents the first step while facing PSS strategies implementation. In this phase, it is analyzed the current market demand, in order to highlight the request of products, services and product-service systems. Then, it is evaluated the positioning and life-cycle stage of the company portfolio of products; this phase is particularly important since PSS initiatives modify product life-cycles. Further, a benchmarking activity of

competitors should be carried out, in order to evaluate other companies strategies, verify market information and at the same time evaluate the innovation introduced by an eventual PSS strategy implementation. The benchmarking activity should be carried out at an international level, even if the company market is national, so as to better predicts new market trends. Finally, since SME businesses often rely on few customers, information / expectations highlighted in the previous phases should be validated with some current company's customers. Particularly, it is appropriate to take into consideration and identify both the expressed and unexpressed demand; this information is essential for evaluating the profit increase from existing customer or the potential of new buyers. The result of the Analysis phase should be a clear understanding of market needs, which is the base of future PSS strategy definition.

Development

This phase refers to the development of the PSS strategy. First, different PSS scenarios should be defined based on the information received on the Analysis phase. An increasing level of services associated to products should characterize the different scenarios. Once PSS scenarios are defined, the company should evaluate the related change of its value/supply chain (VC/SC). Typically, in fact, PSS strategies need an extension of existing VC/SC versus activities that not always are available in the company, and therefore outsourcing and partners' selection issues arise. Once the different scenarios and related VC/SC have been defined, risk analysis, cost analysis, profit analysis and business sustainability analysis should be carried out in order to economically, financially and environmentally characterize the possible strategies. However, the detail achieved in this analytic phase affects the success of the overall project.

Verification

The implementation of a PSS strategy requires a strong effort for changing from an old business model into a new one. This change impacts on the overall company, and therefore it is important to verify the availability of HR/Infrastructural/ICT competences inside the company. However, this information represents an essential trade-off for understanding the level of PSS that should be implemented and which investments would be required. At the same time, in this phase, new partners needed for VC/SC construction should be identified, involved and contracted.

Proposal

The output of the previous phase should be the responsible understanding of all managerial aspects associated to PSS implementation. Therefore, once the company decides to implement the PSS strategy identified, should develop a marketing plan to promote the new business model in the market, both versus existing and new customers. Such marketing plan could involve the proposal of different level of PSS based on market segmentation. This phase does not differ from the marketing of other business models, anyway company could face issues since used to marketing products instead services.

5 Analysis of Results Achieved in the Action Research

The "Global Service" project has been carried out in about one year. Particularly, some specific aspects of the new PSS strategies are yet under definition and implementation. After one year from the end of the project, preliminary results are discussed (the company has been able to establish two long-term contracts based on GS A and GS B).

As scheme for results' analysis it has been decided to use four dimensions that characterize PSS strategies and have been employed in the ADVP framework in the form of critical analyses (this permit both to verify alignment and planning capability); they are:

- profits;
- risks;
- sustainability;
- costs.

For each dimension, results have been planned over a period of 5 years with different criteria that are further detailed. Results and gaps achieved after the first year are therefore discussed.

In order to evaluate the various dimensions, it must be first introduced the turnover planned. Figure 5 makes this by using table and graphs and showing the turnover planned over a period of five years. Turnover attended is expressed as a percentage of the company turnover 2007, the last before GS implementation.

It is possible to remark a planned exponential growth of the turnover attended with the different GSs, which leads globally to a positive result of +26,4%, respect turnover 2007, in 5 years. Such projections of turnover attended have been outlined based on the expertise of the AR team.

After 1 year, it is possible to result a positive gap (+10%) for GS A, while a negative gap (-30%) for GS B.

Qualitatively, is it possible to remark a not significant deviation from turnover attended. However, during the first year the company suffered the organizational transition to the new business model which required an internal reorganization and significant training of marketing and sales personnel.

Results in Terms of Profits

Figure 6 presents through table and graphs the profits planned over a period of five years. Profits attended are expressed as a percentage of turnover planned.

It is possible to remark a planned exponential growth of the various profits attended with the different GSs. Such projections of profits attended have been outlined based on the expertise of the AR team.

After 1 year, it is possible to result a negative gap (-0,06%) for GS A, and a negative gap (-0,12%) for GS B.

Qualitatively, is it possible to bring similar justifications as those given for turnover gaps.

Results in Terms of Risks

The evolution of risks related to the implementation of PSS initiatives can more generally addressed as the risks associated to a new strategy implementation. As a consequence of that, the AR team decided to adopt the framework for risk evaluation proposed by [20], which suggests to qualitative evaluate the following risks:

1. Presence of a strong competitor;
2. Late adoption of the strategy;
3. Internal barriers which contrast change;
4. Presence of a powerful anti-sponsor in the account;
5. Credibility/reputation problems;
6. Lack of alignment amongst decisions makers;
7. Indecisiveness regarding who the decision makers are and how they feel about the new strategy.

Figure 7 presents through table and graphs the risks planned over a period of five years. Risks estimated by the AR team are expressed in a range from 1 to 5. Due to the novelty of PSS based strategies, it is important to remark increasing risks associated to competitors (minimal at the beginning) as well with possible delays in strategy implementation. Risks associated to internal barriers that could contrast

change are planned to reduce as well as lack of alignment and indecisiveness of decision makers.

Risks associated to anti-sponsors or reputation problems have been planned has minimal.

After 1 year, it is possible to result an increased perception of risk associated to internal barriers (+1) that slow change (internal reorganization impacted more then as planned) as well as perceived risk associated to reputation credibility/reputation problems (perspective clients showed reluctance regarding the role of PSS provider performed by a SME). By the other hand, the perception of risk associated to the lack of alignment and indecisiveness of decision makers is reduced, as consequence of the strong effort played by the AR team.

Qualitatively, it is possible to remark that risk associated to internal barriers and credibility/reputation problems need to be faced with particular attention, since they could become determinants for the success of the overall strategy.

Therefore, specific initiatives should be pointed out so as to contain such risks.

Results in Terms of Sustainability

Sustainability has been the hardest thing to define for the AR team. After many researches, it was decided to adopt the methodology proposed by [21] which focus both on producer and consumer dimensions. Particularly, [21] proposes an environmental impact equation where the role of PSS is highlighted, as in Figure 8.

The first term of I/MI (Environmental Impact per Material Input) refers to pollutant emissions from production processes. The second term of MI/Y (Material Input per Yield) means resource productivity. The third term of Y/S (Yield per Service) is called as service intensity. The second term multiplied by the third term becomes MI/S (Material Input per Service): MIPS, a well-known parameter in sustainable literature. The fourth term of S/W, when inversed, leads Wealth per Service unit and can be called as sufficiency against efficiency. In fact, since various stakeholders are involved, PSS has various opportunities to create a sense of wealth. The concept of eco-efficiency is broad, and covers from the first term to the third term. However, it does not cover sufficiency. On the other hand, PSS covers from the second term to the fourth term. So it has the two elements of eco-efficiency and sufficiency [21]. What is important to remark is that PSS has both efficiency (producer's approach) and sufficiency (consumer's approach).

In our work, we decided to focus in this phase only in the efficiency part of PSS, therefore on the MIPS

parameter. Particularly, it was decided to calculate the MIPS based on the turnover generated from products (MI/Y) and the turnover generated from services (Y/S). Since GSs are a mix of products and services, their relative weight was planned as in Figure 9.

Since the turnover planning has been expressed as function (percentage increase) of the initial turnover T_0 (T_0 equals turnover 2007), turnover of a planned year can be expressed as:

$$T_n = T_0 + \alpha T_0 + \beta T_0 \quad [\#1]$$

were:

α = material component multiplied by turnover increase

β = service component multiplied by turnover increase

Therefore, MIPS can be calculated as:

$$MIPS_n = M/S = (T_0 + \alpha_n T_0) / (\beta_n T_0) = (1 + \alpha_n) / \beta_n \quad [\#2]$$

Figure 10 presents through tables and graphs the value planned of α , β and MIPS over a period of five years; MIPS results and gaps are highlighted.

The sustainability of the different GSs is the inverse function of MIPS:

$$\text{Sustainability} = 1/MIPS \quad [\#3]$$

Therefore, a decrease of MIPS equals to an increase of business sustainability.

After 1 year it is possible to remark good results in terms of MIPS reduction, even if not as planned.

Anyway, the strong role of PSS in making business sustainable is doubtless highlighted.

Results in Terms of Costs

Figure 11 presents through table and graphs the costs planned over a period of five years. Costs planned are expressed as a monthly percentage of HR costs 2007, with reference to standards of GSs (costs are volume dependent).

It is possible to remark a constant structure of HR costs attended with the different GSs. Such projections of costs attended have been outlined based on the expertise of the AR team.

After 1 year, it is possible to result a positive gap of costs (-0,05%) for GS A, and a negative gap of costs (0,18%) for GS B.

Qualitatively it is difficult to make sentences regarding the cost results, since costs structure are time dependent and in this case a little horizon time is available.

6 Conclusions

This paper, based on action research, has investigated the PSS topic by analyzing the case of an Italian SME, which implemented this kind of strategy. SMEs need specific support, which relies in the development of frameworks and related guidelines for managing PSS projects. The firm story probably does not differ from some other similar stories from other places in the world. SMEs in fact are suffering the globalization era and need new business models for leveraging their business. Through action research, this paper has revealed several themes that could add to the existing body of knowledge about PSS. Particularly, regarding the internal analysis needed for assessing and implementing PSS strategies, it highlighted what are the main areas, critical factors, and risks to be explored, assessed, and evaluated through the use of the ADVP framework proposed.

Moreover, the paper has offered insights for PPS profit, risk, sustainability and cost related dimensions' calculation.

Such usable knowledge constitutes the base for building future theory.

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APPENDIX A - FIGURES

Figure 1 – The Value Chain of a Traditional Company Competing in a PO Market

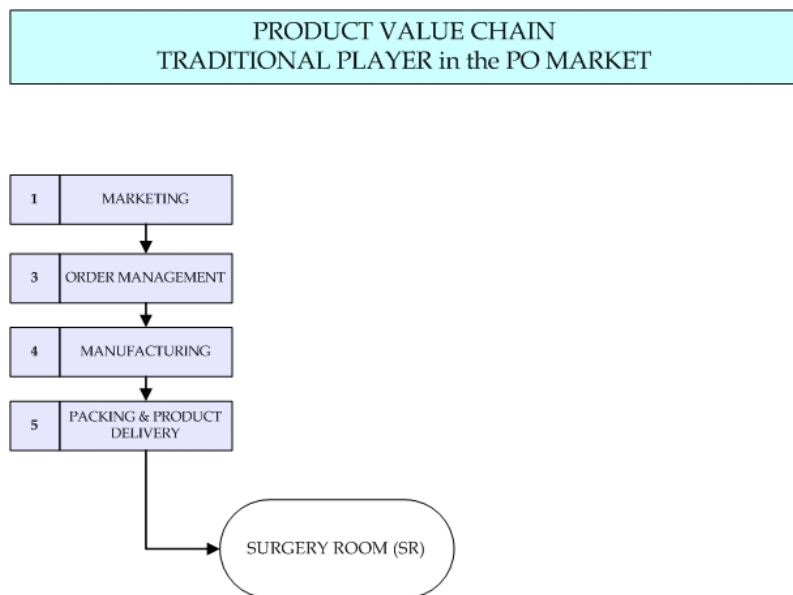


Figure 2 – Evolution of the Company VC in Correspondence of the Different Levels of GS

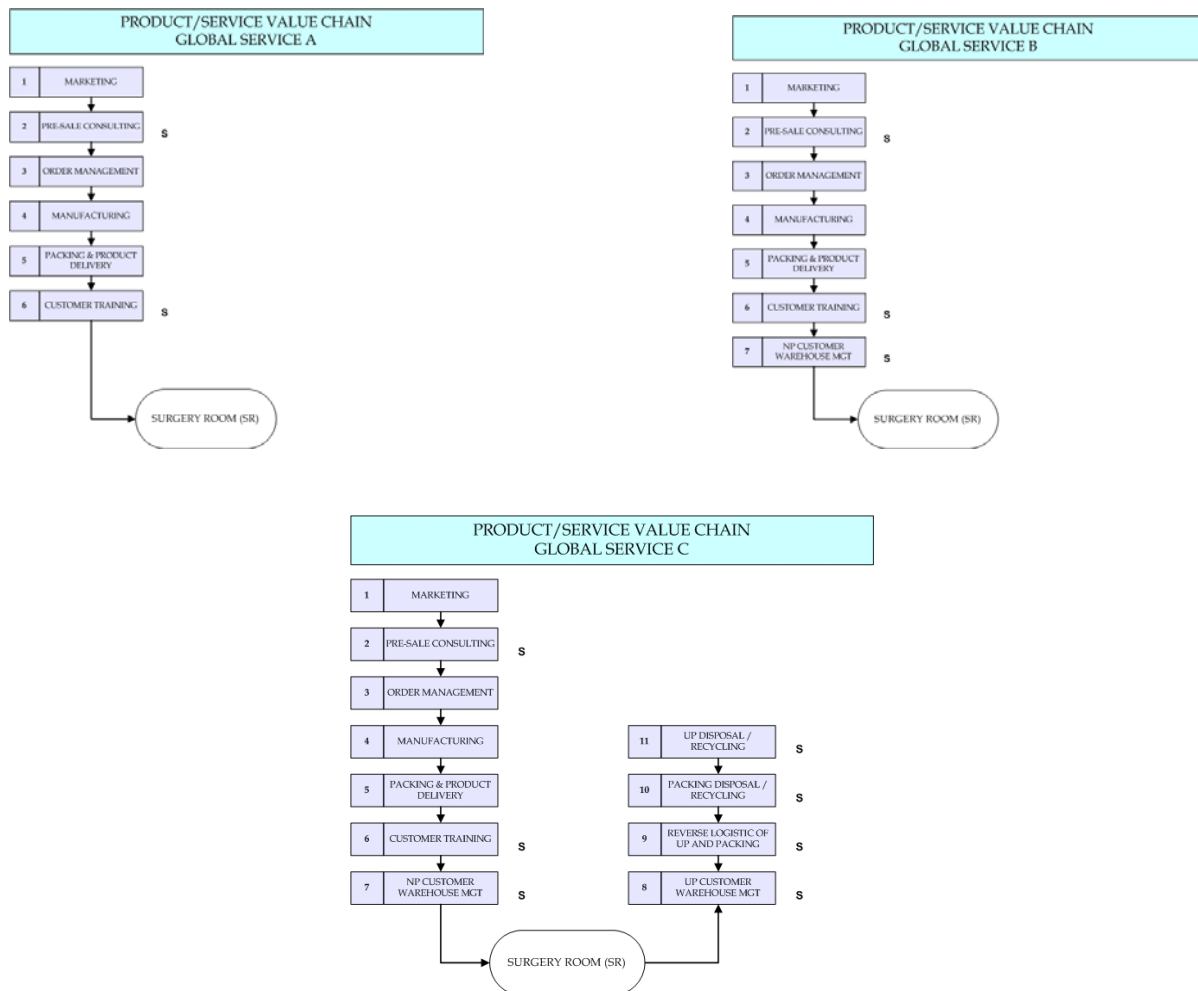


Figure 3 – Evolution of the Company SC in Correspondence of the Different Levels of GS

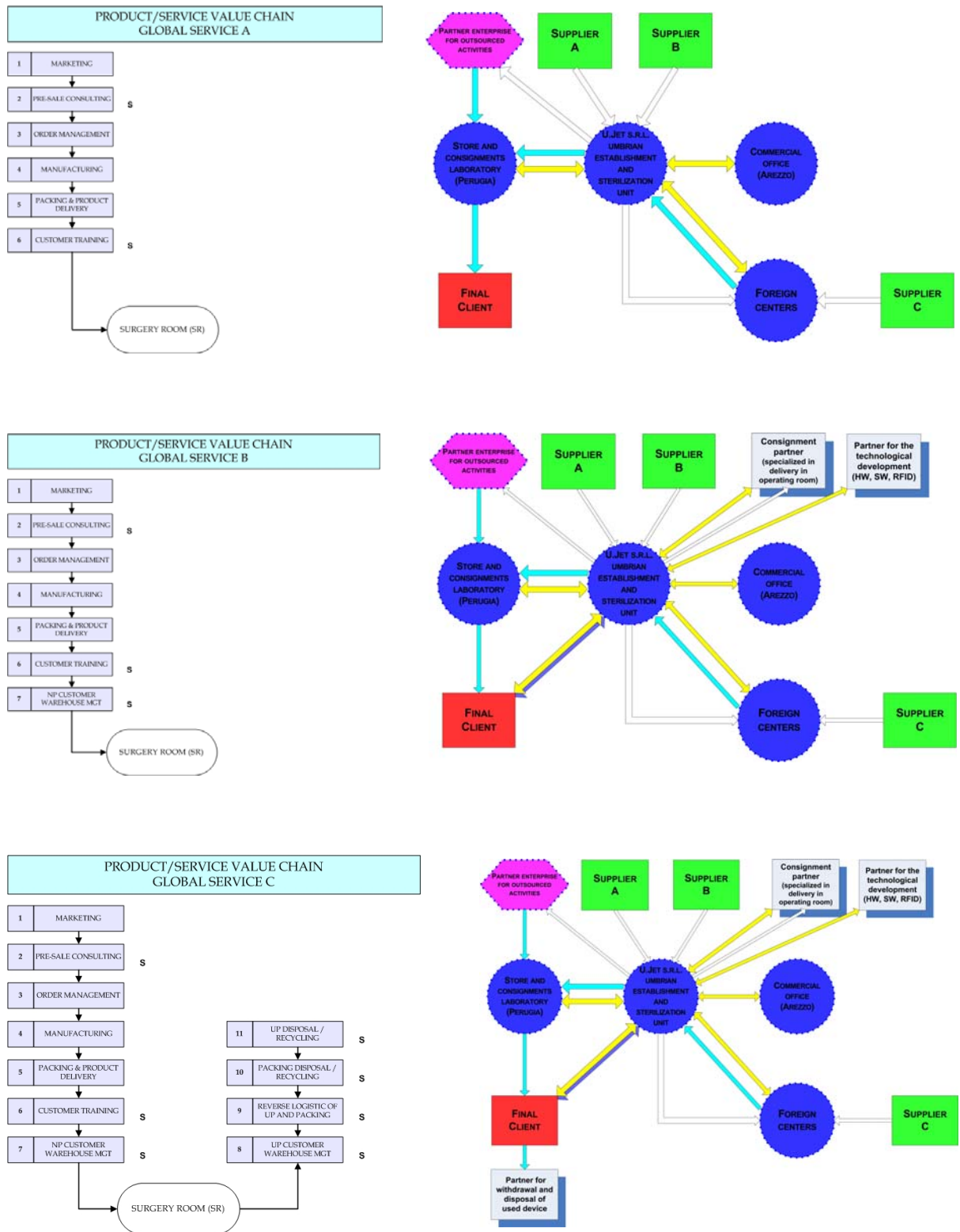


Figure 4 – The ADVP Framework for PSS Assessment and Implementation

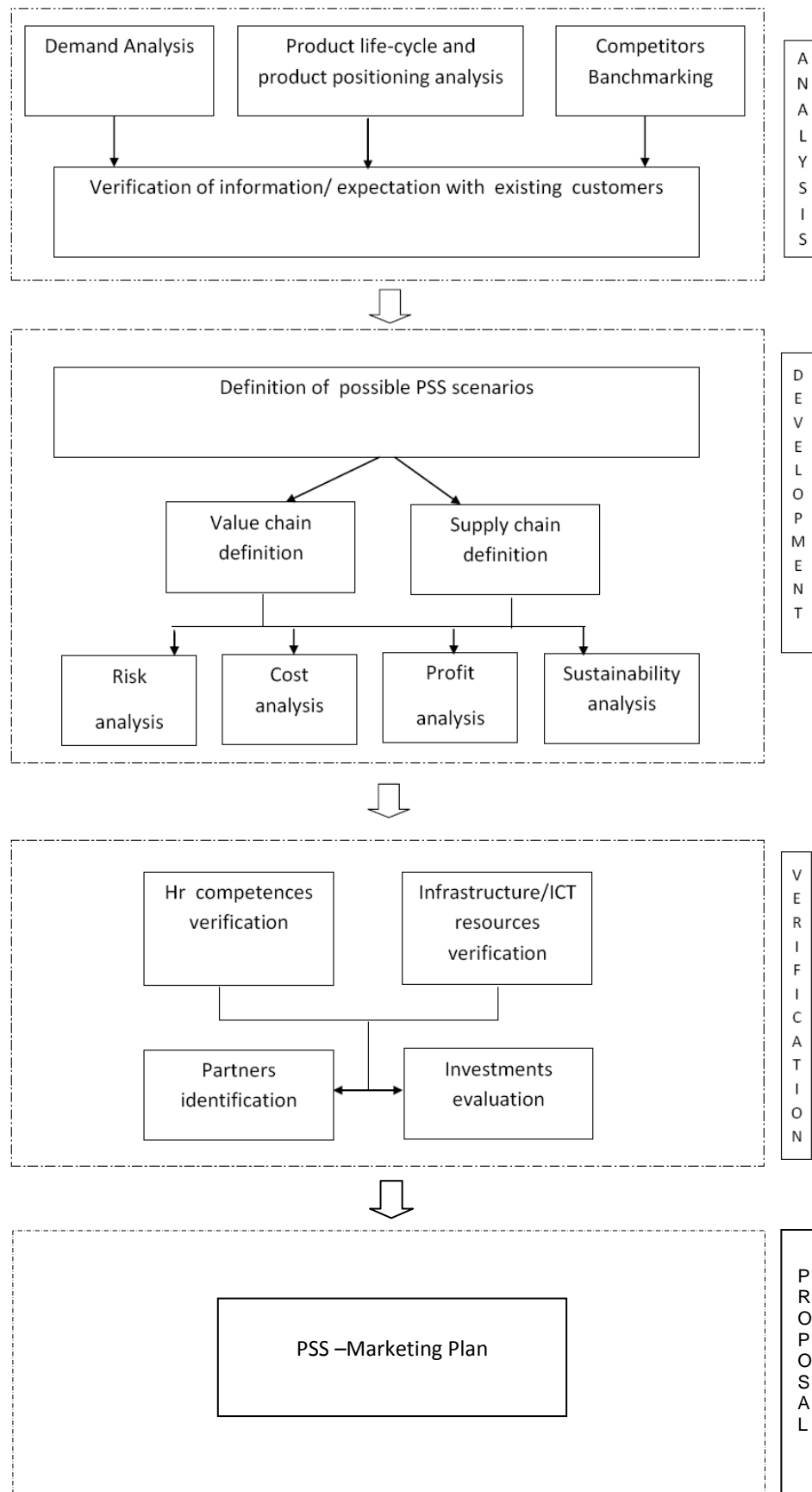


Figure 5 – Turnover Planning and Results

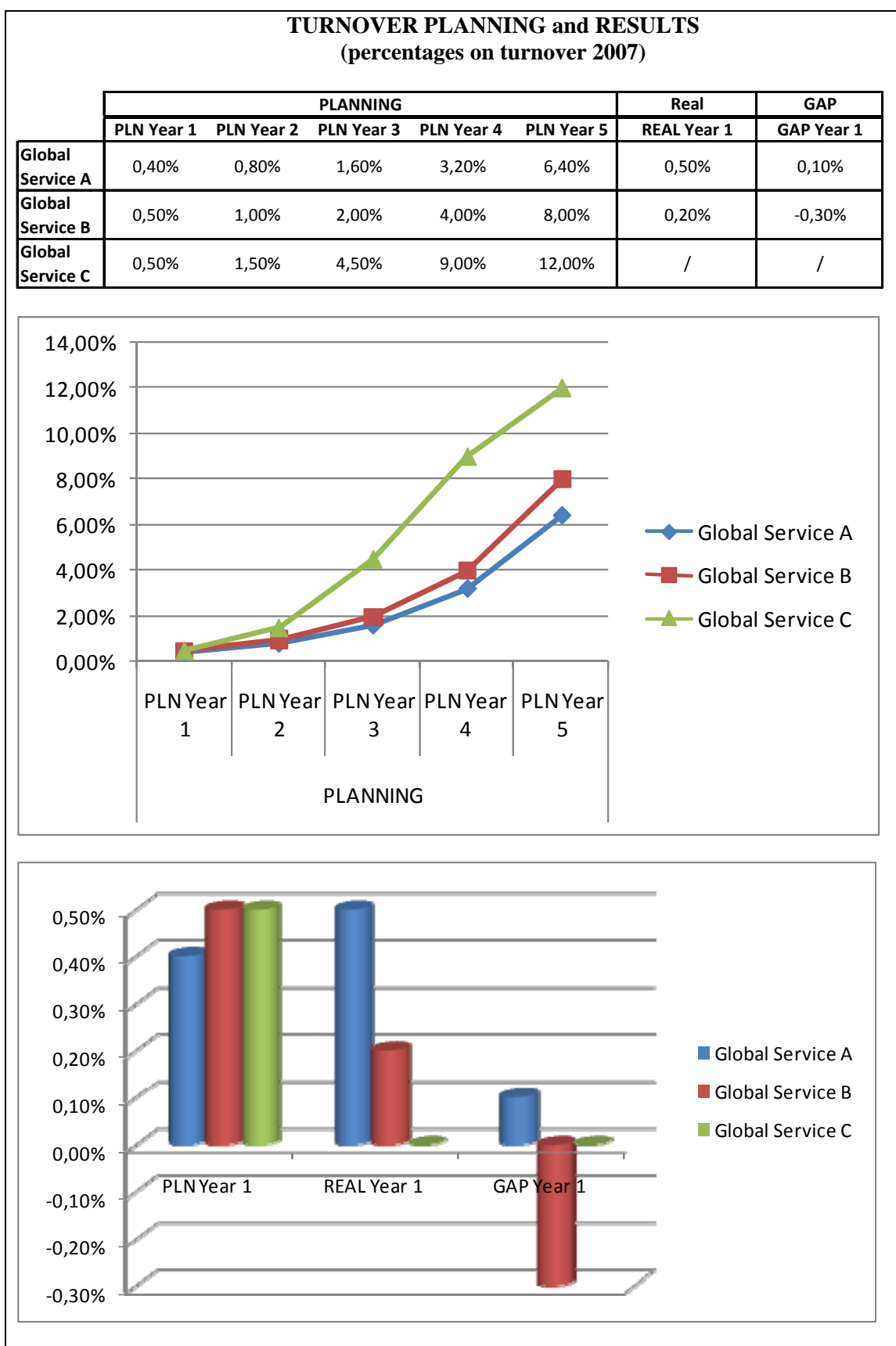


Figure 6 – Profits Planning and Results

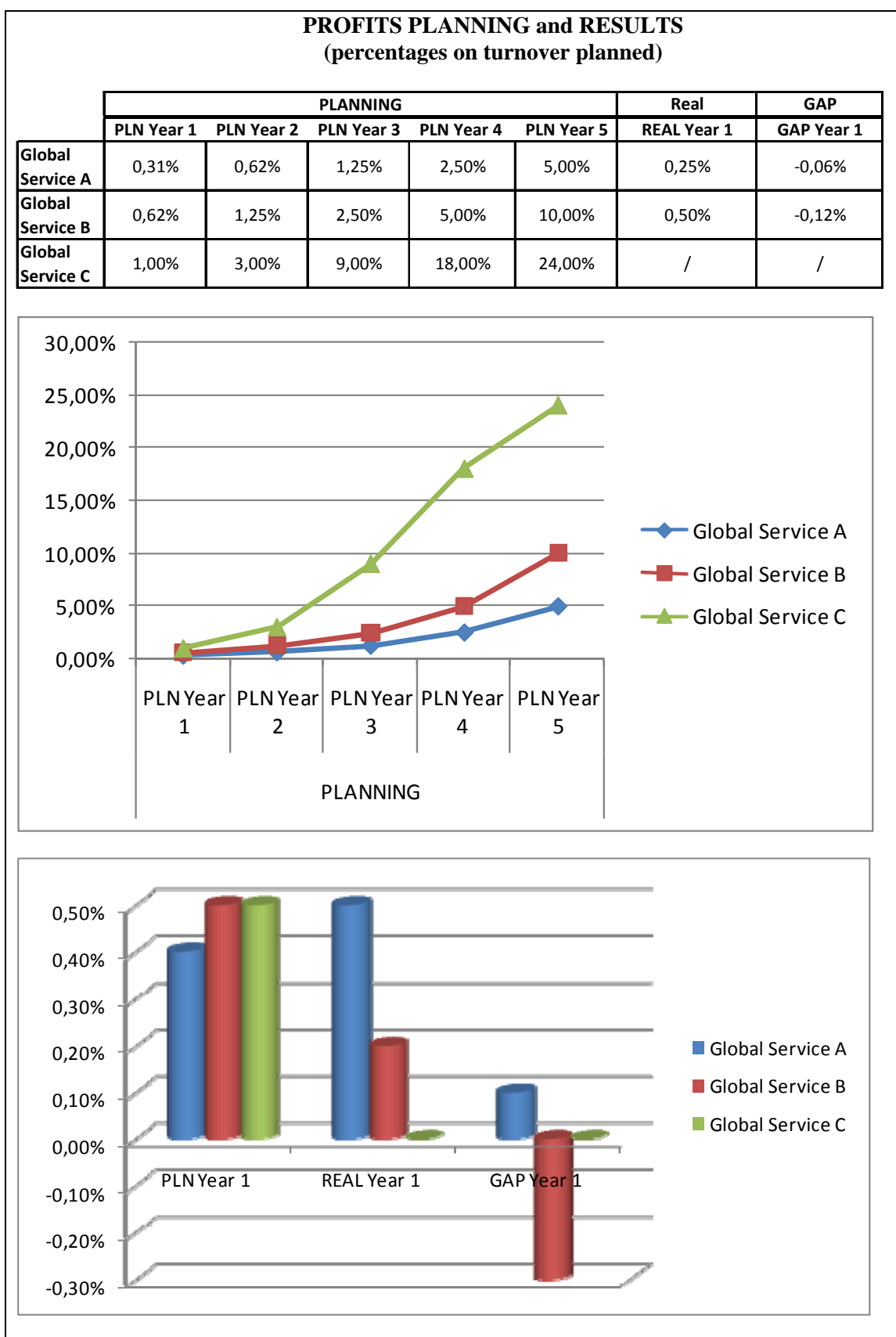


Figure 7 – Risk Planning and Results

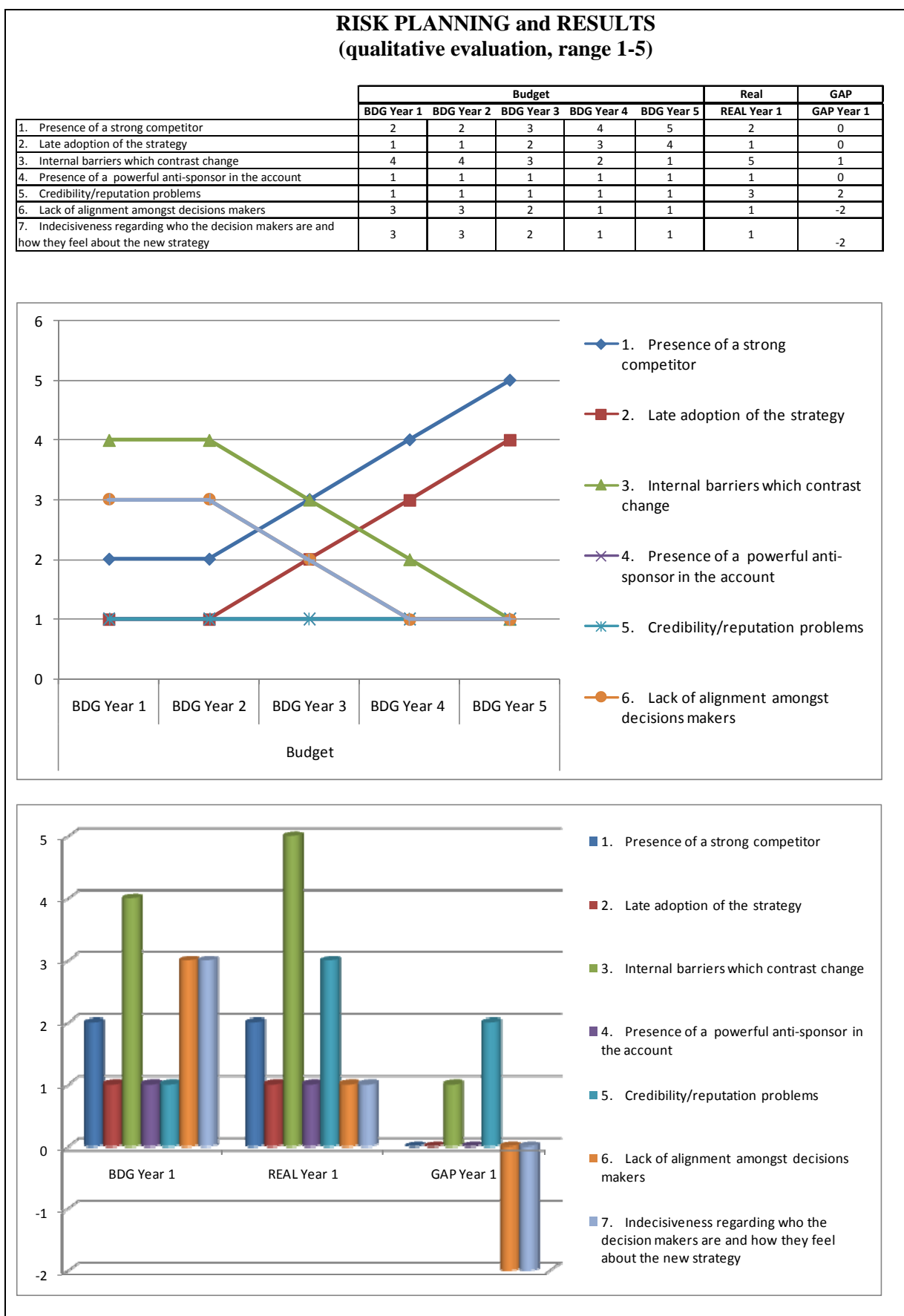


Figure 8 – The Role of PSS in the Environmental Impact Equation [19]

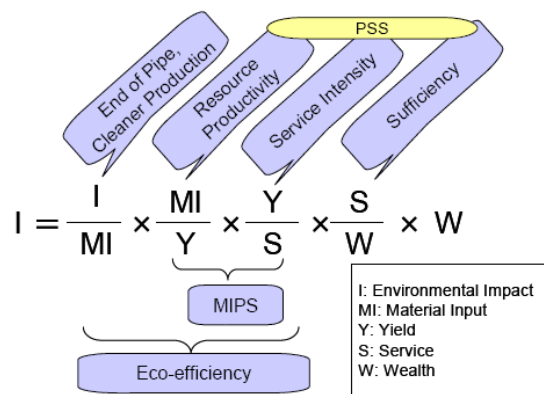


Figure 9 – GSs, Weight of Products and Service Components

	PLANNING	
	Service component	Product component
Global Service A	20,00%	80,00%
Global Service B	30,00%	70,00%
Global Service C	45,00%	55,00%

Figure 10 – Planning of α , β and MIPS, results of MIPS

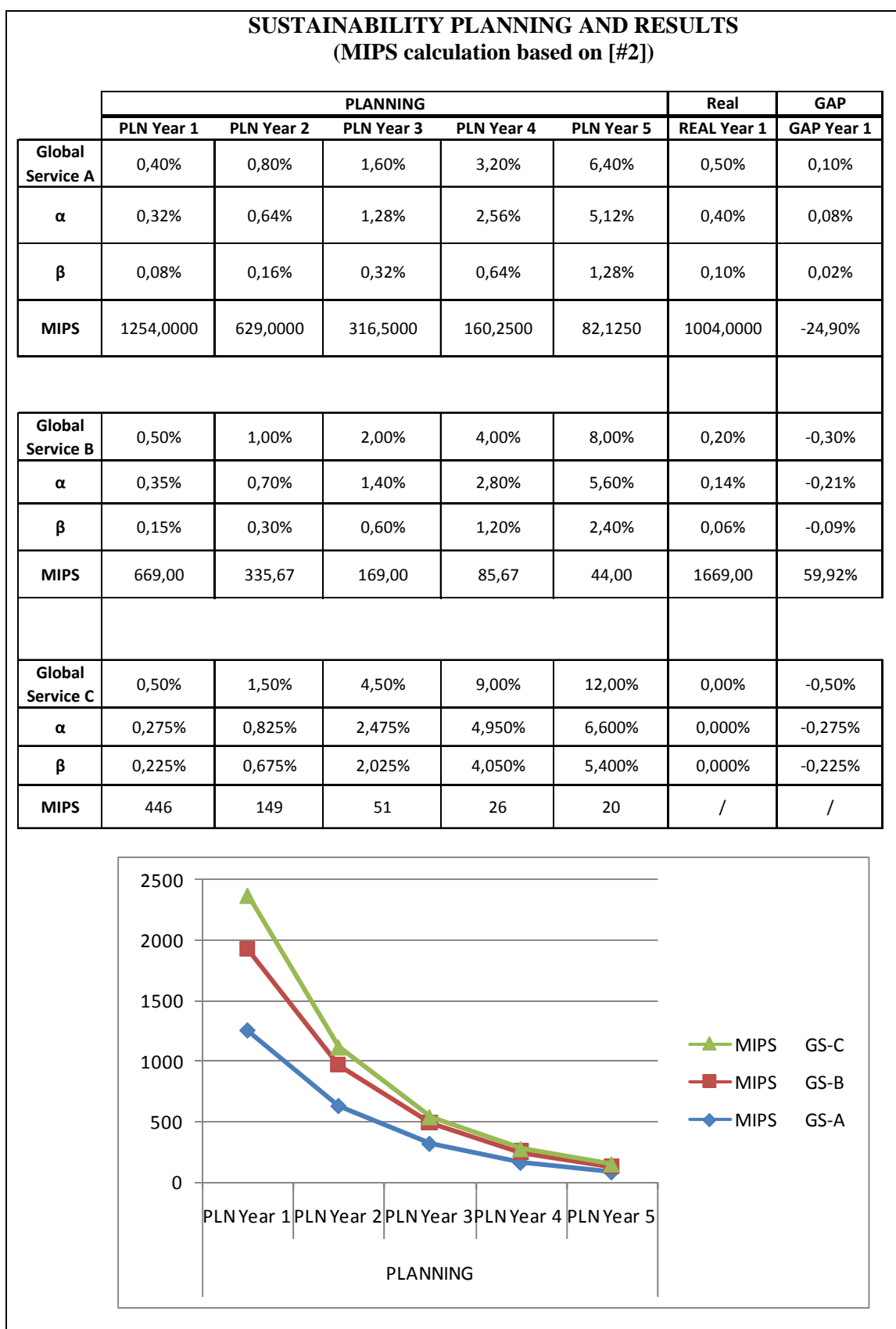


Figure 11 – Costs Planning and Results

