Irregularities in a conventional supplier selection process business essay

Business

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In this paper the relationship between a buyer and his suppliers in the aeronautical sector is studied in order to determine how the suppliers can influence the innovation capabilities of the buyer. The supplier selection process can be classified as a multicriteria decision problem. A model to solve it is proposed using the Analytical Hierarchy Process (AHP) methodology. The evaluation criteria are developed and successfully applied for the case study described in the paper. A detailed step-by-step implementation method is presented and a case study based on an aeronautic company is conducted in order to validate the method. Keywords: analytical hierarchy process; AHP; buyer-supplier relationship; supplier evaluation; innovation; R&D; vendor rating1. IntroductionToday, the competition between corporations grows fast. In highly competitive environments companies which best design and manage their supply chains will be more profitable and hence stronger. ' Supplier' is one of the most important components of a supply chain. A corporation which develops good relationships with its suppliers obtains cost advantages through on-time and desired quality deliveries. Therefore supplier evaluation plays a strategic importance for the corporations (Marufuzzaman, 2009). These considerations become true especially for sectors where the ability to create new products, manage innovation and do R&D, in collaboration with their own partners are critical to the success of a company. This way, an important challenge for researchers and practitioners is to measure the complex processes that influence the supplier's innovation capability, so that they can be optimally managed. The measurement of innovation is also important from an academic research perspective. Within the literature on the innovation management, measures of aspects of innovation management are frequently proposed, responding to the needs of both firms and academics to understand the effectiveness of innovation actions (Kim and Oh, 2002). However such studies appear to be fragmented Empirical studies have found that many organizations tend to focus only on the measurement of innovation inputs and outputs in terms of expenditure, speed to market and numbers of new products, and ignore the processes in-between (Adams et al. 2006). In an attempt to extend measurement theory and practice beyond a focus on output performance, this paper brings together disparate suggestions for innovation management measurement presented in various parts of literature and summarizes commonly used measures at different stages of innovation management in order to evaluate supplier's innovation capabilities. There are many methods used in supplier selection and vendor rating activities, such as, cluster analysis (De Boer et al., 2001), case based reasoning systems (Choy et al., 2003), statistical methods (De Boer et al., 2001), decision support systems (Choy et al., 2003; De Boer et al., 2001), data development analysis (Talluri, 2002; Weber et al., 1998), total cost of ownership models (De Boer et al., 2001; Degraeve et al., 2000), activity based costing (Roodhooft and Konings, 1996), artificial intelligence (Choy et al., 2003; De Boer et al., 2001), mathematical programming (Zhu, 2004; Talluri, 2002; Ghodspour and O'Brien, 2001; 1998) etc. According to authors, inferring a result from the methods described above requires extensive computation as well as time consuming. Also, the above methods do not seem to be efficient to handle complex and unstructured situations. So, in authors opinion there is the need to develop and suggest a better method based on Analytical Hierarchy Process (AHP) to break down a complex and unstructured situation into component parts, then arrange those parts (or variables) into a hierarchical form to deduce a decision, like selecting a supplier according to multiple objectives. In this paper this method has been successfully implemented in an aeronautic manufacturing industry. The paper is structured as follow: section 2 provides a short description of the company analysed in the case study (Alenia Aermacchi); section 3 describes the theoretical background in the supplier selection process topic; section 4 gives an overview of the theoretical methods used (AHP and Redundancy model); section 5 explains the steps proposed in the methodology and its application to the case study; section 6 brings to some conclusions and describes the ongoing work. 2. Industry background and case study introductionThe aeronautical sector of Finmeccanica is led by Alenia Aermacchi SpA, the largest Italian aeronautical industry working in the planning, development, production, maintenance and checking of civil, military and unmanned aircraft, for training and aero structures. Alenia Aermacchi, together with its subsidiaries and affiliates, has a workforce of about 12, 000 people and plays a worldwide leading role in the civil and defence aeronautical industry. Alenia Aermacchi concentrates its own Resarch and Development (R&D) investments for medium-long terms in sectors having a strong direct impact on its areas of activity. R&D programs are realized with internal resources or within projects co-financed by the European Union and by the Italian Ministry of Defence and Research. The major part of this activity deals with aero structures (low observability, composite planning and production, intelligent structures, nanomaterials and nanotechnologies) and with system integration (for both conventional and remote driven aircraft). Alenia Aermacchi’s Supply chain has grown up mainly during the last twenty years, when increasing labour costs have imposed a progressive productive delocalization. All this has allowed the development of an industrial supply park composed of metal-mechanical companies specialized in the manufacturing of metal materials such as titanium, aluminium and steel. In particular, Alenia Aermacchi’s activity (for Boeing 767, 777, ATR, Airbus A319, A320, A321, Eurofighter, etc.) in the past ten years has had a large impact on the companies of the supply network, which have grown up in terms of workforce and skills. As a consequence, these suppliers have experienced an increase in competences and productive ability for those. Along the years these suppliers have enriched their offer by making assemblies both complex and of complete sections of the aircraft, surface treatment of the metal parts, milling of sheets and, more recently, of composite for aeronautical use. However, even though the supply network industries' know-how was enriched by the mutual relationship with Alenia Aermacchi, their growth process has been mostly guided by the search for an adaptation of their productive abilities to the quantities requested by Alenia itself and/or by other aeronautical manufacturers. A consequence of this was that the suppliers focused more to productive investments, which has led to a continuous updating of their machinery, than to realization of new process lines and to the development of technological competences. Not just as significant has been the volume of investments in research and development, in tools and process control methodologies for the implementation of ERP systems (Enterprise Resource Planning) or of the Performance Indicators (KPI). This was the reason why the adoption of a culture of quality and customer satisfaction, as well as the keeping of supply flows in accordance with the specification requested by the client, has taken more time to spread and consolidate. The stricter requirements of competitiveness on cost and time imposed by the market led Alenia Aermacchi to strengthen the collaboration with its suppliers, who were asked not only for a technological adaptation of the productive and control, but also for an improvement of competences, a better communication and computerization level and, most of all, a stronger involvement in the planning, industrialization and production phases. Hence the necessity to select suppliers capable of sharing the business risk (and, at the end, its benefits), strong enough from a financial point of view, and autonomously able to innovate. So a remarkable change in the organizational model between Alenia Aermacchi and its suppliers has taken shape, which from a simple debit/credit relationship has developed into articulate forms of collaboration and sharing of the business and planning risk (partnership). 3. Irregularities in a conventional supplier selection processIn order to validate the proposed supplier selection model, we decided to test it with Alenia Aermacchi, as a case study. We reviewed their current vendor rating and supplier selection method that we named " conventional supplier selection process" as shown in Figure 1 (Marufuzzaman, 2009). The selection processes for some similar industries were investigated and the found scenario was very similar for all of them. From this investigation activity, it was clear that there is no specific and objective set of indicators by which a supplier can be chosen for its innovation and R&D attitudes, especially in such high technological and complex sectors like the aeronautical one. It is usually more like an intuitive process. Supplier selection procedure needs to be well-defined and it should reflect the company’s demand towards a supplier. Suppliers with good R&D performances are the best to become long period partners, especially when involved in high level innovation projects. Great harm for the entire chain and consequently the profitability of the overall supply chain will be reduced in case of interruption of their R&D activities. So, an effective set of indicators and a robust selecting method is required for achieving best performances for the whole supply chain. Taking into examination the conventional supplier selection process, the following disadvantages have come out: It does not consider multiple objectives. Only a few criteria are observed and based on these criteria, the decision which was made often proved to be wrong in the long run. There is no established proportion of the criteria through which it can be understood. As a result there may be the chance for a potential supplier not to be taken into consideration to be omitted. There is no subdivision of the criteria and so mutual comparisons among such subdivisions are missing, which may help the evaluation process to become more precise. It does not collect sufficient data to evaluate a supplier. Very few data are collected instead of a thorough investigation and so the accuracy of the result is very poor. It does not perform any quantitative analysis to assess the value of the supplier in most of the cases. For this reason it is extremely difficult to know the difference between the selected one and the others. There is no a specific and comprehensive set of indicators which help to evaluate and determine the best supplier. So, ratings of suppliers are made intuitively in actual practice. Figure – Conventional supplier selection processThe proposed supplier selection model as shown in Figure 2 overcomes the drawbacks of the conventional supplier selection process. The process starts (once the model is validated) by computing the weighted values of each supplier. The proposed rating model selects a short list of top suppliers, only these could be able to become long term partner, streamlining the selection supplier activity. This selection process considers significant performance indicators in order to determine the best supplier. Figure - Proposed supplier selection process4. Decision analysis models for supplier rating and selection4. 1 Qualitative method for redundancy analysisTwo indicators are related each other if a variation of one causes a variation of the other. The approach commonly used by process analysts to establish the existence of a correlation is based on empirical qualitative reasoning. An " easy to use" method was adopted starting from the content of the relationships matrix. In many cases it is observed that mutually related indicators affect the same objectives of representation. For example, if the i-th indicator influences the u-th objective, then it is probable that the j-th indicator, related to the first, influences the same objective. Under these conditions it is possible to develop a qualitative tool that helps to define the correlations between indicators (Franceschini et al, 2007). This method is obviously a partially solver. In fact, there are related indicators that have no relation with a common objective. Moreover, the dependence of an objective by two indicators is a required but not sufficient condition to evaluate the correlation between the two indicators. So the model proposes the possible relationships between indicators and the analysts are called upon to make the final decision. The first step of the proposed method is the development of the B matrix of relationships. This matrix has the objectives on i-rows and the KPIs on the j-columns. Every element bij represents the grade by which the j-th KPI influences the i-th objective. In particular bij can assume the following values: 9 - if the i indicator has a strong impact on the considered j objective; 5 - if the i indicator has a normal impact on the considered j objective; 1 - if the i indicator has a low impact on the considered j objective; 0 - if the i indicator has no impact on the considered j objective; with i= 1,…., m and j= 1,…., n so we have B ∈ Rm, nIn the second step, the columns bj are normalized by Euclidean norm. So it is possible to obtain a new set of columns vectors vj , which are used to define a new matrix N. The components of the vectors vj are calculated as it is shown: vij = bij / √[∑i (bij)2]with vij = [0, 1] so we have N ∈ Rm, nThe examples in Figure 3 concur to clarify the construction modes of the N and B matrix. BIndicators

NIndicatorsQIndicatorsI1I2I3I4

I1I2I3I4I1I2I3I4ObjectivesO19105

Objectives

O10, 700, 710, 000, 58

Indicators

I11, 000, 550, 080, 86O21195

O20, 080, 711, 000, 58I20, 551, 000, 710, 82O39005

O30, 700, 000, 000, 58I30, 080, 711, 000, 58

I40, 860, 820, 581, 00Figure - Example of B, N and Q matrixThe third step is used to represent the effect of the correlation between the s-th indicator and the t-th indicator, with s, t ∈ j. Particularly, we introduce the Q matrix which has the n KPIs on the rows, and the same n KPIs on the columns. Each element of this matrix is calculated as it is shown: qst = vs x vt = cos (vs , vt) ∀ s, t ∈ j = 1,…., nwith qst = [0, 1] so we have Q ∈ Rn, nFrom a geometrical point of view, this operation identifies the degree of projection of the vector vs on the vector vt. If the value of qst is close to 1 then the correlation between the s-th indicator and the t-th indicator is high. In particular, if qst= 1 then the two indicators are completely overlying on the monitored objectives. Making the calculation of qst for all pairs of vectors of the matrix N it is possible to determine the correlation matrix (Q) between indicators: Q = NTNQ is a symmetric matrix and expresses the degree of correlation between the KPIs. Each element of the diagonal of the matrix Q is equal to 1, by construction. The values contained in Q are compared with a threshold value k. If qst > k, then it is possible to admit a potential correlation between s-th indicator and the t-th indicator, otherwise they are not related. 4. 2 Analythical hierarchy Process (AHP) methodAHP is a decision aid useful to help solving unstructured problems in economics, social and management sciences (Saaty, 1980). AHP has been applied in a variety of contexts: from a simple everyday problem of selecting a school to the complex problems of designing alternative future outcomes of a developing country, evaluating political candidacy, allocating energy resources and so on. The AHP enables the decision makers to structure a complex problem in the form of a simple hierarchy and to evaluate quantitative and qualitative factors in a systematic approach under a multiple criteria environment in confliction. The application of the AHP to the complex problem usually involves four major steps: Break down the complex problem into a number of small constituent elements and thenstructure the elements in a hierarchical formMake a series of pair wise comparisons among the elements according to a ratio scaleUse the eigen-value method to estimate the relative weights of the elementsAggregate these relative weights and synthesize them for the final measurement of given decision alternatives. Saaty (1980) proposed carrying out paired comparisons between the different elements because the human brain is perfectly designed to make comparisons between two elements, hence proposing the scale in Figure 4. Intensity of importanceDefinitionExplanation1Equal importanceTwo activities contribute equal to the objective. 3Moderate importanceExperience and favour slightly favour one activity over another. 5Strong importanceExperience and favour strongly favour one activity over another. 7Very strong or demonstrated importanceOne activity is favoured very strongly over another, its dominance demonstrated in practice. 9Extreme importanceThe evidence favouring one activity over another is of the highest possible order of affirmation. 2, 4, 6, 8For compromise between the above valuesSometimes one need to interpolate a compromise judgement numerically because there is no adequate word to describe it. Reciprocals of the aboveIf activity i has one of the above non zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i. A comparison mandate by choosing the smallest element as the unit of estimate the larger one as a multiple of that unit. Figure - Fundamental scale for paired comparison (Saaty, 1980)Using the scale in Figure 4 the squared matrix $A_{n \times n}$ (Equation 1) is built using: $A = [a_{ij}]$ .... (1)$1 \leq i, j \leq n$where, a_{ij} represents the comparison between element i and element j. This matrix must have the following properties (Saaty, 1986): Reciprocity: If $a_{ij} = x$ then $a_{ji} = 1/x$, with $1/9 \leq x \leq 9$. Homogeneity: If the elements i and j are considered to be equally important then: $a_{ij} = a_{ji} = 1$ and $a_{ii} = 1$ for all i. Consistency: $a_{ik} * a_{kj} = a_{ij}$ is satisfied for all $1 \leq i, j, k \leq n$. For the property of reciprocate; only n (n-1)/2 comparisons are needed in order to build a matrix with dimensions of n×n. The last case or axiom of consistency occurs infrequently due to the innate subjectivity of the decision maker. This subjectivity seeks to objectify the procedure of the paired comparison matrix to the greatest extent possible since the main decision maker must compare the different elements several times in succession, as opposed to just once, in order to build the matrix. Any existing inconsistency can be measured by calculating the Consistency Ratio (CR) of the matrix A and if it does not exceed a certain percentage in relation to the rank of the matrix it is considered valid. If the maximum inconsistency ratio is exceeded in a matrix, the weightings must be revised or their consistency must be increased by using one or more suitable and available program (González-Panchón and Romero, 2004). After that the eigenvectors for the criteria matrix will be defined as vc and indicate the weight or relative importance of each of the criteria used in evaluating the set of alternatives. The eigenvectors of the alternatives matrix for a given criterion will be identified as Vai (column vector) and indicate the weight or relative importance of the alternatives for criterion i. The same number of eigenvectors vai (va1, va2, ..., van) are given that there are criteria (n), with the number of elements of each eigenvector; equal to the number of alternatives (m). The set vai will make up the matrix of alternatives va. Now, the matrix is multiplied by the alternatives by the criteria matrix (Equation 2): va * vc = w .... (2)where, va = [va1, va2, ..., van]dim (va) = m x n. The result is a matrix w whose components express the relative weight of each alternative. This weighting allows the alternatives with greater or lesser interest to be classified and to quantify the level of interest for each alternative in relation to the others using all the available criteria and their importance. The AHP was originally a multi criteria decision-making method finalized at this step since its results allowed the best alternative to be found in relation to the criteria used (Hwang et al., 2005). We decided to adopt the AHP multi criteria decision-making tool in order to select the best supplier..

4. 3 Directions for model developmentThe two methods described can be combined in order to develop a set of indicators useful in the selection

process of suppliers. This set has the property to be strong and descriptive for the problem under consideration. In the following section the two methods will be used to develop a model to evaluate the performance of Alenia suppliers. The procedure used to reach the construction of the final KPI set can be considered standard and then replicated. 5. Implementation of the modelAfter a discussion with the internal Alenia study team and a literature analysis, we proposed seven key areas able to measure innovation and R&D supplier’s capabilities. These areas represent the basis for selecting suppliers in order to establish a long term partnership. The first key area (Innovation Culture) describes the aptitude of the supplier to promote and spread the " values of innovation". Literature suggests measuring the level of risk aversion, the expenditure on training, the ability to perceive external signals and the ability to stimulate and promote innovation within the company. In particular, managerial autonomy catalyzes new or better ways of doing things within the work environment and encourages new initiatives. Therefore good management should motivate its employees to be proactive and to develop new ideas by appropriate instruments (incentives, benefits, discussions, etc.). It is largely demonstrated (Mathisen and Einarsen, 2004) that creative and innovative behaviors are promoted by specific environmental factors encouraging such initiatives. Obviously, it is clear how the nature of these KPIs, used to describe such area, is essentially qualitative. The second key area (Business Skills) assesses elements such as the intellectual capacity of the human factor, the experience and know-how accumulated in the company, plus the ability to problem solving. As shown by a recent literature review (Adams et al., 2006), the skills related to human factors affect the technological experience of the company. The other three identified factors measure the " capacity to absorb knowledge" meaning the ability of a company to acquire and use knowledge. The choice of all the KPIs was made in accordance with the Alenia Supply Chain Management Team. The third key area, which includes three sub-indicators, mainly focuses on the supplier " tangible and intangible assets availability for R&D". This key area identifies parameters such as man-hours expenditure on R&D, average age of equipment, expenses for innovation assets. The more supplier has recent and technologically advanced machinery, the more it will be able to perform complicated and innovative machining. In fact in the aeronautical sector, the potential of innovation for a supplier strongly depends on the processes and materials treatments that he is able to perform.. The fourth key area represents the " financial assets availability for R&D". This key area is probably the easiest to be understood because it identifies whether the supplier is economically able to perform in R&D and whether it is able to find funds for these activities. We use indicators that measure the ability for the supplier to: self-finance its R&D activities, invest in R&D, obtain public or private funding for R&D activities. Particularly, the self-finance ability of a company constitutes an index of economic independence. Economically independent suppliers have a greater chance to decide which activities to perform and how to invest (Chiesa et al., 2009 ; Coccia, 2004). These companies also have an opportunity and a greater willingness to share resources (assets, capital) and increase consequently their risk-sharing aptitude: the supplier who invests his own resources has a greater interest in making those activities as much profitable as possible. The fifth key area describes the supplier organizational capabilities. A research system is the result of the combination of the following three elements: research staff, assets, organizational capability. The last one influences both the research staff and the assets. In fact it represents the process by which different elements are coordinated to achieve the objective (Petroni and Panciroli, 2002). Moreover the organizational capability describes how the research staff is coordinated and how it influences the corporate culture. A proper management of organizational capability leads to a prolific environment for developing new ideas and innovation projects. The sixth key area refers to the collaboration capability. It describes the number of partnerships with customers/partners and with research institutions (university departments, public and private laboratories, research centers, testing or qualification centers) to develop innovative processes of industrialization. The seventh key area measures the ability of the supplier to valorize the results related to his R&D activities (number of new products or technologies developed, number of patents). After a literature review and a discussion activity within the Alenia Team, the proposed decision model for supplier selection included 25 sub-indicators splitted into seven key areas (see Figure 5). The seven main key area indicators representing objective functions are then used to find out the desired output. They are: Key area 1: Innovation Culture - ICKey area 2: Business Skills – BSKey area 3: Tangible and Intangible Assets Availability - TIAKey area 4: Financial Assets Availability - FAKey area 5: Organizational Capability - OCKey area 6: Collaboration Capability – CCKey area 7: R&D Valorize Capability - VAPart of these KPIs were chosen because of the high relevance they deserve within the scientific literature, the remaining were ad hoc developed following to specific directions of Alenia's management. Key areasIndicatorsIdInnovation Cultureactivities, tools, incentives to promote innovationI1middle-management's autonomy level in undertaking new initiativesI2annual number of industrial initiatives and programs (no grant funding)I3annual expenditure in training courses / annual revenueI4scouting activityI5Business Skillslearning curve evaluationI6average level of experience of direct workersI7average number of technologies used / number aeronautical technologiesI8management's level of experienceI9% of resources with a high school graduationI10Tangible and Intangible Assets Availabilityannual man-hours in R&D activitiesI11average age of equipmentI12annual expenditure for production facilities, equipment, software licenses / annual revenuesI13Financial Assets Availabilityannual % of own funds spending for R&D activitiesI14annual R&D expenditure / annual revenuesI15annual amount of public funding received for R&D activitiesI16annual number of relationships with external fundersI17Organizational Capabilitysystem qualityI18annual number of interim positions in the organization chartI19annual % of deliveries in timeI20presence of ICT for planning and controlI21Collaboration Capabilityannual number of R&D collaborations with industrial organizationsI22annual number of R&D collaborations with research institutionsI23R&D Valorize Capabiliityannual number of technologies and products developed as a result of R&D activitiesI24annual number of patents registeredI25Figure - Key indicators of proposed selection modelIn accordance with point 4. 1 of this paper, the redundancy method was applied to the 25 indicators to assess the existence of potential correlations (see

Figure 3 as an example of B, N and Q Matrix). The threshold value k was fixed at 0. 75. Q matrix identifies the pairs of indicators potentially related. So, following the indications shown by the matrix Q (which is not included in this paper because of size limitation) and after an assessment activity the number of KPIs has been reduced from 25 to 12. The final set of indicators has been processed with the AHP method in order to determine the relative weight of each indicator. The pairwise comparison input is obtained from a survey (more than ten Alenia's managers were interviewed). Super Decision Software was used to save time of concerned people and to show the practicability of the approach. However, the method has been explained to managers to get their full involvement. The following steps are needed when modeling the problem with the software. Step 1: Formation of network with goal, clusters and subnets. The supplier selection problem is designed as hierarchical network where the goal is represented by the topmost cluster. The latter is linked to seven other clusters, one for each key area (Tangible and Intangible Assets Availability, Financial Assets Availability, Business Skills, Innovation Culture, Organizational Capability, Collaboration Capability, R&D Valorize Capability). Step 2: One or more nodes, one for each indicator are placed inside each cluster . Step 3: Key Areas and Nodes comparisons. This involves the pair comparison, first among the key areas and then among nodes, using the rating scale presented in Figure 4. Step 4: In this step the Super Decision Software was used to obtain a relative weight for each key area and for each KPI inside it. Step 5: The absolute weight was obtained multiplying the relative weight of each KPI by the relative weight of the Key Areas to which it belongs. Results of AHP analysis are shown in Figure 6. Key areasKey area weightIndicatorsIdKpi absolute weightInnovation Culture22, 4%activities, tools, incentives to promote innovationI17, 8%middle-management's autonomy level in undertaking new initiativesI28, 8%annual number of industrial initiatives and programs (no grant funding)I35, 8%Business Skills14, 4%average level of experience of direct workersI78, 6%average number of technologies used / number aeronautical technologiesI85, 7%Tangible and Intangible Assets Availability9, 2%annual man-hours in R&D activitiesI119, 2%Financial Assets Availability11, 4%annual % of own funds spending for R&D activitiesI145, 6%annual R&D expenditure / annual revenuesI155, 8%Organizational Capability10, 8%system qualityI1810, 8%Collaboration Capability16, 9%annual number of R&D collaborations with industrial organizationsI2211, 5%annual number of R&D collaborations with research institutionsI235, 4%R&D Valorize Capabiity15, 0%annual number of technologies and products developed as a result of R&D activitiesI2415, 0%Figure - AHP analysis resultsFinally, an evaluation scale expressed by a score ranging from 1 to 5 was prepared for each indicator. The overall score for a given supplier is the weighted sum of each result multiplied by the weight of the relative indicator. Beside a bonus and malus score (+0. 5 / -0. 5) based on the trend (increasing or decreasing) of the performance in the previous three years has been provided for each indicator. 6. ResultsA survey was carried out to collect the data useful to perform the ranking of suppliers. The survey focuses on that part of the supply chain including companies supplying Alenia final assembly lines with machined parts and aircraft assemblies. The results collected by the survey have been converted, for each indicator, on a scale from 1 to 5 and the bonus and malus score added. In accordance with steps 2 of Figure 2, the total score is made by a weighted sum, i. e. for supplier C: 3*7, 8% + 5*8, 8% + 4, 5*5, 8% + 4*8, 6% + 2*5, 7% + 4, 5*9, 2% + 4*5, 6% + 3, 5*5, 8% + 5*10, 8% + 5, 5*11, 5% + 3, 5*5, 4% + 4, 5*15 = 4, 27The same computation was repeated for each supplier. So it was possible to establish a suppliers' ranking, as shown in Figure 7.

SUPPLIERId IndicatorWeight (%)ABCDEFGHILMNOPQRI17, 85, 04, 0

3, 0

1, 04, 02, 05, 04, 01, 05, 04, 04, 05, 04, 04, 03, 0I28, 81, 01, 0

5, 0

1, 04, 02, 02, 04, 01, 02, 01, 02, 01, 04, 01, 02, 0I35, 82, 03, 0

4, 5

1, 04, 01, 02, 03, 53, 03, 52, 02, 02, 05, 03, 53, 5I78, 62, 04, 0

4, 0

4, 01, 02, 04, 02, 03, 05, 01, 02, 04, 03, 01, 04, 0I85, 72, 04, 0

2, 0

2, 04, 54, 04, 05, 54, 04, 04, 04, 51, 04, 01, 02, 0I119, 22, 01, 5

4, 5

1, 03, 51, 01, 51, 01, 02, 01, 05, 05, 55, 01, 02, 0I145, 65, 05, 0

4, 0

5, 02, 01, 03, 01, 05, 05, 05, 05, 05, 05, 01, 05, 0I155, 82, 01, 0

3, 5

1, 02, 50, 53, 01, 01, 01, 01, 05, 04, 02, 01, 02, 0I1810, 84, 04, 0

5, 0

4, 04, 01, 04, 02, 02, 04, 01, 02, 02, 02, 04, 02, 0I2211, 52, 01, 0

5, 5

1, 02, 01, 02, 01, 01, 01, 01, 02, 01, 05, 51, 01, 0I235, 41, 01, 0

3, 5

1, 03, 01, 01, 02, 01, 01, 01, 02, 04, 05, 51, 01, 0I2415, 02, 02, 0

4, 5

1, 05, 01, 04, 02, 01, 01, 01, 05, 04, 54, 51, 03, 5TOTAL SCORE(MIN= 0, 5; MAX= 5, 5)2, 482, 52

4, 27

1, 863, 391, 403, 052, 301, 792, 701, 693, 373, 234, 121, 702, 56RANKING10°9°1°12°3°16°6°11°13°7°15°4°5°2°14°8°Figure - Supplier's rankingThe first level includes vendors with the score greater then 4. This is significantly higher (+20%) than the second level score. Looking at the results we can notice a significant increase for 6 of the 12 KPIs considered. These suppliers have been oriented to innovation since their founding. This fact has a positive effect on all areas examined for evaluation: a large number of collaborations, a high level of decision-making autonomy of the middle management, a significant number of industrial initiatives and a good aptitude to promote research and development. These indications were confirmed by the opinion reported by the Alenia Procurament Department during the previous assessment. The second group consists of 4 suppliers. The average score is around the value of 3. 25. These suppliers, unlike the previous ones, have focused their efforts on innovation in the development of a single product. The difference between the first group and the second mainly depends on the scores obtained in the key areas of " Innovation Culture" and " Collaboration Capability". The " R&D valorize Capability" score is still at medium-high level, in fact the performance in this area represents a necessary condition to achieve a top position in the rank. Furthermore, the suppliers of the second group are investing in R&D more than the suppliers of the first group. So in order to have a good innovation performance, the availability of physical and financial assets are not decisive, but it is necessary to create a corporate culture oriented to innovation and keep the skills alive and active through a continuous dialogue and collaboration inside and outside the company. Suppliers of the third group perform R&D mainly to improve their work or because they are towed by the leader company (Alenia Aermacchi). So companies in this group focus their efforts mainly to productive activities: R&D is a marginal activity. The average score for this group drops to 2. 5. Finally, the remaining suppliers belong to the fourth and last group. These suppliers have many values equal to 1: the performances are significantly below the groups average, and they achieve low values in almost all the key areas monitored. 7. ConclusionIn this paper, we have proposed a supplier selection model using a multi criteria decision-making method which includes identifying key indicators, sub-indicators and detailed step-by-step analysis. We use AHP method for the purpose of supplier selection problems. The proposed model of supplier rating was implemented in an aeronautical firm and was developed to describe high innovation contexts. This rating process helps the managers to individuate suppliers from a dynamic and high innovation environment. Basically, aeronautical context is totally different considering other markets, because suppliers must have high level of technology and R&D capabilities. Furthermore the demands of the marketplace, constant changes in product specifications, together with other continuous improvement initiatives within the organisations and the whole sector meant that the supply chains never actually reached a stable state. So, the main company absolutely needs to individuate suppliers with advanced mechanical production equipment while meeting the quality and efficiency standards too, and the proposed supplier rating process was designed and developed to reach this scope.

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