Improvements of Logistics in Region Campania Using a Profiling/Competence-based Approach, Enriched with Experience

Clara Bassano[1], Maria Vincenza Ciasullo[2], Giuseppe D'Aniello[3], Matteo Gaeta[3], and Luigi Rarità[3]

[1] Dipartimento di Studi Aziendali e Quantitativi,
University Parthenope of Naples,
Via Generale Parisi, 13 (Palazzo Pakanowski), 80132, Naples, Italy
clara.bassano@uniparthenope.it
[2] Dipartimento di Studi e Ricerche Aziendali – Management & Information Technology,
University of Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy,
mciasullo@unisa.it
[2] Dipartimento di Ingegneria dell'Informazione, Ingegneria Elettrica e Matematica Applicata,
University of Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano (SA), Italy
{gidaniello, mgaeta, lrarita}@unisa.it

Abstract. This paper focuses on improvements of logistics via removal of weakness points inside the district Agro Nocerino Sarnese (Italy, region Campania), famous for the export of products of high quality to other Italian regions and/or foreign countries. The logistic chain is guaranteed by fleets of trucks, whose aim is to transport goods from a point to another inside the region. In order to repair eventual faults of trucks, the logistic network has particular nodes that are small family business, which have decision processes of naïf type dealing with tradition and related to a leadership. In absence of such leadership, a management crisis might occur, with consequent delays on repair processes and on the delivery of products to the final customers. Hence, possible improvements on performances of the logistic network are achieved trying to reproduce the leadership's decisions (making them stable) via a profiling/competence-based approach, enriched by experience. Precisely, models, dealing with profiles of clients, competences of workers and experience of the leadership, are mixed up and used to reconstruct the leadership's decisions. A real case of small business is useful to test the proposed approach.

Keywords: logistics, competence, profiling, experience

1 Introduction and motivations

Phenomena connected to logistics inside Italian regions are nowadays object of particular attention, due to the survival of regional economy as well as the wealth of the Italy itself. Indeed, region Campania represents a geographical portion in which some aspects connected to transports and distribution of products are fundamental in

order to guarantee profits. This is evident thinking of various goods that region Campania produces. For instance, the famous pizza “di Napoli” is obtained via some operations that derive from high quality products, such as the tomatoes of San Marzano and/or the water of sources near the Vesuvius. It is obvious that other parts of Italy, as well as other foreign countries, require products of region Campania, with the aim of reproducing foods and meals of acceptable standards.

On the other hand, region Campania has the necessity of exporting its own products, as the primary intention is an increment of prestige at national and international level. For this reason, various efforts are made in order to guarantee efficient supply chains, where the satisfaction of producers meets the one of consumers, also thanks to an efficient logistic network that involves the whole region Campania. In particular, the so-called district “Agro Nocerino Sarnese” (ANS), namely an area in Campania, is useful to understand the complex dynamics of region’s logistics. In fact, the district ANS is characterized by the production of many consumer goods, that are then distributed throughout the region and exported to other parts of Italy and/or to foreign countries. One factor that implies wealth in region Campania is the quality of goods that are produced by the district. In particular, the production and the consequent export are the key factor for the success of all operations, which occur inside the region.

In particular, the transport of products from a point to another is often guaranteed by “padroncini”, i.e. owners of trucks. Padroncini aim at managing their fleets of vehicles in order to achieve high quality standards in terms of relationships of type producer-consumer. Indeed, extraordinary events, such as malfunctions and technical problems of trucks, might cause failures for the products’ transports, with consequent disadvantages for the final customer and the performances of the overall logistic network of region Campania.

Indeed, the logistic network has some particular nodes, consisting of small family business, whose job is to repair possible faults of trucks. It follows that a possible high critical situation for logistics inside region Campania depends on how activities of small family business are managed, see [9]. In fact, delays in repairing faults are easily translated into delays in distribution and consequent deterioration of products. As a consequence, nodes, which represent small family businesses, influence the logistic chain. Hence, a possible policy for improvements foresees the reproduction of leadership’s decisions for the work teams assigned at each work order. In fact, the leadership, thanks to its experience, knows the client that has to be served first and how to serve him, see [4]. Indeed, such problem is very complex, as decision criteria are based on experience and tradition of the company and the leadership might vary during years. This last aspect represents a fundamental point, as wrong decisions could cause negative consequences on the served customers (in our case, padroncini).

In this paper, with the aim of improving the logistics inside region Campania, we study a possible methodology for capturing the leadership’s decisions of family businesses. Such approach foresees the fusion of models that are often used individually or in pipe and deal with profiles, competences and experience, i.e. it is a profiling/competence-based approach, shaded with experience.

In particular, as for profiles, the clients' characteristics are studied in order to establish some priorities among the work orders that arrive at a generic small business, see [5], [10]; as for competences, a model based on Knowledge, Skills and Attitude is considered (for further explainations, see [6], [7], [8], [17], [18] and [20]); finally, as for experience, a Pattern Mining algorithm, and precisely an Apriori one (more details are in [1], [2], [3], [11], [12], [13], [14], [15], [16], [19], [21]), is used to understand if the leadership proposes typical group of workers. This last aspect is very interesting because the Apriori algorithm is useful to understand all those features that are difficult to reproduce with the usual knowledge methodologies.

The approach is tested on a real small business inside region Campania. The results for work teams of first choice (the teams chosen by the leadership) and second choice (the alternative teams if first choices are not possible) are very positive. In particular, for the work teams of second choice, the proposed approach indicates that 90% of leadership's decision is reproduced (also if the leadership is absent, and this makes the process stable).

The paper is organized as follows. In Section 2 the real conditions of logistics inside region Campania are described, with emphasis on the transport of goods and problems due to unexpected events. Section 3 considers the case study of a real critical node in region Campania. Section 4 reports the final research results. The paper ends with Conclusions in Section 5.

2 Logistics in region Campania

Inside region Campania, Italy, there is the area of Agro Nocerino – Sarnese (usually called district ANS), which consists of two different geographical parts, the Agro Sarnese and the Agro Nocerino, both located in the valley of the river Sarno, precisely between Naples and Salerno. The district ANS produces many consumer goods, distributed throughout the region and exported to other parts of Italy. The main groups of these products are the following: meat, fish, fruit, milk and dairy products, vegetables (in particular, tomatoes and onions).

Obviously, depending on the type, the previous goods undergo several steps in the producer-consumer chain. Their transit to the consumer is due to a dense logistic network, which involves the whole region Campania. In this context, many factors allow the success of the operations. In particular, we consider the speed of transportation from one point to another in the region, the need to maintain appropriate conditions on the goods during transports (for example, the existence of the cold chain for fish), the partial reduction of unexpected events, such as faults to the means that allow transits in the various points of the network. Notice that, as for big distances and quantities, large transport companies with internal workshops manage trucks that provide the location of goods to another node of the logistics network, thus ensuring an effective, efficient and redundant service. On the contrary, the whole universe of small and medium retailers, served primarily by "padroncini", deals with the regional network.

These small transportation companies, often consisting of just one person, are fundamental to ensure the supply of products to small and medium-sized municipalities as they represent the backbone of the region. Padroncini use a number of workshops/establishments, which are inside the district ANS and are specialized in repair, customization and maintenance of trucks. An example of workshop is the Santonicola F.lli SNC, located in Siano, province of Salerno.

The establishments manage the padroncini's demands because means useful for the transports of goods are often subject to malfunctions of different types, such as mechanical failures for the transport itself and technical problems relating to the storage of the product. The latter is much more critical because the necessary condition that guarantees intact products inside distribution centres is that conservation devices of trucks could work in optimal conditions. Considering such phenomena, as for the transits of trucks in the logistic network, there are further nodes, consisting of sets of small family businesses, whose task is to repair eventual faults of trucks. This suggests that a possible optimization or, in better terms, a possible improvement of the internal dynamics of the district ANS may depend on the management of activities inside small family business. Such situation is easy to understand if you think that delays in repairs of faults imply cascade delays for the distribution of products inside distribution centres, with consequent deterioration of products before they arrive at the final consumer. Hence, nodes representing small business are critical, as they influence the logistic distribution inside region Campania.

In order to overcome such problems, it is necessary to focus on these nodes and their activities. This subject is complex because the decision criteria within small businesses are very empirical, based on experience and tradition and taken by a leadership that, over the years, may be subject to changes. The transition from a leadership to the next one may cause negative trends, as possible decisions are not structured and the whole knowledge of the previous leadership is not transferred to the new generation. This has meaningful impacts on either served customers (in this case, padroncini) or the company itself. Such situations imply, undoubtedly, negative performances inside the logistic chain.

Considering the scenario of the district ANS, the aim of this analysis is to study a possible critical node, providing for it an appropriate solution to address the needs of padroncini and ensuring, therefore, a possible improvement of performances inside the logistic network.

3 Analysis of a real critical node

In what follows, we consider the analysis of a real critical node of the logistic network inside region Campania. The activities of such enterprise are managed by a family and deal with single work orders that are satisfied according to clients' exigencies.

In particular, the leadership considers each work order and, according to the clients' types and priority reasons, assignes a work team, which consists of a subset of workers, the most suitable either for their skills/abilities or for the characteristics of

work orders and priorities of padroncini. The enterprise has different workers, who are listed as follows and whose names are not reported for privacy. There are four coach builders (C1, C2, C3 and C4), four varnishers (V1, V2, V3 and V4), four welders (W1, W2, W3 and W4), two electricians (E1 and E2), three mechanics (M1, M2 and M3) and two upholsterers (U1 and U2).

We consider sixteen work orders to which the leadership assigned a work team. Unlike the case reported in [9], a deeper analysis allowed establishing the so-called teams of "second choice", i. e. the teams chosen by the leadership when some of the most suitable workers for a given work order are already busy or not available. The analysed work orders and the work teams of second choice are in Table 1.

Table 1. Work orders and the corresponding work teams of second choice

Work order	Work team	Work order	Work team
1 – Engine restoration	C1, M3, V1	9 – Leaf spring substitution	W4
2 – Mobile case restoration	V2, W1	10 – Cabin substitution	C2, E1, M3, V3
3 – Refrigerator restoration	V2	11 – Truck recovery	C2, E2, M2, V1
4 – Cargo bed modifications	V1, W4	12 – Truck restoration	E1, M1, V2, W1
5 – Truck preparation	V2, V3, W1, W3	13 – Tractor transformation	C2, E2, U2, V1, V2
6 – Pitch stretching	E1, M1, V3, W3	14 – Soft top construction	E1, V4, W2, W3
7 – Case painting	V1, W4	15 – Cistern painting	C3, C4, V1, V3
8 – Cabin painting	C2, V1	16 – Bartolini case restoration	V3, V4, W3, W4

Notice that the work teams of second choice are not always used by the leadership. Indeed, for some particular work orders (1, 9, 12, 14, 15 and 16, indicated in gray in Table 1), the enterprise does not prefer to assign alternative teams because of the delicacy of the required actions. In these cases, the work teams are the first choices of the leadership. Hence, if it is not possible to assign the team of "first choice", the work order is queued and the corresponding operations are made in a second moment. Moreover, queues of work orders might also occur if it is not possible to create work teams of second choice. In this last case, the work orders are completed with a priority, which is strictly dependent on the clients' characteristics.

In order to improve all operations inside the logistic network, an obvious analysis of work orders and teams is necessary, with the aim of reproducing the possible choices of the leadership. This problem is very difficult, as it deals with the tradition and history of the enterprise. For this reason, various approaches, whose combination might imply a partial reproduction of the leadership's choices, should be considered. Decomposing the original problem into possible factors that are suitable to find a correct solution, it is possible to recognize that the choices' characteristics obey the following criteria: client's features; competences of workers involved in work teams; leadership's experience. Hence, the approach that we are going to follow is profiling/competence – based and it is enriched with experience. Indeed, there are many models dealing with such problems, but are often used separately or in pipe.

The real efforts in this work foresee the fusion of existing approaches, with the aim of obtaining an acceptable reconstruction of leadership's decisions.

In detail, as for the profiling, we follow a model based on convex combinations of factors (see [10] for an example) that are useful to represent the enterprise's clients.

As for the competence representation, we consider Knowledge, Skills and Attitudes, see [18] for details. In particular, Knowledge is the set of support information for a given task; Skill is the capacity of developing the task; Attitude indicates a particular behavior in facing some situations. Indeed, we indicate as KSA Model (see [7], [8], [17], [20]) the competence representation in terms of Knowledge (K), Skills (S) and Attitudes (A). Such model is implemented via Lightweight Ontologies (written in SKOS and similar to taxonomies, see [6]), whose aim is to model a particular domain in a hierarchical way. In particular, each element of type K, S and A has a score, that indicates the competence levels for a particular knowledge domain.

Finally, as for the leadership's experience, Pattern Mining techniques are useful to find relevant patterns in data sequences. In this paper, we use a Pattern Mining algorithm called "Apriori" (see [1], [2], [9], [11], [12], [14], [15], [16], [19], [21]).

In what follows, first we describe some features of the chosen methods for profiling, competences and experience; then, we briefly analyse the approach for the reconstruction of leadership's decisions.

3.1 Profile modelling

Suppose that each client C_i, $i = 1,...,K_C$, of the enterprise is indicated by a vector, whose components are the following:

- Sales figures, C_i^1.
- Time payments, C_i^2.
- Brand, C_i^3, seen as a measure of the company's perception.
- Number of annual reports, C_i^4.
- Loyalty, C_i^5.

For the client C_i, $i = 1,...,K_C$, the component C_i^1 is given by the average sale figures in last three years, while the component C_i^3 indicates the average number of work orders in last three years. The remaining parameters C_i^2, C_i^4 and C_i^5 are variable and generally estimated by the enterprise.

The priority of each client C_i, $i = 1,...,K_C$, is computed as:

$$p^{C_i} = \sum_{j=1}^{5} \omega_j C_i^j ,$$

where $0 < \omega_j < 1$, $j = 1,...,5$, $\sum_{j=1}^{5} \omega_j = 1$.

3.2 Competence modelling

For the analysed enterprise, two different types of KSA models are considered, precisely for workers and work orders. Notice that a different KSA model is defined for each type of worker (coach builder, electrician, mechanic, upholsterer, varnisher and welder). Then, following the characteristics of the various work orders, KSA models for work orders are constructed. Indeed, KSA models for workers and work orders have a precise difference: the former focus on all characteristics of workers while the latter consider what is useful for an assigned work order. For a better comprehension, consider Table 2, that reports the thirtytwo concepts of the KSA model for the worker "varnisher", divided into Knowledge, Skills and Attitudes. In particular, the eight bold concepts allow constructing the KSA model for the work order 3.

Table 2. Complete KSA model for the worker "varnisher"

Knowledge	**Skills**			**Attitudes**
Abrasive materials	Reading instructions on manuals	Application of safety procedures in production	Quality check for the done work	**Accuracy**
Thinners and solvents	Preparation of surfaces to paint	Application of routine maintenance for plants and equipment	Application of painting techniques on metals	**Manual skills**
Regulations	Protection of the area surrounding the objects to paint	Running the painting by sprinklers inside booths for painting	Application of procedures for maintenance and plants machinery	Flexibility and adaptability
Reaction of materials in painting treatments	Preparation of the spray equipment	Application of further paintworks	Application of procedures for noncompliance of unfinished parts	Work in team and cooperation
Features of paints	Adjustment of the equipment according to the features of materials	**Application of any other materials**	Application of techniques to clean metal surfaces	
Mechanical drawing	Application of criteria for paint preparation	Transport of painted parts in ovens and interest for drying stages	Use of instruments for painting	
Specifications of metal materials	Use of personal protection devices	**Visual check or measurement of the thickness of the paint application**	Application of quality control procedures	

Notice that the concepts for each KSA model (either for workers or for work orders) correspond to different *skos:ConceptScheme* and *skos:Concept*, as shown in Fig. 1, that represents an extract of the KSA Model for Welders (shortly indicated by KMW).

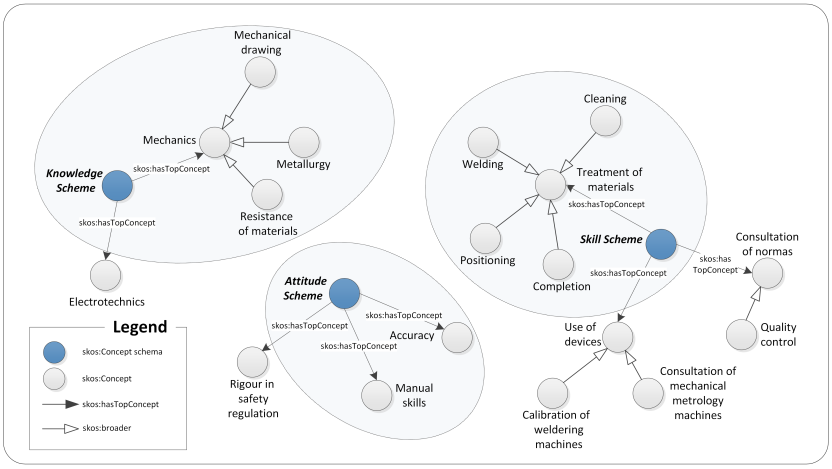

Fig. 1. A portion of KMW

From Fig. 1, we get that the category Knowledge has the subcategories Mechanics and Electronics; Skills has treatment of materials and use of devices, and so on. The ellipses indicate the subsets of welder qualities useful to construct a Worker Order KSA model (shortly indicated by WOKMW), and precisely the work order 9. Notice that, using the only KMW, the welder to choose is W2 (the best worker for the work order), while WOKMW proposes W4. This last choice is coherent with the leadership one (see Table 1), as it indicates the best worker for the assigned work order.

3.3 Shades of experience

The interaction among workers is an important parameter for the success of an enterprise. Indeed, the leadership often foresees that some workers have a high degree of cooperation. Such phenomenon is difficult to model, as it deals with the behavioural attitudes of single workers and the empathy with other colleagues. This situation is captured via the "Apriori" algorithm. It considers that, if a given item set is frequent, its subsets are frequent too. Precisely, consider a transaction database T and a support threshold ε. Let C_k be the candidate item set of length k and L_k be the frequent item set of length k. A possible pseudo code for the algorithm is the following:

$Apriori(T, \varepsilon)$
$L_1 \leftarrow \{\text{itemset of length 1}\}$
$k \leftarrow 2$
while $L_{k-1} \neq \varnothing$
$C_k \leftarrow \text{generate } L_{k-1}$
for transactions $t \in T$, $C_t \leftarrow \text{subset } (C_k, t)$;
for candidates $c \in C_t$, $count[c] \leftarrow count[c] + 1$; $L_k \leftarrow \{c \in C_k : count[c] \geq \varepsilon\}$;

$k \leftarrow k+1$

return $\bigcup_k L_k$

The Apriori algorithm was able to identify the following couples of workers that often occur in work teams of second choices: (C2, V1), (V1, W2), (V3, W3), (E1, M1) and (V1, W4). Such couples represent persons who often work together, and depend only on the leadership itself, i.e. on its experience. The found couples are a quite meaningful example to capture the leadership's experience, a heritage that is difficult to transmit to future generations.

3.4 The whole approach

The whole approach foresees the fusion of the three chosen models (often used individually, see subsections 3.1, 3.2 and 3.3) in order to capture suitable work teams of first and second choice. The steps of the approach are the following (consider Fig. 2 for an abstract vision):

- Reorder the work orders according to the clients' importance and priorities.
- For each work order, choose the team obtained via the KSA models. If such teams coincides with some choices of the leadership, stop; otherwise, try to change workers of work teams using the association rules obtained by the Apriori algorithm.
- If, for the work order in consideration, first and second choice's teams have already been assigned, put the client in queue.

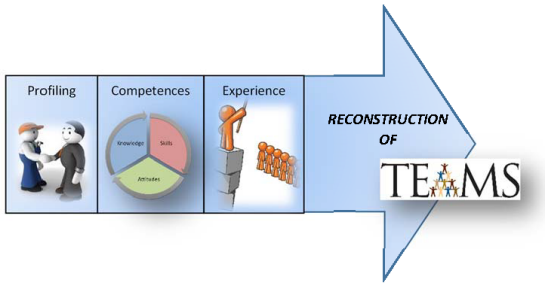

Fig. 2. Chain of the proposed approach

4 Results

In this section, we present the results obtained for the enterprise described in Section 3. In particular, Table 3 reports the comparison between the leadership's work teams (LWT) of first and second choice for the various work orders (WOs) and the ones obtained via the fusion among profiling modelling (clients' characteristics), competence modelling (KSA models), and experience (APriori algorithm). Gray lines

indicate cases in which the leadership does not foresee second choices, and the reconstruction's percentage is also indicated for each reconstructed team.

Table 3. Work orders of first and second choice and their reconstruction

WOs	LWT of first choice	Reconstructed teams of first choice	LWT of second choice	Reconstructed teams of second choice
1	C1, M3, V1	**C1**, **M3**, **V1** (100%)	C1, M3, V1	Not applied
2	V3, W2	**V3**, **W2** (100%)	V2, W1	**V2**, **W1** (100 %)
3	V4	**V4** (100%)	V2	**V2** (100 %)
4	V4, W4	**V4**, **W4** (100%)	V1, W4	**V1**, **W4** (100 %)
5	V1, V2, W2, W3	**V1**, V3, **W2**, **W3** (75%)	V2, V3, W1, W3	**V2**, **V3**, **W1**, **W3** (100 %)
6	E1, M1, V3, W2	**E1**, **M1**, **V3**, **W2** (100%)	E1, M1, V3, W3	**E1**, **M1**, **V3**, **W2** (100 %)
7	V4, W4	**V4**, **W4** (100 %)	V1, W4	**V1**, **W4** (100 %)
8	C2, V1	**C1**, **V1** (100%)	C2, V1	**C2**, **V1** (100%)
9	W4	**W4** (100%)	W4	Not applied
10	C2, E1, M3, V2	C1, **E1**, **M3**, V3 (50%)	C2, E1, M1, V3	C2, **E1**, **M1**, V3 (50 %)
11	C1, E2, M2, V1	**C1**, **E2**, M3, **V1** (75%)	C2, E2, M2, V1	**C2**, **E2**, M1, **V1** (75 %)
12	E1, M1, V2, W1	**E1**, **M1**, V3, W2 (50%)	E1, M1, V2, W1	Not applied
13	C1, E2, U2, V1, V3	**C1**, **E2**, U1, **V1**, **V3** (80%)	C2, E2, U2, V1, V2	**C2**, **E2**, **U2**, **V1**, **V2** (100 %)
14	E1, V4, W2, W3	E2, V3, **W2**, **W3** (50%)	E1, V4, W2, W3	Not applied
15	C3, C4, V1, V3	C1, **C4**, **V1**, **V3** (75%)	C3, C4, V1, V3	Not applied
16	V3, V4, W3, W4	**V3**, **V4**, **W3**, **W4** (100%)	V3, V4, W3, W4	Not applied

As for the first choices, the approach is able to capture a total correspondence for the work orders 1, 2, 3, 4, 6, 7, 8, 9 and 16, i.e. a 100% reconstruction occur for 9/16 situations. As for second choices, considering that work orders 1, 9, 12, 14, 15 and 16 have not to be analyzed, we have a 100% correspondence in cases 2, 3, 4, 5, 6, 7, 8, 11 and 13.

Such results are in Table 4 in terms of correspondence percentages.

Table 4. Correspondence percentages for work teams of first and second choice

Case	100%	More than 50%	Less or equal than 50%
Work teams of first choice	9/16	13/16	3/16
Work teams of second choice	8/10	9/10	1/10

Notice that, using the fusion of the various approaches described in Section 3, we have that:

- For the work teams of first choice, 13/16 work orders (about 80%) present a more than 50% correspondence with the leadership's decisions.

- For the work teams of second choice, 9/10 work orders (90%) have a more than 50% correspondence with the leadership's decisions.

This indicates that the proposed approach is quite useful for the reconstruction of the enterprise's activity with a high degree of accuracy.

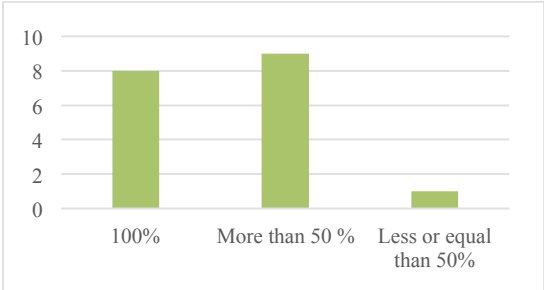

Fig. 3. Number of work teams of second choice with more than 50 % correspondence

5 Conclusions

In this paper, an analysis of logistics inside the district Agro Nocerino Sarnese (Italy, region Campania) is studied. Possible improvements are obtained via the reproduction of decisions inside small family businesses.

Considering a real case of enterprise and using a profiling/competence-based approach, enriched with experience, it was possible to reproduce the dynamics of leadership's choices with a 80% and 90% degree accuracy, respectively, for work teams of first and second choice.

6 References

1. Agrawal, R., Srikant, R.: Fast Algorithms for Mining Association Rules, In: Proceedings of the 20th VLDB Conference, pp. 487 – 493 (1994)
2. Ashtana, P., Singh, A., Singh, D.: A Survey on Association Rule Mining Using Apriori Based Algorithm and Hash Based Methods. International Journal of Advanced Research in Computer Science and Software Engineering. 3(7), pp. 599 – 603 (2013)
3. Barile, S., Saviano M., Polese F.: Information asymmetry and co-creation in health care services. Australian Marketing Journal. 22(3), pp. 205 – 217 (2014)
4. Cabrera-Suárez, K.: Leadership transfer and the successor's development in the family firm. The Leadership Quarterly. 16, pp. 71 – 96 (2005)
5. Capuano, N., D'Aniello, G., Gaeta, A., Miranda, S.: A personality based adaptive approach for information system. Computers in Human Behaviour. 44, pp. 156 – 165 (2015)
6. Clark, D.: Bloom's Taxonomy of Learning Domains. Online version: http://www.nwlink.com/~donclark/hrd/bloom.html
7. Del Nostro, P., Orciuoli, F., Paolozzi, S., Ritrovato, P., Toti, D.: A Semantic – Based Architecture for Managing Knowledge – Intensive Organizations: The ARISTOTELE

Platform, In: Web Information Systems Engineering – WISE 2011 and 2012 Workshops, pp. 133 – 146 (2013), Springer
8. Gaeta, A., Gaeta, M., Piciocchi, P., Ritrovato, P., Vollero, A.: Evaluation of the human resources relevance in organisations via knowledge technologies and semantic social network analysis. Internation Journal of Knowledge and Learning. In press (2014)
9. Gaeta, M., Perano, M., Piciocchi, P., Rarità, L.: Construction of decision criteria for family – run business, In: Proceedings itAIS 2014, pp. 1 – 12 (2014)
10. Gaeta M., Piscopo R., Rarità L., Trevisant L., Novi D.: A Knowledge Management Strategy to Identify an Expert in Enterprise. Smart Organizations and Smart Artifacts, Lecture Notes in Information Systems and Organisation, Springer International Publishing Switzerland 2014. 7, pp. 173 – 182 (2014)
11. Gu, J., Wang, B., Zhang, F., Wang, W., Gao, M.: An Improved Apriori Algorithm. Communications in Computer and Information Science. 224, pp. 127 – 133 (2011)
12. Hong, T., Kuo, C., Wang, S.: A fuzzy AprioriTid mining algorithm with reduced computational time. Applied Soft Computing. 5(1), pp. 1 – 10 (2004)
13. Hong, T. P., Wang C. Y., Lin C. W.: Providing timely updated sequential patterns in decision making. International Journal of Information Technology & Decision Making. 9(6), pp. 873 – 888 (2010)
14. Jia, C. Y., Ni, X. J.: Association rule mining: A Survey. 30, pp. 145 – 149 (2011)
15. Kaur, C.: Association Rule Mining using Apriori Algorithm: A Survey. International Journal of Advanced Research in Computer Engineering & Technology. 2(6), pp. 2081 – 2084 (2013)
16. Lin, C., Hong, T., Lan, G., Wong, J., Lin, W.: Incrementally mining high utility patterns based on pre – large concept. Applied Intelligence. 40(2), pp. 343 – 357 (2014)
17. Loia, V.: Special issue on new trends for ontology – based knowledge discovery. International Journal of Intelligent Systems. 25(12), pp. 1141 – 1142 (2010)
18. Loia, V., De Maio, C., Fenza, G., Orciuoli, F., Senatore, S.: An enhanced approach to improve enterprise competency management, In: 2010 IEEE World Congress on Computational Intelligence, WCCI (2010)
19. Patel, B., Chaudhari, V. K., Karan R., K., Rana YK: Optimization of Association Rule Mining Apriori Algorithm Using ACO. International Journal of Soft Computing and Engineering. 1(1), pp. 24 – 26 (2011)
20. Sampson, D., Fytros, D.: Competence models in technology – enhanced competence based learning, In: H. H. Adelsberger, Kinshuk, J. M. Pawlowski, D. G. Sampson (Eds.), Handbook on Information Technologies for Education and Training, International Handbooks on Information Systems, Springer Berlin Heidelberg, pp. 155 – 167 (2008), doi:10.1007/978-3-540-74155-8-9
21. Sumithra, R., Paul, S.: Using distributed apriori association rule and classical apriori mining algorithms for grid based knowledge discovery, In: 2010 International Conference on Computing Communication and Networking Technologies, pp. 1 – 5 (2010)