Decision aiding in manufacturing improvement approaches

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In an increasingly complex environment, faced with an open market and tough competition, the manufacturing company must excel in its production function. In this context, multicriteria objectives are defined coherently with the manufacturing company's strategy and performance improvements are launched continuously to reach these objectives [1]. The steps of improvement approaches generally implemented use the traditional feedback loop principle, in accordance with the Deming wheel (Plan-Do-Check-Act). In this context, the definition of performance indicators which give pieces of information about the objectives' satisfactions during all the improvement approach period is a key point [2]. Moreover in order to globally control the improvement approach, it is useful for the decision-makers DMs to obtain an overall performance expression synthesizing the elementary ones, for instance to choose or rank the potential improvement actions. So MCDA methods have been considered which define preference model in order to express coherently the different performance expressions. In particular, in our previous works, we have considered the MACBETH methodology which allows the definition of consistent performance expressions according to interval scales. It has been implemented with the 2-additive Choquet Integral to take the criteria pair interaction into account for improving the *service rate* of a SME that manufactures kitchens, bathrooms and storing spaces [3]. In other respects, we have applied the ELECTRE to create an improvement action hierarchy in a Business Turnover increase approach [6].

Our purpose is to generalize the use of such MCDA tools in several manufacturing companies involved in different improvement approaches (Quality and Environmental Plan, Lean Manufacturing, Sustainable development, Supply Chain Management) [4,5]. At this step some remarks can be made. Manufacturing DMs appreciate the decision making process formalization particularly when it supplies quantified performances. This formalization provides a rigorous framework to assess the decision. On the other hand, the preference model building is not so obvious because some concepts (the strengths of preference, the criteria interaction or the different thresholds) are not usual for them. It is a critical point of the methods because the provided decision aiding depends directly on the preference model and then, on the DM's understanding of these basic concepts. Another remark concerns the decision problem type which is not only a choice of one single action among n potential others at an instant t, but rather a continuous adaptation of a set of improvement actions over a long time.
Therefore, we would like to enrich our current approach using the MCDA community works concerning particularly:

- the decision problem specification which deals in the manufacturing context, with diagnosis, potential action definition, action(s) choice, action changes …
- the building of necessary information types (ordinal, cardinal, other) according to the considered decision problem,
- the facility/difficulty to collect the required knowledge for the preference model building,
- the relevance of the preference model for each intermediary milestone of an improvement approach defined in the medium or long term.

Our middle term goal is the proposition of a grid allowing the manufacturing DMs to select a method adapted both to the given manufacturing decision problem(s) and to the available knowledge in order to provide useful decision aiding.

[1] Berrah L. Clivillé V., Harzallah M., Haurat A., Vernadat F., 2001, A cyclic enterprise reengineering method, *International Conference On Engineering Design and Automation (EDA'01)*, Las Vegas, NV, USA, actes sur CD-ROM 6 p.
[2] Berrah L., G. Mauris , L. Foulloy and A. Haurat, 2000, Global vision and performance indicators for an industrial improvement approach. Computers in Industry, 43, 211-225.
[3] Clivillé, V. Berrah, L. Mauris, G. 2007, Quantitative expression and aggregation of performance measurements based on the MACBETH multi-criteria method, International Journal of Production Economics, Vol. 105 (1), p. 171-189.
[4] Berrah, L., Montmain, J., Mauris G. and Clivillé, V., (2011), Optimising industrial making improvement within a quantitative multi-criteria aggregation framework, *International Journal of Data Analysis Techniques and Strategies*, Vol. 3(1), pp. 42-65.
[5] Clivillé, V., Berrah, L. (2011) Overall performance measurement in a supply chain: towards a supplier-prime manufacturer based model, *Journal of Intelligent Manufacturing*, Vol. 22, 11 p.
[6] Clivillé, V., Berrah, L. Evaluation de la Performance industrielle pour le Tableau de bord prospectif par la méthode ELECTRE, 8e Conférence Internationale de MOdélisation et SIMulation - MOSIM'10 - 10 au 12 mai 2010 - Hammamet – Tunisie.