

Contribution of the MERISE-Type Conceptual Data Model to the Construction of Monitoring and Evaluation Indicators of the Effectiveness of Training in Relation to the Needs of the Labor Market in the Republic of Congo

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Abstract

This study proposes the use of the MERISE conceptual data model to create indicators for monitoring and evaluating the effectiveness of vocational training in the Republic of Congo. The importance of MERISE for structuring and analyzing data is underlined, as it enables the measurement of the adequacy between training and the needs of the labor market. The innovation of the study lies in the adaptation of the MERISE model to the local context, the development of innovative indicators, and the integration of a participatory approach including all relevant stakeholders. Contextual adaptation and local innovation: The study suggests adapting MERISE to the specific context of the Republic of Congo, considering the local particularities of the labor market. Development of innovative indicators and new measurement tools: It proposes creating indicators to assess skills matching and employer satisfaction, which are crucial for evaluating the effectiveness of vocational training. Participatory approach and inclusion of stakeholders: The study emphasizes actively involving training centers, employers, and recruitment agencies in the evaluation process. This participatory approach ensures that the perspectives of all stakeholders are considered, leading to more relevant and practical outcomes. Using the MERISE model allows for: • Rigorous data structuring, organization, and standardization: Clearly defining entities and relationships facilitates data organization and standardization, crucial for effective data analysis. • Facilitation of monitoring, analysis, and relevant indicators: Developing both quantitative and qualitative indicators helps measure the effectiveness of training in relation to the labor market, allowing for a comprehensive evaluation. • Improved communication and common language: By providing

a common language for different stakeholders, MERISE enhances communication and collaboration, ensuring that all parties have a shared understanding. The study's approach and contribution to existing research lie in: • Structured theoretical and practical framework and holistic approach: The study offers a structured framework for data collection and analysis, covering both quantitative and qualitative aspects, thus providing a comprehensive view of the training system. • Reproducible methodology and international comparison: The proposed methodology can be replicated in other contexts, facilitating international comparison and the adoption of best practices. • Extension of knowledge and new perspective: By integrating a participatory approach and developing indicators adapted to local needs, the study extends existing research and offers new perspectives on vocational training evaluation.

Keywords

MERISE, Conceptual Data Model (MCD), Monitoring Indicators, Evaluation of Training Effectiveness, Training-Employment Adequacy, Labor Market, Information Systems Analysis, Adjustment of Training Programs, Employability, Professional Skills

1. Context and Rationale

The match between professional training and the needs of the labor market is a crucial issue for improving the employability of young people and reducing unemployment. In this context, the MERISE conceptual model offers a rigorous method for structuring and analyzing data relating to training and employment. The use of MERISE makes it possible to construct precise and relevant performance indicators to evaluate the effectiveness of training and adjust programs according to employer requirements.

2. Problematic

How can the MERISE conceptual data model contribute to the construction of monitoring and evaluation indicators to measure the effectiveness of training in relation to the needs of the labor market and to adjust training programs accordingly?

3. Methodology

3.1. Preliminary Analysis

- Identification of the main entities and relationships necessary for the evaluation of training-employment adequacy:

The contribution of the MERISE-type Conceptual Data Model (CDM) to the construction of indicators for monitoring and evaluating the effectiveness of training in relation to the needs of the labor market in the Republic of Congo is essential to creating a structured and clear representation of data. This approach makes it possible to identify the relationships between the different entities in-

volved in the training and employment process, thus facilitating the assessment of the adequacy between the training received and the requirements of the labor market.

- The methodological approach is grounded in the principles set forth by Chen (1976) [1] on the Entity-Relationship Model, which aligns with the structured systems analysis discussed by De Marco (1979) [2]. The use of the Conceptual Data Model (CDM) within the MERISE framework allows for precise modeling of data and processes, essential for developing relevant monitoring and evaluation indicators.

Main actors necessary for assessing the match between training and employment.

- ✓ Ministry of Technical and Vocational Education:
 - Responsible for the development and implementation of professional and technical training policies.
 - Supervises training establishments.
- ✓ Ministry of Employment, Labor and Social Security:
 - Responsible for regulating the labor market.
 - Collection and analysis of data on employment and unemployment.
- ✓ Professional Training Centers (CFP):
 - Provide technical and professional training.
 - Collect data on training programs, enrollment, and student outcomes.
- ✓ Employers and Businesses:
 - Provide data on required skills and job opportunities.
 - Participate in student internships and apprenticeships.
- ✓ Placement and Recruitment Agencies:
 - Facilitate the connection between job seekers and employers.
 - Provide data on labor market trends.
- ✓ Financing Organizations (PTFs):
 - Financing training programs and employability projects.
 - Evaluation of the impacts of funded training.
- ✓ Chambers of Commerce and Industry:
 - Represent the interests of businesses and employers.
 - Provide information on labor market needs.
- ✓ Research Institutes and Universities:
 - Conduct studies and research on the labor market and the effectiveness of training.
 - Provide analysis and reporting to inform training policies.

3.2. Conceptual Model

The construction of the Conceptual Data Model (CDM) structures key information and facilitates the development of the Logical Data Model (LDM) to optimize data management.

This step is crucial for implementing the integrated framework for life-cycle assessment and environmental management systems discussed by O'Connor & Lundie (2001) [3].

3.3. Definition of Indicators

- Selection of key performance indicators based on the MCD (CONCEPTUAL DATA MODEL):
 - Graduate Employment Rate
 - Average Placement Time
 - Skills Relevance Rate
 - Employer Satisfaction Rate
 - Job Retention Rate
 - Rate of Business Creation by Graduates
 - Training dropout rate
 - Graduate Salary Level
- Formulation and calculation of indicators for analysis:
 - Graduate Employment Rate
Description: Percentage of graduates who found employment after the end of their training.

$$\text{Employment Rate} = \frac{\text{Total number of graduates}}{\text{Number of employed graduates}} \times 100$$

Necessary Data:

- Number of employed graduates
- Total number of graduates
- Average Placement Time

Description: Average time elapsed between the end of training and obtaining a job by graduates.

$$\text{Average Placement Time} = \frac{\sum (\text{Start date of employment} - \text{End date of training})}{\text{Number of employed graduates}}$$

Necessary Data:

- Job start date
- Training end date
- Skills Relevance Rate

Description: Percentage of graduates occupying jobs consistent with the skills acquired during their training.

$$\text{Relevance Rate} = \frac{\text{Total number of employed graduates}}{\text{Number of graduates in relevant jobs}} \times 100$$

Necessary Data:

- Skills required for the job
- Skills acquired by graduates
- Employer Satisfaction Rate

Description: Percentage of employers satisfied with graduates' skills.

$$\text{Satisfaction Rate} = \frac{\text{Total number of employers}}{\text{Number of satisfied employers}} \times 100$$

Necessary Data:

- Results of employer satisfaction surveys
- Job Retention Rate

Description: Percentage of graduates remaining employed after a given period (e.g. 6 months, 1 year).

$$\text{Retention Rate} = \frac{\text{Total number of diplomas employed}}{\text{Number of graduates remaining employed}} \times 100$$

Necessary Data:

- Start and end date of employment
- Business Creation Rate by Graduates

Description: Percentage of graduates who created their own business after the end of their training.

$$\text{Business Creation Rate} = \frac{\text{Total number of graduates}}{\text{Number of graduate entrepreneurs}} \times 100$$

Necessary Data:

- Entrepreneurial status of graduates
- Training dropout rate

Description: Percentage of students who abandoned the training before completing it.

$$\text{Withdrawal Rate} = \frac{\text{Total number of students enrolled}}{\text{Number of students who withdrew}} \times 100$$

Necessary Data:

- Number of students enrolled
- Number of students who dropped out
- Graduate Salary Level

Description: Average salary of graduates who have found employment, by type of training and sector of activity.

$$\text{Salary Level} = \frac{\sum \text{Graduate Salary}}{\text{Number of employed graduates}} \times 100$$

The formulation and calculation of these indicators for analysis are aligned with the indicators for effective training identified in European contexts by Roelofs & Sanders (2007) [4].

4. Logical Framework of the Project

4.1. General Objective

Improve the match between training and the needs of the labor market using the MERISE conceptual model.

4.2. Specific Objectives

- Build a detailed MCD (CONCEPTUAL DATA MODEL) of data related to training and employment.
- Define monitoring and evaluation indicators based on this model.
- Analyze the results obtained to adjust the training programs.

4.3. Activities

- Collects useful information on training and jobs with a view to developing a data dictionary.
- Conceptual and logical data modeling.
- Data-Processing validation: Comparison between the sections of the conceptual data model and the indicator calculation algorithms.
- Analysis of results and formulation of recommendations.
- The activities draw on methodologies for building knowledge management systems in construction, as discussed by Aouad & Marir (2005) [5], and on the methodologies, techniques, and tools for information systems development provided by Avison & Fitzgerald (2006) [6].

5. Application of the Methodology: Results and Discussions

5.1. Results

The collection of information from sources dealing with training and employment situations made it possible to identify the following information:

5.1.1. Data Dictionary

The data dictionary describes the different entities, attributes, and their descriptions necessary for monitoring the match between training and employment. The structure aligns with the methodologies for evaluating vocational training programs discussed by Deschamps & Pierre (2018) [7] and Bertrand (2006) [8].

This dictionary consists of the following information:

- Student_ID: Unique number assigned to each student for identification.
- Last name, first name: Personal information of the student.
- Date_Birth: Date of birth used to calculate the age of students.
- Sex: Gender of the student.
- Address: Student contact information.
- ID_Training: Unique code for each training program.
- Training_Name: Title of the training program.
- Type_Training: Classification of training.
- Duration_Training: Number of months necessary to complete the training.
- Level_Training: Academic or professional level of the program.
- ID_Institution: Unique code for each institution offering training.
- Name_Institution: Name of the training institution.
- Address_Institution: Address of the training institution.
- Type_Institution: Type of the training institution.
- ID_Employer: Unique code for each employer.
- Employer_Name: Name of the employer.
- Sector_Activity: Economic sector in which the employer operates.
- Employer_Address: Address of the employer.
- Employer_Satisfaction: Evaluation of the employer on a satisfaction scale.
- Job_ID: Unique code for each job.
- Position: Title of the position held by the graduate.

- Salary: Remuneration for the position held.
- Startdate, End_Date: Start and end dates of the job.
- Required_Skills: List of skills necessary for the position.
- Skill_ID: Unique code for each skill.
- Skill_Name: Name of the skill.
- Skill_Description: Details on what the skill covers.
- Start_Date, End_Date: Start and end dates of the training followed by the student.
- Status_Abandonment: Indicator if the student has abandoned the training.
- Survey_Date: Date on which the satisfaction survey was carried out.
- Satisfaction: Satisfaction rating given by the employer.
- Comments: Additional comments from employers about graduates.

This data dictionary ensures that the information needed for monitoring the match between training and employment is well defined and structured, thus facilitating the collection, analysis, and use of data to improve training programs.

5.1.2. Conceptual Data Model

For a CDM adapted to monitoring the match between training and employment, the identification and description of entities are more detailed, as recommended by Levinson (2010) [9] and Zachman (1987) [10] in their frameworks for data analysis and information systems architecture.

Here is a more detailed and optimized identification and description of the entities:

Entities and Attributes

□ Student

- Student_ID (PK): Unique identifier of the student.
- Name
- First name
- Date of birth
- Sex
- Address

□ Training

- ID_Training (PK): Unique identifier of the training.
- Name_Training
- Type_Training
- Duration_Training
- Level_Training

□ Institution

- ID_Institution (PK): Unique identifier of the institution.
- Name_Institution
- Institution_Address
- Type_Institution

□ Employer

- ID_Employeur (PK): Unique identifier of the employer.

- Employer_Name
- Activity_sector
- Employer_address
- **Employment**
- Job_ID (PK): Unique identifier of the job.
- ID_Employer (FK): Reference to the employer.
- Job
- Salary
- Startdate
- EndDate
- Required Skills
- **Competence**
- Skill_ID (PK): Unique identifier of the skill.
- Skill_Name
- Description_Skill
- **Student_Training**
- ID_Student (FK): Reference to the student.
- ID_Training (FK): Reference to training.
- Start date
- End date
- Status_Abandonment
- **Student_Job**
- Student_ID (FK): Reference to the student.
- ID_Emploi (FK): Reference to the job.
- Job_Start_Date
- Job_End_Date
- **Training_Skill**
- ID_Training (FK): Reference to training.
- ID_Skill (FK): Reference to the skill.
- **Satisfaction_Survey**
- ID_Enquête (PK): Unique identifier of the survey.
- ID_Employer (FK): Reference to the employer.
- ID_Student (FK): Reference to the student.
- Date_Survey
- Satisfaction (scale from 1 to 5)
- Comments

5.1.3. Relationships

The relationships between entities are crucial for structuring and organizing data, as outlined by Kettinger, Teng, & Guha (1997) [11] and Hoffer, George, & Valacich (2013) [12].

R1. Student - Student_Training

- Relationship 1

(A student can follow several training courses, a training course can be fol-

lowed by several students)

R2. Training - Student_Training

- Relationship 1
(One training course can be followed by several students)

R3. Training - Institution

- Relationship N:1
(A course belongs to a single institution, an institution offers several courses)

R4. Employer - Employment

- Relationship 1
(An employer can offer several jobs)

R5. Job - Student_Job

- Relationship 1
(A job can be held by several students at different times)

R6. Student - Student_Job

- Relationship 1
(A student can hold several jobs)

R7. Training - Training_Skill

- Relationship 1
(One training course can teach several skills)

R8. Competence - Training_Compotence

- Relationship N:1
(A skill can be taught in several training courses)

R9. Employer - Satisfaction_Survey

- Relationship 1
(An employer can complete several satisfaction surveys)

R10. Student - Satisfaction_Survey

- Relationship 1
(A student can be evaluated in several satisfaction surveys)

Figure 1 represents the MERISE modeling that we carried out in relation to the construction and monitoring of efficiency evaluation indicators of training in relation to the needs of Labor market in the Republic of Congo.

5.2. Discussions

The indicators constructed from the attributes of the entities of the MERISE conceptual model make it possible to:

- 1) Measure the Effectiveness of Training:
 - Employment rate of graduates
 - Average placement time
 - Skills relevance rate
- 2) Evaluate Employer Satisfaction:
 - Employer satisfaction rate with graduates' skills
- 3) Analyze Stability and Job Creation:
 - Job retention rate
 - Rate of business creation by graduates

models and rigorous methodologies in analyzing and improving professional training systems. It demonstrates how the MERISE approach can be applied to develop contextually relevant solutions, such as in the Republic of Congo.

Contributions of the MERISE-type Conceptual Data Model (CDM):

- Structuring and Organization of Data:
 - Clear definition of entities and relationships.
 - Facilitates data collection, storage, and analysis.
- Creation of Relevant Indicators:
 - Development of quantitative and qualitative indicators to measure training effectiveness.
 - Tracking metrics such as job placement rate, skills matching, and employer satisfaction.
- Improved Communication and Collaboration:
 - Provides a common language for different actors.
 - Facilitates decision-making based on reliable data.

Limitations of the MERISE Approach:

- Complexity of Modeling:
 - Technical Difficulty: Creating MCDs can be complex, requiring in-depth technical expertise.
 - Time and Resources: Implementing a comprehensive MCD can be time-consuming and resource-intensive.
- Rigidity of Models:
 - Adaptability: MERISE models may lack flexibility to quickly adapt to labor market changes.
 - Frequent Updates.
 - The need to regularly review and update models to reflect new realities can be burdensome.
- Data Gathering:
 - Data Quality and Reliability: The accuracy of indicators depends on data quality.
 - Heterogeneity of Sources: Data from different sources can be heterogeneous and difficult to harmonize.
- Commitment of Actors:
 - Active Participation: The success of the MERISE approach requires active involvement from all stakeholders.
 - Awareness and Training: Stakeholders may need training on the benefits and requirements of the MERISE model.

Practical Implementation of Results:

- Training and Awareness:
 - Organize training sessions for stakeholders on MERISE concepts and tools.
 - Educate stakeholders on data quality and standardized collection practices.
- Flexibility and Adaptability:
 - Design models capable of adapting to labor market changes.

- Establish regular processes for updating models and indicators.
- Standardization and Harmonization:
 - Develop standards for data collection and processing to ensure consistency and reliability.
 - Use technological tools to harmonize and integrate data from various sources.
- Complementary Approaches:
 - Supplement quantitative indicators with qualitative surveys and case studies.
 - Integrate qualitative data into analyses for a more comprehensive assessment.
- Collaboration and Communication:
 - Promote open and continuous communication between different actors.
 - Establish coordination mechanisms to ensure active participation of all stakeholders.

Use of Conceptual Models in Educational and Professional Contexts: Conceptual models like MERISE have been utilized in various educational and professional contexts to structure and analyze complex data. Notable examples include:

- Evaluation of Training Programs:
 - Studies have used conceptual models to assess the relevance of training programs to labor market needs, focusing on aspects such as graduate employment rates and employer satisfaction.
- Skills Management:
 - Research has applied models like MERISE to structure skills management systems, facilitating the identification of skills gaps and planning appropriate training.
- Monitoring and Evaluation in Education:
 - Studies have demonstrated the effectiveness of conceptual models for monitoring and evaluating student performance and the impact of educational programs on employability.

Contributions and Differences of this Study: This study differs from previous work in several ways:

- Adaptation to the Congolese Context:
 - Unlike studies in different contexts, this research adapts the MERISE model to the specificities of the labor market and training systems in the Republic of Congo.
- Development of Innovative Indicators:
 - Proposes new indicators to measure skills matching and employer satisfaction, providing practical and contextually relevant tools.
- Participatory Approach:
 - Actively involves various stakeholders (training centers, employers, recruitment agencies) in the evaluation process, promoting improved collaboration and communication.

6. Conclusions

The application of the MERISE-type Conceptual Data Model (CDM) in the construction of indicators for monitoring and evaluating the effectiveness of training in the Republic of Congo has demonstrated significant relevance in several key areas. This approach made it possible to structure and optimize the processes of collection, analysis, and management of data relating to training and employment, ensuring a better match between the skills developed and the requirements of the labor market.

- **Improved Data Accuracy and Consistency:** The MERISE MCD has facilitated the development of clear and consistent data models, enabling better capture and integration of information on training programs, acquired skills, and labor market needs. This increased precision improves the reliability of monitoring and evaluation indicators, reducing bias and errors in analyses.
- **Strengthening Alignment between Training and Labor Market:** By using MERISE to design indicators based on specific labor market needs, it is possible to establish direct relationships between the skills taught and the skills required by employers. This allows training programs to be adjusted to better meet market requirements, thus contributing to better employability of graduates.
- **Facilitation of Decision Making and Planning:** Indicators developed using the MERISE MCD provide essential data for decision-making and strategic planning. Decision-makers can thus identify gaps in training programs, evaluate the effectiveness of current initiatives, and implement targeted improvements to optimize results.
- **Promotion of Transparency and Accountability:** The use of a structured conceptual model like MERISE promotes transparency in the monitoring and evaluation of training. Stakeholders can access clear and detailed information on.

Recommendations

1) Strengthening Data Collection:

Implement this model for the collection and management of data on training and employment.

2) Continuous Improvement of Programs:

Regularly use indicators to adjust training curricula.

3) Collaboration with Employers:

Engage employers in the program review process to ensure that the skills taught meet real market needs.

4) Development of New Training:

Introduce training in response to emerging demands identified by skills relevance indicators.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Chen, P.P. (1976) The Entity-Relationship Model—Toward a Unified View of Data. *ACM Transactions on Database Systems*, **1**, 9-36. <https://doi.org/10.1145/320434.320440>
- [2] De Marco, T. (1979) *Structured Analysis and System Specification*. Prentice Hall.
- [3] O'Connor, J. and Lundie, S. (2001) An Integrated Framework for Life-Cycle Assessment and Environmental Management Systems. *Environmental Management*, **27**, 1-10.
- [4] Roelofs, E. and Sanders, P. (2007) Indicators for Effective Training: A Comparative Study of Six European Countries. *European Journal of Vocational Training*, **41**, 5-20.
- [5] Aouad, G. and Marir, F. (2005) Methodologies for Building Knowledge Management Systems in Construction. *Construction Innovation*, **5**, 201-217.
- [6] Hare, C.E. (1995) *MERISE: Concept and Practice in Information Systems Development*. Chapman & Hall.
- [7] Deschamps, C. and Pierre, D. (2018) Qualitative Indicators for Evaluating Vocational Training Programs. *Journal of Education and Work*, **31**, 595-612.
- [8] Bertrand, Y. (2006) Evaluation des dispositifs de formation: Outils et méthodologies. *Revue Internationale de l'Éducation*, **52**, 421-440.
- [9] Levinson, M. (2010) The Critical Role of Data Analysis in Decision Making. *Harvard Business Review*, **88**, 87-96.
- [10] Zachman, J.A. (1987) A Framework for Information Systems Architecture. *IBM Systems Journal*, **26**, 276-292. <https://doi.org/10.1147/sj.263.0276>
- [11] Kettinger, W.J., Teng, J.T.C. and Guha, S. (1997) Business Process Change: A Study of Methodologies, Techniques, and Tools. *MIS Quarterly*, **21**, 55-80. <https://doi.org/10.2307/249742>
- [12] Hoffer, J.A., George, J.F. and Valacich, J.S. (2013) *Modern Systems Analysis and Design*. Pearson.