Strategies for Data Reengineering

Henrard, Jean; Hick, Jean-Marc; Hainaut, Jean-Luc

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Jean Henrard, Jean-Marc Hick,
Philippe Thiran, Jean-Luc Hainaut

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Laboratory of Database Application Engineering
Laboratoire d'Ingénierie des Bases de Données
www.info.fundp.ac.be/libd

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Plan

- Introduction
- Problem statement
- Reengineering strategies
  - 2 dimensions
  - 3 strategies
- Conclusion

Introduction

- Legacy system =
  - large and old programs build around legacy DBMS
  - vital to the organization
  - significantly resists modifications and changes
  - expensive to maintain
- Solution : migrate to new platform and technologies
  - expensive and complex process
- Incremental strategy is less risky
  - migrate the DB is one of the steps

Problem statement

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- Data reengineering =

  deriving a new database from a legacy database and adapting the software components
  - the functionalities of the system do not change
- Three main steps:
  - schema conversion
  - data conversion
  - program modification

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Problem statement

- Schema conversion
  - translation of the legacy schema
    into equivalent schema in the new technology
  - DBRE + database design
- Data conversion
  - migration of the data instances from the legacy system to the new one
  - depends on the schema conversion

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Problem statement

- Program modification
  - modification of the programs so that they access the new DB instead of the legacy one
  - functionalities, programming language, user interface unchanged
  - complex process that relies on the schema conversion

Reengineering strategies

- 2 dimensions
  - *database* dimension (schema migration)
  - *program* dimension (program modification)
- Data conversion is directly dependent on the database dimension

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Database migration strategies

Physical conversion (D1):

- translate to the closer construct into the target DMS (e.g. 1 file ⇒ 1 table)
- no semantic interpretation
- cheap but poor quality DB

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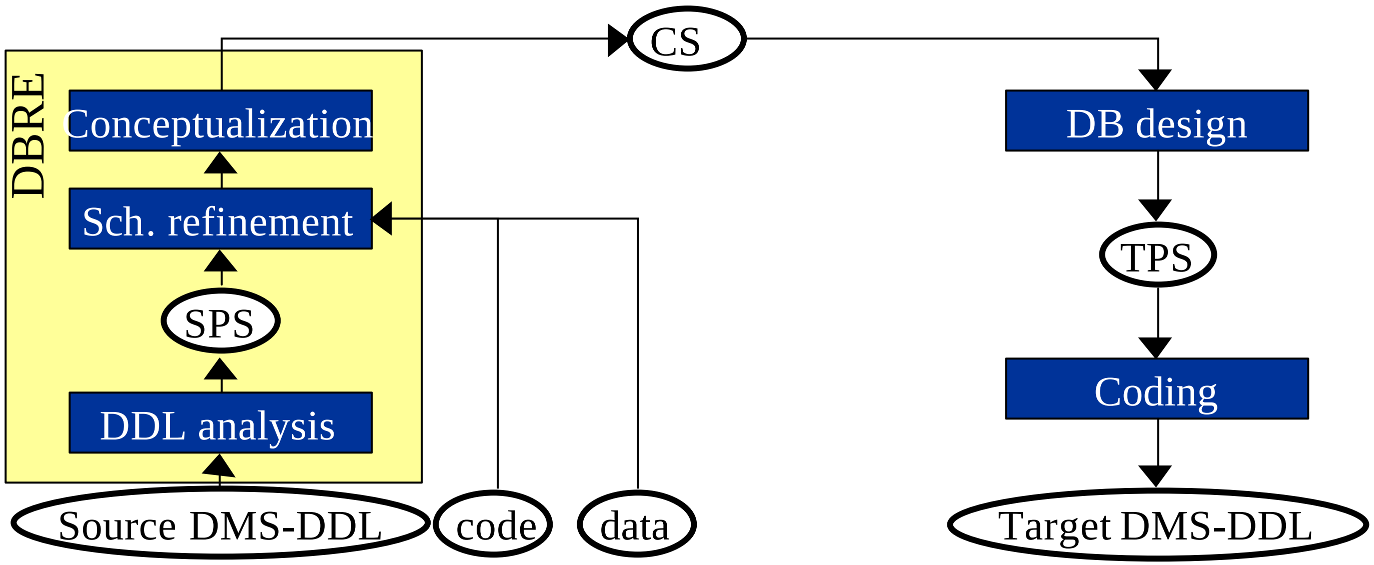
Database migration strategies

- *Conceptual conversion (D2)*
  - recovering the semantic (conceptual sch) - DBRE
  - developing the new DB from the conceptual sch
  - good quality and documented DB but expensive



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Database migration strategies

- Schema conversion = schema transformation
- History = chain of transformations
- **Mapping** between the source (SPS) and target (TPS) physical schemas

= SPS-to-TPS for physical migration

= SPS-to-CS-to-TPS for conceptual migration

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Program modification strategies

- Wrappers (P1)
  - wrappers encapsulate the new database
    - data wrapper =
      - data model conversion
      - semantic conversion
      - functionality simulation
    - "inverse" wrapper: simulate the legacy data interface on the new DB
      - ex: uses COBOL read, write for accessing SQL data
      - SPS -- TPS mapping ⇒ automated generation of wrapper
  - programs use legacy data access logic
  - program logic not changed
  - local changes: 1 instruction ⇒ *x* instructions

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Program modification strategies

- Statement rewriting (P2)
  - legacy DMS-DML ⇒ target DMS-DML
    ex: replace COBOL file access statement by SQL statement
  - rewriting the access statements (new DMS-DML)
    - each legacy DML statement must be located
      and replaced by equivalent statements in the new DML
    - SPT--PTS mapping ⇒ automatic program modification
  - program logic not changed
  - local changes: 1 instruction ⇒ *x* instructions

Program modification strategies

- Logic rewriting (P3)
  - program rewritten to use the new DMS-DML power
    - explicitly accesses new data
    - takes advantage of the new DML
  - logic of the program is changed
    - requires a deep understanding of the program
  - global change: *x* instructions $\Rightarrow$ *y* instructions)

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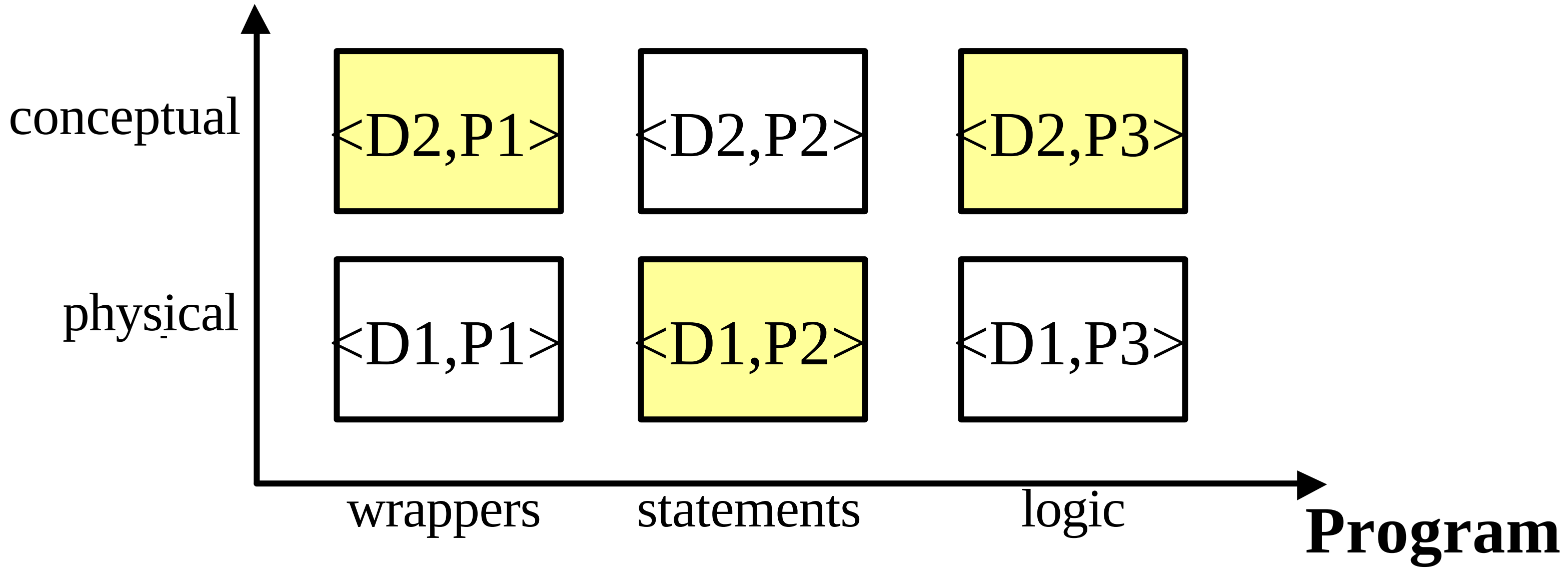
Reengineering strategies (summary)

- Six strategies

Database (schema)



- <D1,P3> useless

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Wrapper strategy <D2,P1>

- modification of the legacy code is minimal,
  new DB well structured and optimized w.r.t. the new DMS
- good solution for complete migration:
  first the DB and later the programs... Illustration

```
READ PRODUCT
     KEY IS PROD-CODE
     INVALID KEY
          GO TO ERR-123.

DELETE PRODUCT
   END-DELETE.
```

⇒

```
CALL WR-ORD-MNGMT
  USING "READKEY","PRODUCT",
        "PROD-CODE",
        PRODUCT,WR-STATE.
IF STATUS OF WR-STATE NOT= 0
    GO TO ERR-123.

CALL WR-ORD-MNGMT
  USING "DELETE ","PRODUCT",
        "",PRODUCT,WR-STATE.
```

Statement rewriting strategy <D1,P2>

- Illustration

```
  MOVE CUS-CODE TO ORD-CUSTOMER.
  START ORDER KEY >= ORD-CUSTOMER.
  MOVE 0 TO END-FILE.
  PERFORM READ-ORD UNTIL END-FILE = 1.
READ-ORD SECTION.
BEG-ORD.
  READ ORDER NEXT

    AT END MOVE 1 TO END-FILE
           GO TO EXIT-ORD.
  <<processing current ORD record>>
EXIT-ORD.
  EXIT.
```

⇒

```
EXEC SQL declare cursor ORD_GE_K1 for
  select ORD_CODE,ORD_CUSTOMER,ORD_DETAIL
  from ORDER where ORD_CODE >= :ORD-CODE
  order by ORD_CODE END-EXEC.
  ...
  EXEC SQL declare cursor ORD_GE_K2 for
  select ORD_CODE,ORD_CUSTOMER,ORD_DETAIL
  from ORDER where ORD_CUSTOMER >= :ORD-CUSTOMER
  ORDER BY ORD_CUSTOMER END-EXEC.
  ...
  MOVE CUS-CODE TO ORD-CUSTOMER.
  EXEC SQL open ORD_GE_K2 END-EXEC.
  MOVE "ORD_GE_K2" to ORD-SEQ.

  IF ORD-SEQ = "ORD_GE_K1"
    EXEC SQL fetch ORD_GE_K1 into :ORD-CODE,
         :ORD-CUSTOMER,:ORD-DETAIL END-EXEC
    ELSE IF ORD-SEQ = "ORD_GE_K2"
      EXEC SQL fetch ORD_GE_K2 into :ORD-CODE,
          :ORD-CUSTOMER,:ORD-DETAIL END-EXEC
     ELSE IF ...
     END-IF.
  IF SQLCODE NOT = 0
     MOVE 1 TO END-FILE GO TO EXIT-ORD.
  <<processing current ORD record>>
```

Statement rewriting strategy <D1,P2>

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- modification of the legacy code is minimal, DB not restructured, mimics the legacy DB
- Quick and dirty solution....

Logic rewriting strategy <D2,P3>

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Illustration

```
DISP-ORD.
  READ ORDER KEY IS ORD-CODE
    INVALID KEY
      GO TO ERR-ORD-NOT-FOUND.
  PERFORM DISP-ORD-CUS-NAME.
...
DISP-ORD-CUS-NAME.
  MOVE ORD-CUSTOMER TO CUS-CODE
  READ CUSTOMER
    INVALID KEY
      DISPLAY "ERROR: UNKOWN CUST"
    NOT INVALID KEY
      DISPLAY "ORD-CODE: ”
              ORD-CODE NAME.
```

⇒

```
DISP-ORD.
  EXEC SQL
    SELECT O.CODE, C.NAME
      INTO :ORD-CODE, :NAME
      FROM ORDER O, CUSTOMER C
      WHERE O.CUS_CODE = C.CODE
         AND O.CODE = :ORD-CODE
  END-EXEC.
  IF SQLCODE = 0
    DISPLAY "ORD-CODE:  »
            ORD-CODE NAME
  ELSE
    GO TO ERR-ORD-NOT-FOUND.
```

Logic rewriting strategy <D2,P3>

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- program is rewritten (long, difficult, risky)
  new DB well structured and optimized w.r.t. the new DMS
  programs optimized w.r.t. the new DMS
- good solution if no program migration planned, only the DB is migrated

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Conclusion

Strategy	Database migration	Program conversion	Quality
D2, P1	complete DBRE, expensive	cheap, fully automated, wrapper semi-automatically generated	good quality DB, the programs unchanged (call to the wrapper)
D1, P2	cheap, fully automated	cheap, fully automated	poor quality DB, the programs unchanged (call the new DML)
D2, P3	complete DBRE, expensive	very expensive, requires a deep understanding of the programs	good quality DB, programs semi-renovated

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Conclusion

Strategy	Performance	Maintenance	Evolution
D2, P1	Poor: legacy logic, mismatch, emulation	like the legacy system, but the semantics of the DB is known and data access simulated by the wrapper	easier, the new functions can directly access to the new DB
D1, P2	Poor: legacy logic, mismatch	like the legacy system, the semantics of the DB is not recovered but data access are simulated by the new DML	difficult, the DB simulates the legacy one
D2, P3	Good: new logic, matching	easier, the semantics of the DB is known	easier, the new functions can directly access to the new DB