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Church/Smith REA Framework: Closing the loop and integrating uncertainty

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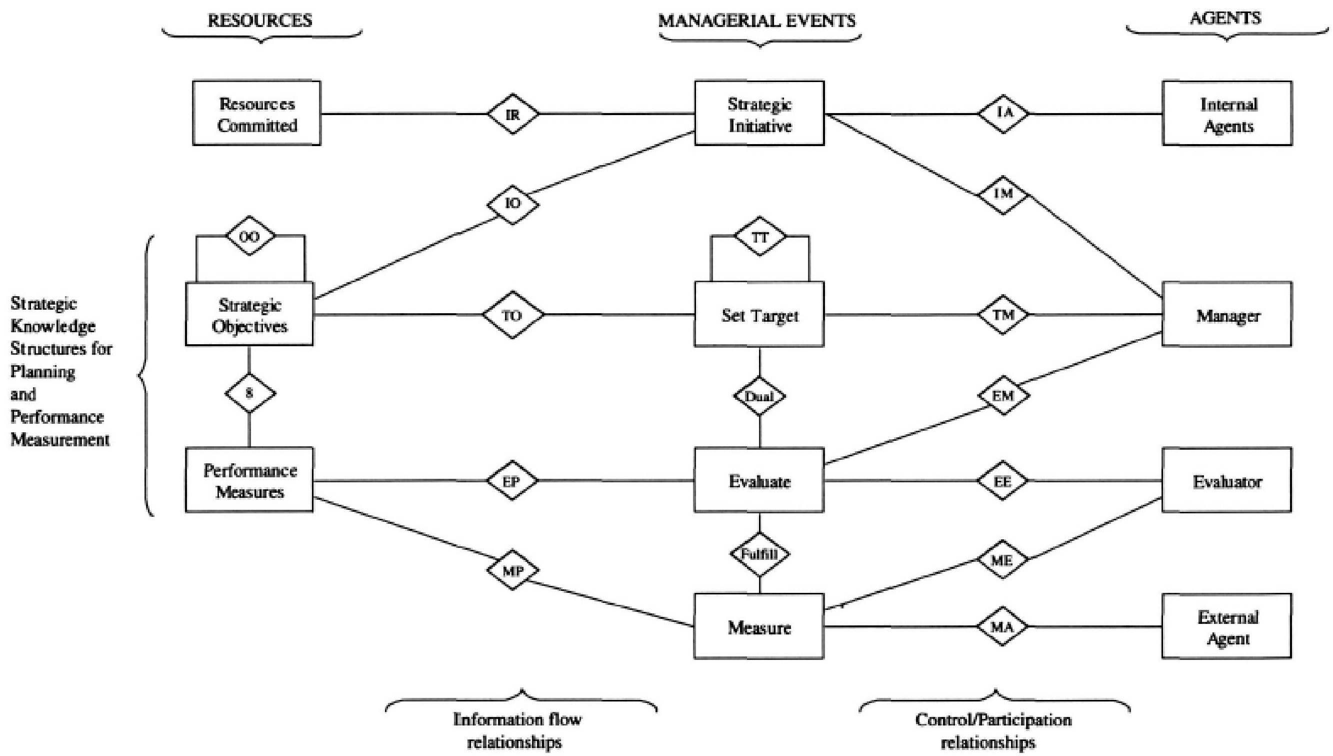
Problem Statement

Church / Smith REA Framework

- Church K./Smith R.: An Extension of the REA Framework to support Balanced Scorecard Information Requirements, Journal of Information Systems, No. 21 (1), Spring 2007, 1-25
- ***Abstract***: *In this paper, we propose extensions to the resource-event-agent (REA) framework to encompass the information requirements of the balanced scorecard and other management systems that incorporate nonfinancial measures.* … (Church/Smith 2007, p. 1)
- *We also include identifiable balanced scorecard management activities, e.g. setting targets, measuring performance, and evaluating performance against targets, within the broader definition of events. The management events are clearly business activities that need to be planned, controlled, and evaluated.* (Church/Smith 2007, p. 15).

Church / Smith REA Framework: Policy level infrastructure

FIGURE 4
Managerial Planning and Measurement Process REA Extension



The relationships (diamonds) are identified with the first letters of the names of the participating entities, except for the duality relationship between *Set Target* and *Evaluate* events and the fulfillment relationship between *Evaluate* and *Measure* events. Recursive relationships are modeled as entities related to themselves (designated OO and TT in this example).

Problem Statement

Church/Smith REA Framework: Shortcomings

Although its important extensions with respect to the informational requirements of operational and strategic management systems the Church/Smith REA framework is still **incomplete concerning**

- the different **types of management systems** and
- the **inclusion of the uncertainty**, which nowadays characterizes any business environment.

Agenda

- Problem Statement
- Church/Smith REA Framework: Closing the Loop
- Church/Smith REA Framework: Integrating Uncertainty
- Conclusion
- Literature

Church / Smith REA Framework: Closing the loop

Otley / Berry (1980, p. 236): Categorization of control types (1 / 2)

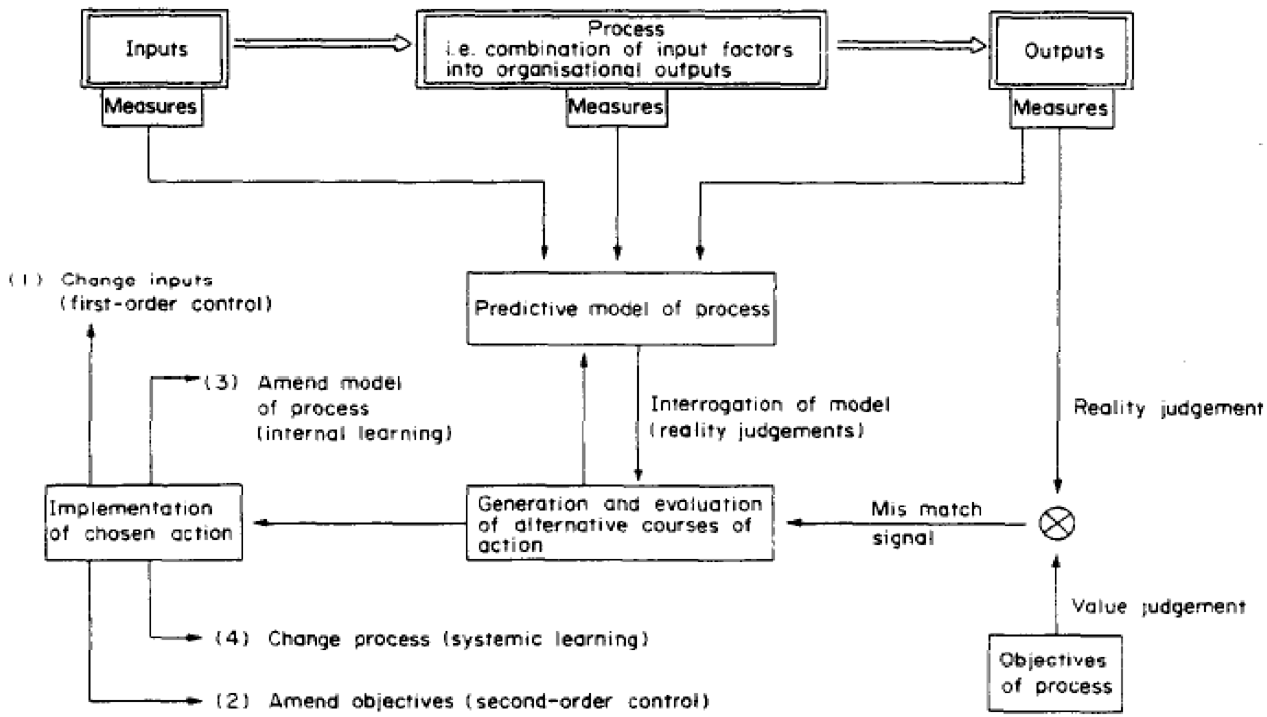


Fig. 2. Outline scheme of necessary conditions for a controlled process.

Church / Smith REA Framework: Closing the loop

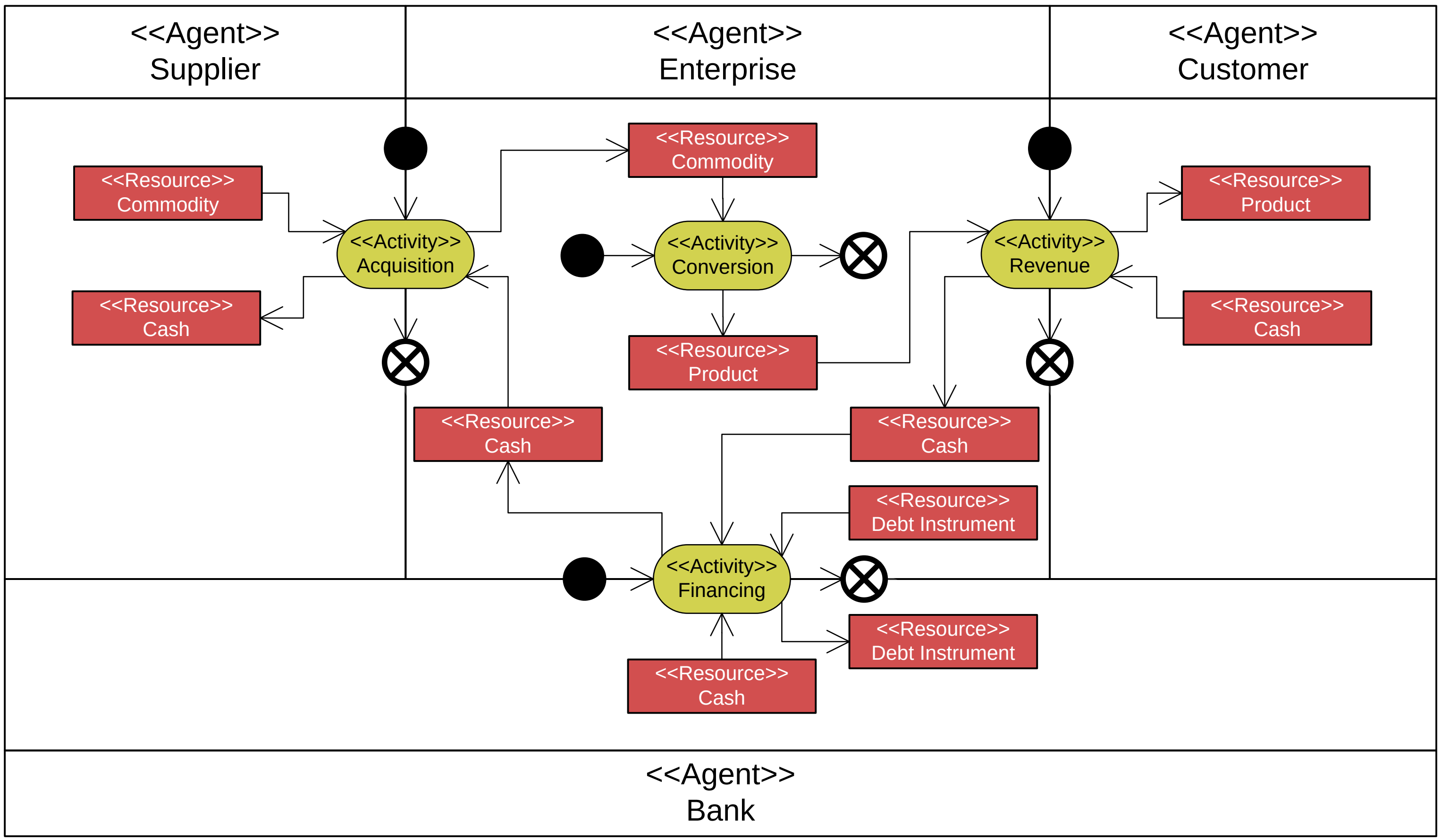
Otley / Berry (1980, p. 236): Categorization of control types (2 / 2)

Otley and Berry (1980) distinguish four different types of control

- **first- order control** by changing in the process input,
- **second-order control** by amending the objectives,
- **internal learning** by amending the process model, and
- **systemic learning** by changing the process model.

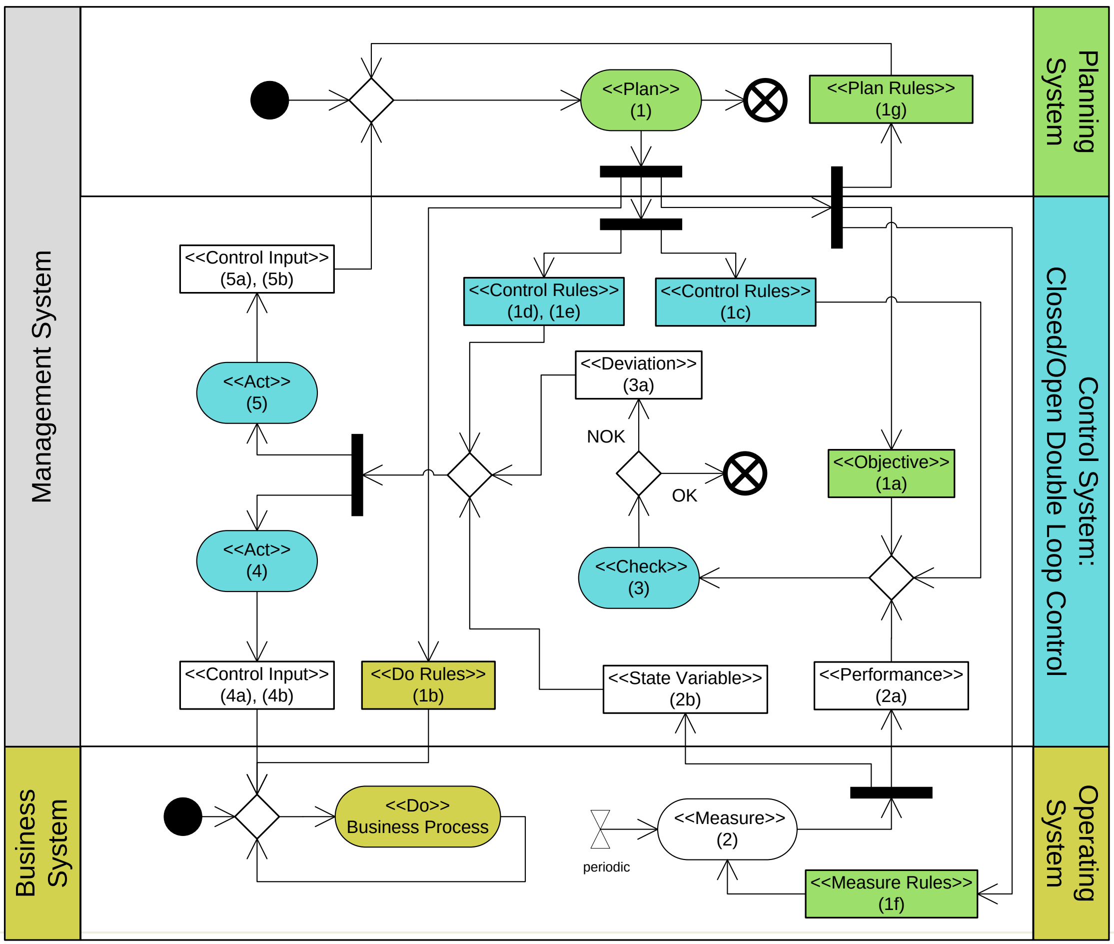
Church / Smith REA Framework: Closing the loop

Business process modeling: REA-Activity Diagram



Church / Smith REA Framework: Closing the loop

Management systems modeling: MGT-Activity diagram



(1) PLAN-Activity
- (1a) Objective
- (1b) DO-Rules
- (1c) CHECK-Rules
- (1d) Corrective ACT-Rules
- (1e) Adaptive ACT-Rules
- (1f) Measure-Rules
- (1g) PLAN-Rules

(2) Measure-Activity
- (2a) Performance Measure
- (2b) State Variable Value

(3) CHECK-Activity
- (3a) Deviation

(4) Corrective ACT-Activity
- (4a) Closed Loop Control Input
- (4b) Open Loop Control Input

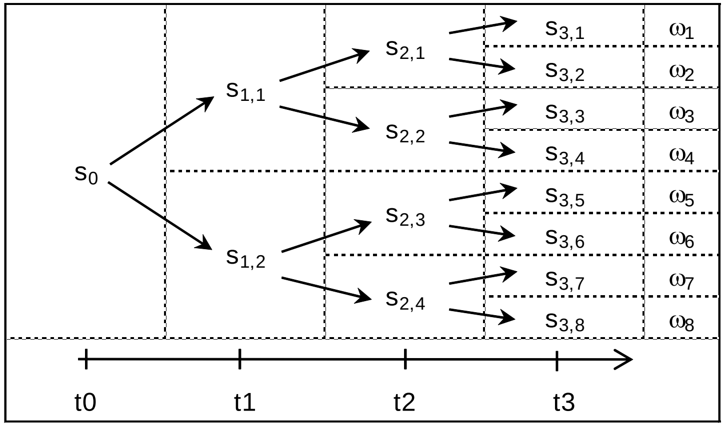
(5) Adaptive ACT-Activity
- (5a) Closed Loop Control Input
- (5b) Open Loop Control Input

Accounting: Recording economic transactions over time

Source: finance.yahoo.com

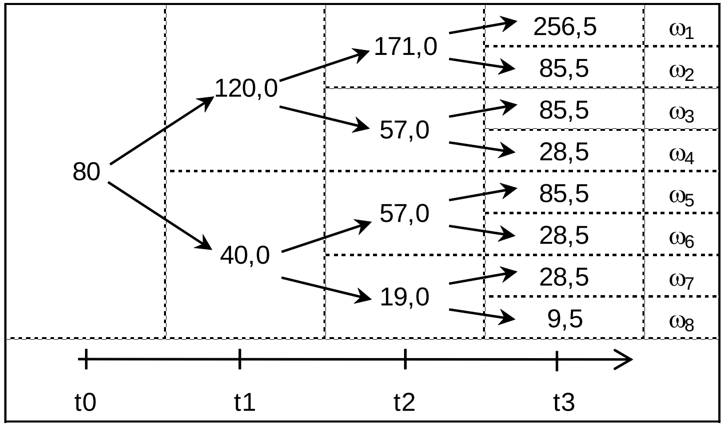
- Realizations of stochastic processes over time
- E.g. Dow Jones Industrial Average

Finance: Modeling the future uncertainty – Event Space



- Modeling the future developments (paths, realizations) of stochastic processes
- E.g. binomial process

Finance: Modeling the future uncertainty – State Space

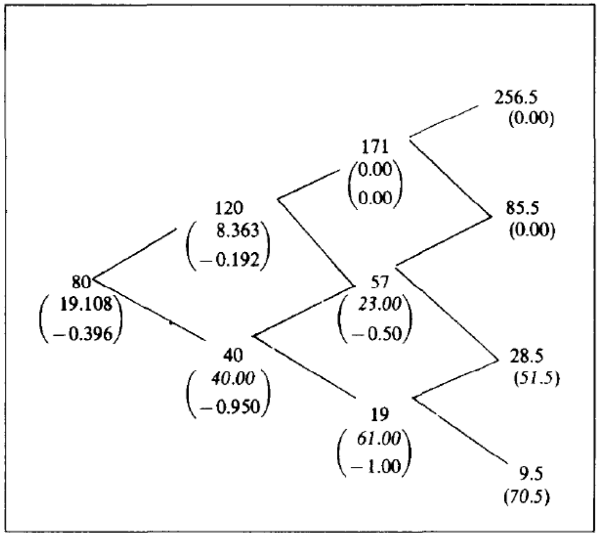


- Modeling the future values of stochastic processes on the different paths
- Mathematical definition of stochastic processes as functions that map the filtered event space into real numbers (state space)

Church / Smith REA Framework: Integrating uncertainty

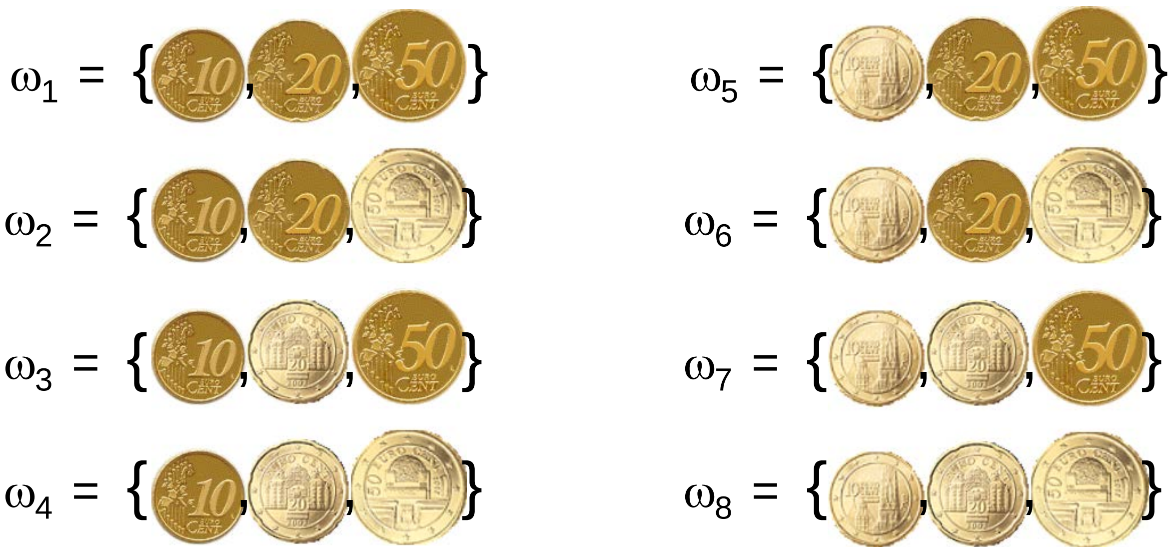
Finance: Stock option pricing via duplication strategy

Table 3



- Cox/Ross/Rubinstein Model (1979): Pricing the put option via duplication of its intrinsic value at the option's termination point with a portfolio consisting of short positions in the risky stock and long positions in the riskfree asset

Experiment: Collective coin flipping (1 / 2)



- Take three coins with different face values and flip the coins
  - Event space: Which realization (elementary event ω) corresponds to your outcome?
  - State space: Which values are associated to your realization?

Church / Smith REA Framework: Integrating uncertainty

Experiment: Collective coin flipping (2 / 2)

$\Omega \times T$	t0	t1	t2	t3
ω_1	$\Omega=\{\omega_1, \omega_2, \omega_3, \omega_4, \omega_5, \omega_6, \omega_7, \omega_8\} = s_{0,1}$	$\{\omega_1, \omega_2, \omega_3, \omega_4\} = s_{1,1}$	$\{\omega_1, \omega_2\} = s_{2,1}$	$\omega_1 = s_{3,1}$
ω_2				$\omega_2 = s_{3,2}$
ω_3			$\{\omega_3, \omega_4\} = s_{2,2}$	$\omega_3 = s_{3,3}$
ω_4				$\omega_4 = s_{3,4}$
ω_5		$\{\omega_5, \omega_6, \omega_7, \omega_8\} = s_{1,2}$	$\{\omega_5, \omega_6\} = s_{2,3}$	$\omega_5 = s_{3,5}$
ω_6				$\omega_6 = s_{3,6}$
ω_7			$\{\omega_7, \omega_8\} = s_{2,4}$	$\omega_7 = s_{3,7}$
ω_8				$\omega_8 = s_{3,8}$

- **Probabilistic information structure**
  - Constructing the event space by partitioning the sample space $\Omega = \{\omega_1, \dots, \omega_8\}$ into disjunct subsets
  - Partitions get finer (more granular) for later time points
- Probabilistic information structures are used to

  A) model the uncertainty related to the future and

  B) model the information, which reveals over time

Conclusion

Church / Smith REA Framework: Completion

- **Integrating uncertainty** via defining event types w.r.t. probabilistic information structures
- **Closing the loop** via modeling the management processes with MGT-activity diagrams
- The benefiters of the "completed Church/Smith REA framework" are the same as for the Church/Smith REA framework, i.e. *organizations that are implementing* accounting as well as operational and strategic management information *systems and the systems developers that assist them* (Church/Smith 2007, 23). The main advantage is the completeness with respect to the act activities and the business environment uncertainty, which allows more realistic and flexible designs and implementation of accounting and management information systems.

Literature

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