Day 1 – Classical Accounting

Miniseminar: Gateway to NEXT

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"Learning is not a spectator sport" – Moshe Y. Vardi

Formalities

- Active participation and prototype work required to pass
- Homepage is: `http://topps.diku.dk/next/rea`
- Contact: `henglein@diku.dk` or `cstef@diku.dk`
- In eight hours you will all have implemented a small accounting system
- Questions?

Why we are here: The NEXT project

- Navision/MBS, ITU, and DIKU
- The REA model for ERP systems
- Project suggestions
- Purpose is to seduce you to participate in NEXT
- What are your backgrounds?

Today's program (regex):

- (lecture exercises*)+ lunch (lecture* exercises)+ presentation discussion

An Infinitesimal History and Why We Need Accounting

Usually attributed to the friar Luca Pacioli (1445-1517)[1]. Known as the Venetian Method of Bookkeeping.

The company's stakeholders (owners, investors, employees, tax authorities, etc.) desire to know e.g.:

1. Cashflow
2. Status (inventory)
3. Profit

[1] There has been a lot of controversy to this point in the recent years.

Assets and Liabilities

- What is an asset?
- What is a liability?
- What is owner's equity[2]?

A house on the lake? Money in the bank? Prepaid bribe? A laptop? An IOU? Well-educated employees (computer scientists)? An invoice? An order? Half-finished production inventory?

[2] *Dansk: egenkapital*

The Accounting Equation

Axiom: Any firm will at any given time obey the invariant[3]

$$\boxed{\text{Assets}=\text{Liabilities}+\text{Equity}}$$

LHS: **What** resources the firm has control over

RHS: **Who** owns them

[3] *Dansk:*

Aktiver = Passiver

idet passiver defineres som gæld (evt. fremmedkapital) plus egenkapital.

The Accounting Equation (cont'd)

Hence for any transactions we must have

$$\Delta\text{Assets} = \Delta\text{Liabilities} + \Delta\text{Equity}$$

This gives rise to the principle of double bookkeeping, since any change must be complemented by a counter-change in order to maintain the invariant.

You are now ready to write a very simple system for bookkeeping. Make sure every atomic transaction obeys the invariant and the system is sound wrt. the accounting equation.

The Accounting Equation in Action

Now let's consider some simple examples. Initial situation is $0 = 0 + 0$. Registered activities for the year 20x2 (deliberately ambiguous):

1. Invested DKK 20000 in the company
2. Bought 1 computer for DKK 15000
3. Bought 10 cookies worth DKK 20
4. Sold 5 cookies for DKK 15 to X
5. Sold 2 cookies for DKK 6 to Y
6. Received bank transfer of DKK 20 from X
7. Bribed our (non-)national dealership with DKK 500
8. Year ends

What is our economic situation?

Lessons Learned

1. The concept of an *account* springs out naturally

2. We cannot make do with positive figures only. Accounts can go below zero.

3. The source of the profit is not clear.

4. The capital flows are not clear.

Debit and Credit

There are four types of transactions:

- +A, -A – affects LHS only
- +LE, -LE – affects RHS only
- +A, +LE – affects both sides
- -A, -LE – affects both sides

We would like the same procedure on all transactions regardless if they affect an asset, a liability/equity account, or both.

Letting assets be on the debit side and liabilities/equity on the credit side achieves this.

Instead of signs, accounts traditionally have a column for each sign: *debit* and *credit*.

The Income Equation

For any period a firm will have[4]:

$$\boxed{\text{Revenue}-\text{Expenses}=\text{Profit}}$$

Notice that the accounting equation expresses a property of the status at any given time, whereas the income equation expresses a property of any set of transactions.

(Dansk: Omsætning-Omkostninger=Resultat. Ofte nærmere specificeret som overskud eller underskud.)

[4] Revenue AKA turnover, Expenses AKA costs

A Hierarchy of Accounts

(See Wolk, Tearney and Dodd: *Accounting Theory* page 332)

Income statement (*DRIFTSKONTI*, initially 0, periodically transferred to owner's equity)

Sales (increase is credited)

Costs (increas is debited)

Balance (*STATUSKONTI*, this period's closing balance is the opening balance of next period)

Assets (increase is debited)

Liabilities, Equity (increase is credited)

The Trade Company

Activity chain:

1. Place purchase order with supplier
2. Receive goods, add to inventory
3. Pay supplier
4. Receive sales order from customer
5. Complete sale and deliver goods
6. Receive customer payment
7. Sales tax reconciliation

Some activities are not registered!

The Production Company

More elaborate inventory (ie. work-in-progress) handling

1. Place raw material purchase order
2. Receive raw material, add to inventory
3. Pay supplier
4. Produce and pay wages
5. Purchase external production steps
6. Pay external producer
7. Add completed production to inventory
8. Receive sales order
9. Complete sales and deliver goods
10. Receive customer payment
11. Pay worker income taxes etc.
12. Sales tax reconciliation

Worked Example

- Sales and payment
- Procurement and payment
- Sales tax (Value-added tax) *(moms)*
- Depreciation (linear depreciation *(lineært)*, declining balance (*(saldometoden)*)

Suppose I buy a car worth 10.000 Euros. Have I just incurred a cost of 10.000 Euros?

Interlude on Gifts

A Danish lawyer will probably tell you something like[5]:

> Ved en gave forstås en vederlagsfri overdragelse af et formuegode, således at ydelsen erlægges på giverens bekostning og ikke sker til opfyldelse af en retspligt.

Notice the absence of a dual. Que faire?

[5] All apologies, I did not bother to properly translate this one.

Worked Example (cont'd)

- Deferred charges
- Partial tax deduction ((*repræsentation*)
- Goodwill
- Taxes (perhaps two income statements are necessary, internal and official)
- Company taxes

Worked Example (cont'd)

- Income Statement (AKA Profit and Loss Account) *(Resultatopgørelse)*
- Balance Sheet
- Cash Flow Statement *(Likviditetsbeskrivelse)*

Materialization/Consolidation

(Årsafslutning)

Income Statement

	Sales
-	Cost of goods sold
	Contribution margin *(dækningsbidrag)*
-	Advertising
-	Administration
-	Salaries
	Net profit from operations before depreciation *(indtjeningsbidrag)*
-	Depreciation *(afskrivninger)*
	Earnings before interest
-	Interest expense
	Earnings before taxes
-	Taxes
	Net income

The Cash Flow Statement[6]

	Net profit
-	Depreciation
	Net profit from operations (indtjeningsbidrag)
-	Δ Debtors
+	Δ Creditors
+	Δ Inventory
	Cash flow from op. activities *(driftens likviditetsvirk.)*
-	Δ Fixed assets
-	Interest paid
+	Interest received
-	Drawings taken by proprietor (hævet af ejer)
	Total cash flow *(periodens likviditetsvirkning)*
+	Opening cash balance*(likvide midler primo)*
	Closing cash balance *(likvide midler ultimo)*

(If time: see McDonald's)

[6] Abbreviated version

A General Model

The G/L can be represented as a set of tuples, say:

$$(I, A, D, C)$$

for Id, Account, Qualifying Data, Amount in Currency (debit is positive, credit is negative).

Invariants

Local invariant:

$$\forall I'. \sum_{(I,A,D,C)\in GL} C[I = I'] = 0$$

Which immediately yields the global invariant:

$$\sum_{(I,A,D,C)\in GL} C = 0$$

These definitions are directly realizable in, say, Standard ML or any SQL database.

G/L Data Model/Prog. Paradigm - discussion

- Object-oriented? Is inheritance of any use?
- Functional?

The G/L is not all – what more do we need?

More Needs

Examples:

- A/P
- A/R
- Inventory

A/R Data Model

A/R subsystem: Print invoices, interest, base data (address, contact person, etc.), payment history, sales statistics

Maintains a number of journals and accounts much similar to those of the G/L. Perhaps the two systems share data structures or A/R consolidates its data in the G/L.

Who should this be modeled/implemented?

(customers, invoices, invoicelines, connection to inventory?)

A/R Data Model

Data Model is structurally often equivalent to that of the A/R subsystem. Other pieces of base data are required, but there will still be a number of journals and accounts.

Who should this be modeled/implemented?

(creditors, invoices received, electronic payment)

Inventory Data Model

Handles inventory, requisitions and procurement affect inventory.

(product list, bundled products)

Issues

- Not all events are registered (e.g. executory contracts)
- Phantom assets/liabilities occur often
- Subsystems are heterogenous
- A priori flat structure of accounts
- Some accounts are artifacts without obvious ontological foundation (e.g. accumulated depreciation)

More Accounting Needs

1. Only focused on *economic* events and only *ex post*
2. Timesheet, project rentability
3. Workflow
4. We mentioned trade companies and production companies. A third increasingly important company type is missing[7]. Which?
5. Management Accounting – Financial accoutning only covers the past, we need information to act on *ex ante*.

[7] This is probably for historical reasons. The percentage of service companies is often a coarse indicator for the stage of development in society.

Regulatory Bodies

US GAAP, IASC, and local legislation. Ground principles in Danish legislation (*Bogføringsloven og Årsregnskabsloven*):

1. (Transaktionssporet)

2. (Periodisering)

3. (Forsigtighed)

4. (Going concern)

5. (Kontinuitet)

Exercises, Projects, and Beer Discussions

E Do the bookkeeping! Do sales, procurement, cash sales, debtor/creditor payments, debtor bankruptcy, acquiring fixed assets, depreciation, sales tax, salaries, deferred charges, partial tax deduction on representation. Invent the amounts yourselves.

E Do the corresponding income statement, balance sheet, and cash flow statement

E Try the same with a production company

Exercises, Projects, and Beer Discussions

P A classical system of G/L, A/R, and inventory handling in your language of preference. Make sure materialization is possible for any given period (even across fiscal year boundaries).

P Derive an OO model of G/L, A/R, A/P and inventory. Code a system to demonstrate key advantages.

P Implement a small system with G/L, A/R, A/P and inventory in a functional language (e.g. Standard ML)

Pick one project and present your solution later this afternoon.

Exercises, Projects, and Beer Discussions

- Foundational: Is the axiom “A=L+OE” valid?

- Do we have an accurate and satisfactory overview of the company’s activities with the income statement, the balance sheet and the cash flow statement. Do we perhaps need more? What for instance?

$$Q \wedge A$$