A Generic Tool Based on System Dynamics Approach To Assess SME Business Stability And Help Designing Business Tactics And Action Plans Within Transient, Non-Stationary Conditions

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ABSTRACT
SMEs play an important role in developing countries economy leveraging. The SMEs are subjected to non-stationary conditions affecting business stability. These conditions arise due to economic environment transition or during business start-up phase. The problem is that business-monitoring tools such as the balanced scorecards are long term oriented and strategically focused. The SMEs' response in the short term during non-stationary conditions may cause serious damaging results or even lead to total business collapse. The objective is to develop a tool to monitor the SMEs' business short-term transient response to non-stationary conditions. Also to help developing business tactics and action plans. The chosen platform is a system dynamics model to provide simulation ability under different scenarios. The model is formulated in a generic way with the ability to define business attributes through set of model variables. The model is built using five basic sub-models: financial, human resources, operational, risk and environmental.

Keywords: SME, Business health/stability, causal loop, non-stationary, developing countries, start-up, variable.

OVERVIEW
In the developing countries, large scale business firms holding large scale projects are the ones having the most apparent and announced stories of economic development scenario. However, underneath lies the beehive full of actual business movers, the small traders, manufacturers, service providers and the blue-collar crew, the SMEs. Taking Egypt as an example, most Egyptians work for mini-firms that are invisible to the grand-scale planners and bankers and stockbrokers: 99.7% of Egypt's non-agricultural

private enterprises have fewer than 50 employees, most have fewer than ten and many fewer than four [The Economist print edition, Mar 18th 1999].

These medium-to-small-to-minuscule firms provide 80% of the value added by the private sector, and employ 75% of the non-agricultural private labor force—not including the uncounted hundreds of thousands of moonlighters from virtual jobs in the public sector. Of the 550,000 new jobs that the country hopes to create each year until 2017, according to a government document, "Egypt in the 21st Century", the tiddlers are supposed to come up with 325,000 [The Economist print edition, Mar 18th 1999].

Most of Egypt's bankers cannot be bothered with micro businesses wanting micro loans. They fear default, and demand to see things like feasibility studies or business plans which the credit-seekers, possibly illiterate, have little chance of providing. Some 95% of small enterprises do not even have a bank account. So, an Egyptian wanting to start or enlarge a small factory or a car-washing company or a fish-peddling business will almost certainly borrow from a moneylender, or get credit from his supplier. Often paying interest of up to 5 – 7 times the nominal interest [The Economist print edition, Mar 18th 1999].

Another fact to add is that many of the SMEs entrepreneurs lack knowledge regarding business navigation, governmental attitudes, foreign trade directions and the most critical factors and exchange rate forecasting. Moreover, the external environment directly affects the SMEs through factors such as exchange rate, import/export barriers, taxation …etc.

The above factors cause the SMEs to pass through a transient, non-stationary phase. This is most likely to happen during the business start-up phase or during an economic turbulence and transition, which are frequently anticipated in developing countries. Taking Egypt as an example in 2001 – 2002, the currency exchange rate variations caused a lot of business turbulence for many SMEs. Some of them had even to shut down. A reason for this problem is that the current nominal exchange rate doesn't represent (and being less than) the actual real effective exchange rate, which is a function of many variables such as economy competitiveness, trade balance, import/export regulations, … etc. To get out of the loop, government tries to narrow the gap between the nominal and the real effective exchange rates by decreasing the nominal exchange rate and imposing new economic and international trade regulations. The problem might be as limited as a conventional *crawling peg* strategy for the economy to reach the real effective exchange rate. However, the real trick is that the span of exchange rate fixation and the amount of depreciation at the end of such periods are totally unknown/unannounced.

The missing WHAT-IF approach arises a lot of surprises that might cause the whole business to collapse, if the enterprise is not business wise prepared.

The above briefly mentioned factors calls for a tool to assess business stability/resilience in such environment to help SMEs determining the most convenient track to follow in different probable scenarios.

PROBLEM DEFINITION

To develop a common platform, first business health/stability convention has to be built and used throughout this text. The business health/stability from the perspective of the paper is defined as how well the business is performing from the following aspects: 1) financial aspect represented by liquidity and profitability. 2) Human Resources (HR) aspect represented by staff productivity. 3) Operational aspect represented by the ability to deliver commitments. 4) Risk associated with the business. 5) Environmental aspect represented by the effect of economic environmental measures such as Rate OF Exchange (ROE).

As a strategic tool, the balanced scorecard concept monitors and controls the health of the business. However, it gives more attention to the steady state, on the long term. An under-valued aspect is the transitional short-term phase, either at start up or during economic transitions.

OBJECTIVE

The objective of this paper is to develop a tool to facilitate the determination of the stability/survival of the SME within non-stationary conditions such as economic environmental transitions or in the start up phase when the SME is more sensitive to such factors. This tool should be able to monitor closely the health of the SMEs business in the short term. It can be used on the tactical level to help prepare action plans.

The chosen platform is system dynamics model to provide the needed insight to the SME's functional elements interaction, the most likely outcomes within different probable scenarios as well as the control variables and using them to design efficient tactics.

CONCEPTUAL FRAMEWORK

The framework emphasizes the cause-effect relationships among factors affecting the SME health/stability. These relationships are formulated in a common generic way to be applied for different SMEs.

The mental model is based upon Five basic sub-models, namely: Financial, Human Resources, Operational, Risk and Environmental. Each of them is described in details in later sections.

KEY VARIABLES

- Stability : A measure of business local relative health/stability.
- Profit : Measured by EBIT (Earnings Before Interest and Taxes)/Net Sales.
- Liquidity : Measured by Net Cash Flow From Operating Activity.
- Delivery : The SME ability to deliver the contracted commitments.
- Current Status : The current health of the business in terms of profitability, liquidity, …etc. In the start up phase it can be thought of as the initial investment. This variable acts as an initial status or inertia for the model.

- Staff productivity :Measured as output value per unit currency of staff expenses.
- Risk :The risk associated with SME business.
- Economic stability :The stability of the economic environment within which the SME is running (ROE, import barriers, …).

OVERALL SYSTEM ARCHITECTURE

The system consists of three major layers. The input layer represents the immediate inputs to stability.

The core layer, which is the business stability, consists of a number of characteristics that describe the system behavior. However, as stability in the context of this paper is defined as the local relative stability, the matrix of behavior characteristics evaluates to a relative local stability comparative score.

The output layer represents the immediate effects of business stability.

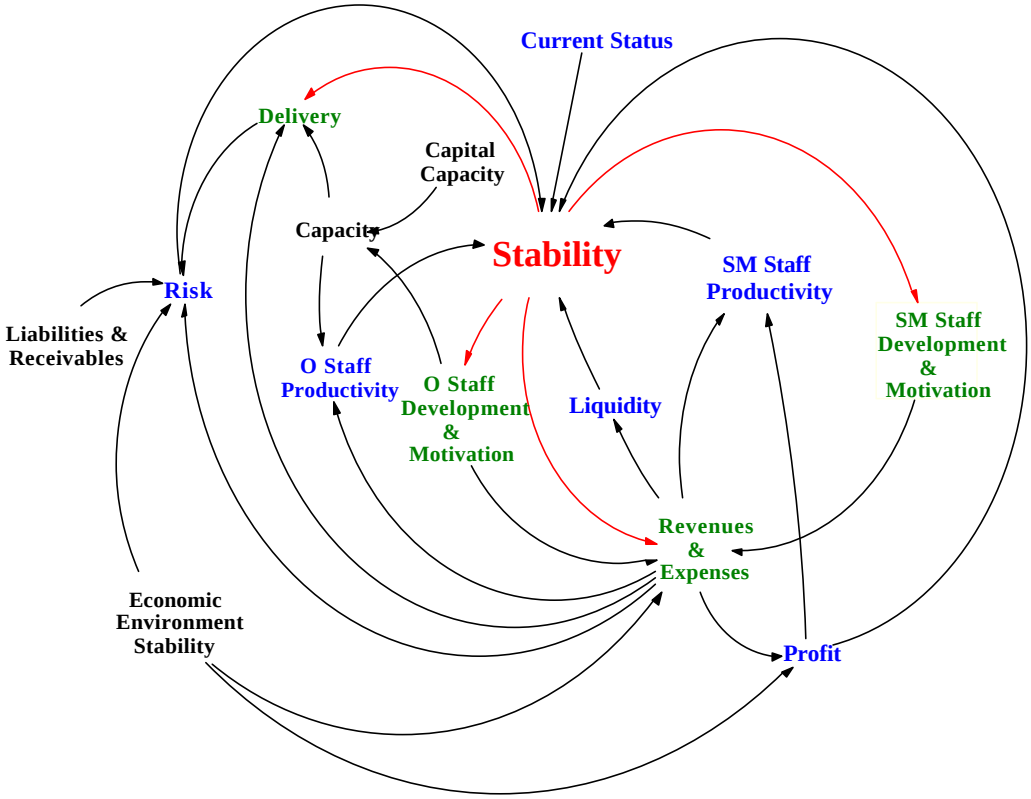

Fig. 1: Overall system architecture

THE INPUT LAYER

The proposed main determinants of short-term stability (first order input layer) are Liquidity, Profit, Staff productivity (Sales and marketing "SM", Operational "O"), Risk and Current status.

The liquidity provides the SME with the daily fuel to continue operating. Profitability represents the SME's success, investment attractiveness and healthy existence. Staff

productivity is very important factor on three different levels. First, on the sales and marketing level, the productivity affects the SME stability supplying it with profitable opportunities. Second, on the operational level, the productivity affects the stability through the delivery ability and capacity to take available opportunity. Third, on the support level (logistics, legal, funding, …) which affects the facilitation of other aspects activities. However, the support structure staff is out of the scope of this paper to avoid SME restructuring approach. Risk greatly affects the SME stability especially in non-stationary conditions. It represents a major threat that the SME can collapse in certain scenarios if not ready such as considerable devaluation of local currency, introduction of new trade barriers, …etc. The current status variables play a shock absorption role, or represent the inertia of the SME. It is a damping factor that smoothes out high frequency transitions among different stability levels.

THE OUTPUT LAYER

The proposed main outcomes of short-term stability (first order output layer) are Revenues, Delivery, Staff (Sales and marketing "SM", Operational "O" development and motivation.

The impact of the SME stability feeds back positively to revenues through ability to finance more sales. It also enhances the staff building process (sales/marketing and operation) via hiring more staff, motivating the current staff and continually improving their capabilities via training and developing programs. Another important effect is on the delivery capabilities of the SME. The more stable the SME, the more it can deliver the committed projects and continue the business cycle.

CAUSAL LOOP DIAGRAM

This section describes the behavior of each sub-model as a stand-alone block. Next, the interactive behavior of the sub-models is described. First, the system variables are defined.

ENDOGENOUS VARIABLES

- Stability : SME business health/stability (%).
- Revenues : Annual SME revenues (unit currency/time: LE/year).
- Cash Sales : Rate of revenues that is collected in short term (unit currency/time: LE/month).
- Credit Sales : Rate of revenues that is collected in long term (unit currency/time: LE/month).
- Avg. cash collection period : Average collection period for cash sales (time: month).
- Avg. credit collection period : Average collection period for credit sales (time: month).
- Expenses : Rate of SME expenses (unit currency/time: LE/month).

- Profit : Business profitability. It is measured by EBIT (Earning Before Interest and Tax) From Operating activities/Net Sales (%).
- Liquidity : Business liquidity (unit currency: LE). It is measured by Net Cash Flow From Operating Activity.
- Delivery : The SME ability to deliver the contracted products/services (%).
- SM Staff number : Number of sales and marketing employees (Person).
- SM Staff performance : A measurement of how satisfactory the sales and marketing staff performance is (%).
- SM Staff productivity : How productive are the sales and marketing staff. This variable is a modified blend of the company efficiency ratios using personnel as the input factor (sales per employee, profit per employee). Instead of measuring the sales and profit per employee, they are measured per unit currency of staff expenses (%).
- Secured sales : The pool of available secured sales for the SME. This variable can be considered as potential revenues. It is an outcome of market opportunities, sales and marketing activities (unit currency/time: LE/month).
- Market opportunities : The average available market opportunities for the SME business strategic segment (unit currency/time: LE/month).
- O Staff number : Number of operational employees (Person).
- O Staff performance : A measurement of how satisfactory the operational staff performance is (%).
- O Staff productivity : How productive are the operational staff. It is measured as output value measured per unit currency of operational staff expenses (%).
- Capacity : The overall SME delivery capacity. This is measured by the output value can be produced per time (unit currency/time: LE/month).
- COGS : Equivalent cost of goods sold in local currency. (unit currency : LE)
- ROE : The rate of exchange from foreign to local currency. (%)
- Risk : The risk associated with SME business. (%)

EXOGENOUS VARIABLES

- Maximum assets capacity : The maximum output value that can be produced using SME assets. This is measured by the maximum output value that can be produced per time (unit currency/time: LE/month).
- Local business : The average rate of local currency liabilities. (Unit currency/time: LE /month).
- Local liability accrual period : The period over which local liabilities have to be settled (time: month).

- Import business : The average rate of foreign currency liabilities. (Unit currency/time: USD /month).
- Import liability accrual period: The period over which import liabilities have to be settled (time: month).
- Inventory level differential : The average rate of inventory value change. (Unit currency/time: LE/month).
- Inventory turnover period : The average inventory turn over period. (time : month).
- Economic stability : The stability of the economy within which the SME is running. This affects many important factors relevant to SME business such as rate of exchange, import barriers and regulations, …etc. This variable is measured as percentage stability of completely determined environment (%).
- Current Status : The current shape of the business in terms of profitability, liquidity, …etc. In the start up phase it can be thought of as the initial investment. This variable acts as an initial value or inertia for the model (%).

AUXILIARY VARIABLES

- On time complete delivery : The ability to deliver projects on time completely (%).
- Credit Period : The average period of delayed accrued receivables (time: month).
- Receivables : Value of SME receivables (unit currency: LE).
- Internal expenses : Direct rate of expenses spent by the SME or business unit (LE/month).
- Other expenses : Indirect rate of expenses spent by the SME or business unit, such as depreciation, … etc. (LE/month).
- SM Staff Development : The rate of sales and marketing staff development expenditure (unit currency/time: LE/month).
- SM Staff Motivation : The equivalent sales and marketing staff motivation expenditure. It is calculated as monetary equivalent for psychological/financial motivation (unit currency/time: LE/month).
- Quality of SM staff : The quality of hired sales and marketing staff (%).
- SM Staff expenses : Total sales and marketing staff expenses.
- #Projects : Number of projects carried out by the SME (Project).
- Project conditions : The average project conditions in terms of needed output, delivery time, … etc. This can be approximated by rate of output value delivery (unit currency/time/project: LE/month/project).
- O Staff Development : The rate of operational staff development expenditure (unit currency/time: LE/month).

- O Staff Motivation : The equivalent operational staff motivation expenditure. It is calculated as monetary equivalent for psychological/financial motivation (unit currency/time: LE/month).
- Quality of O staff : The quality of hired operational staff (%).
- O Staff expenses : Total operational staff expenses.

EXCLUDED VARIABLES (LIMITATIONS AND ASSUMPTIONS)

- Management and Support : General SME structure is not subjected to major changes in the short term or start-up phase.
- Capital structure : It is not in the scope of this paper, however, the results obtained from this model must be integrated with further information for long term planning.
- Technical environment : Assumed to be constant over the short-term tactical plans.

FINANCIAL LOOP

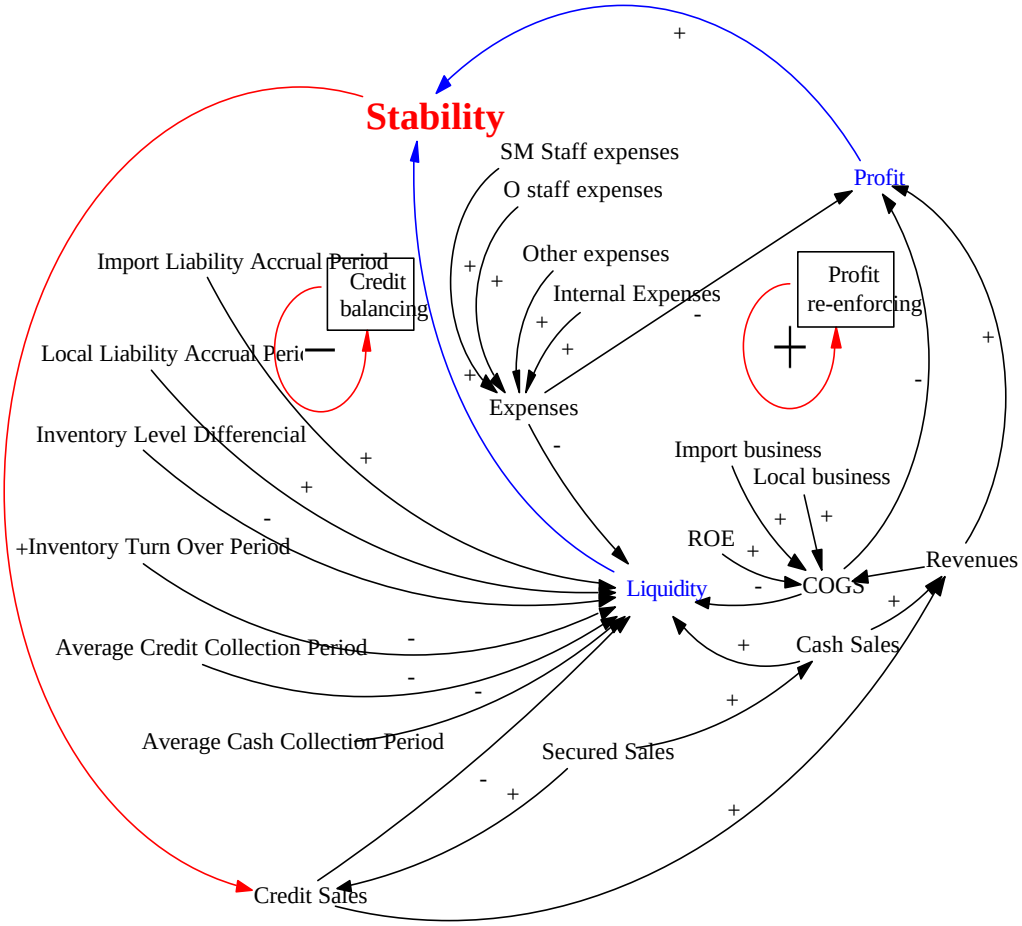

Fig. 2: The financial loop

The variables of interest are profit and liquidity. Profit is the simple subtraction of revenues – COGS – operating expenses. Revenues can come either from cash sales or credit sales. COGS are either local liabilities or import liabilities. The import liabilities are transformed into equivalent local liabilities through multiplication by Rate Of Exchange (ROE). Expenses consist of staff expenses (sales/marketing and operation, to focus within the paper scope, support staff expenses are included in the "other" expenses), internal expenses and other expenses.

Liquidity is more complex to calculate and also more crucial to business health in the tactical and operational levels. It is considered as the difference between the cash supply into the SME (inflow generated by revenues) and the out drain from that cash pool (outflow liabilities and expenses). The main driving forces are cash sales, credit sales, COGS, expenses and inventory level differential. The main controlling valves are average cash collection period, average credit collection period, local liabilities accrual period, import liabilities accrual period and inventory turn over period.

There exist two feedback loops. One balancing negative loop *"Credit Balancing"* where a stability increase leads to increased ability for financing credit sales, this reducing the liquidity and subsequently decreases the stability in a balancing effect.

The Other loop is the positive feedback loop *"Profit Re-enforcing"* where a stability increases leads to increased ability for financing credit sales which in turn increases revenues. This revenues increase also increases the profits and finally further increases the stability in a re-enforcing effect.

HR: SALES AND MARKETING (SM) LOOP

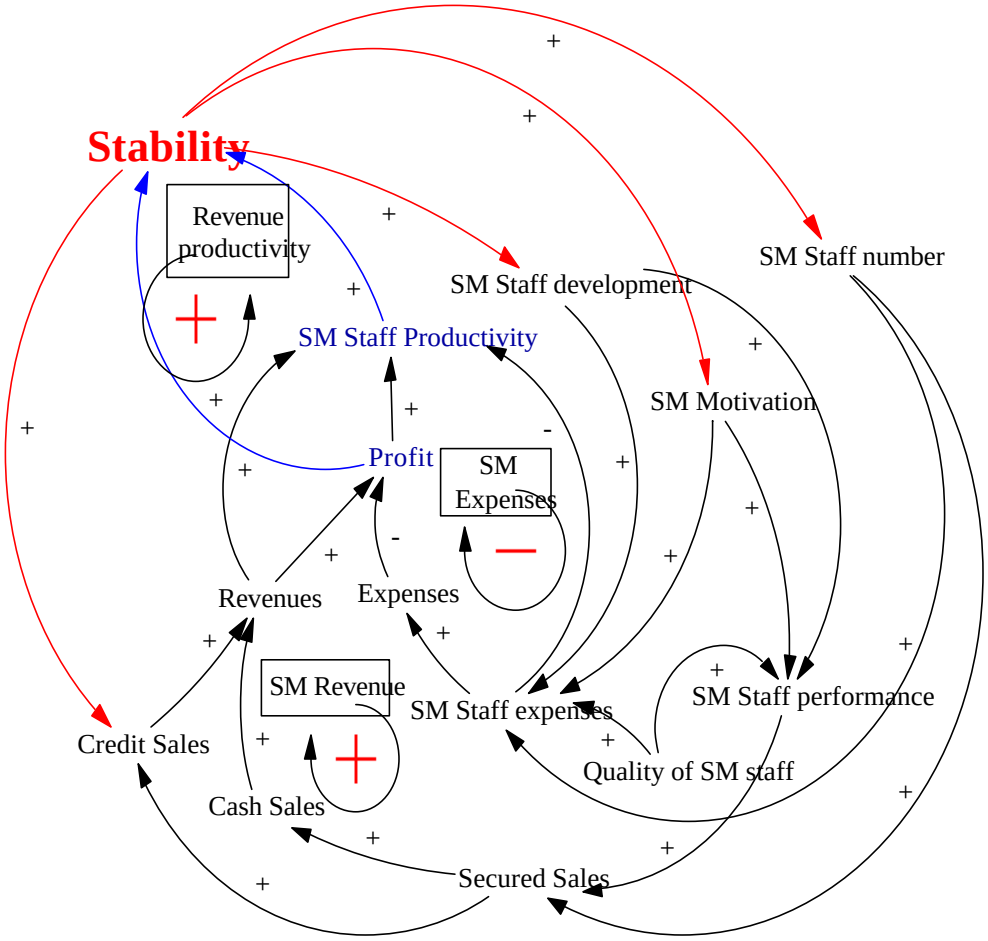

Fig. 3: HR sales and marketing loop

The effective output variables of this module is the SM staff productivity, as the productivity increases, the stability increases. The productivity is a measure of sales and marketing staff expenditure leverage. It is the ratio of achieved revenues and profits to the total SM staff expenses. The SM staff expenses include hiring more persons, motivating and developing the hired staff. The caliper of the hired staff also has positive relation with expenses. All the mentioned factors have positive relation with expenses and with staff performance. The increases staff performance leads to more secured sales and revenues ultimately at higher profits. However, the SM staff expense reduces the profits. Staff motivation has financial and non-financial (Psychological) components. However, both are calculated as equivalent total motivation. The feedback from stability has positive relation to motivation, development, and number of hired persons and from revenues point of views it has positive relation to credit sales, which in turn increases revenues.

There are 3 major feedback loops. First a positive feedback loop *"Revenue productivity"* through stability to revenues and profits, SM staff productivity and positive to stability again.
Another positive feedback loop *"SM revenue"* is through stability which positively affects the SM staff development, motivation and number (all of them are considered similar loops) then positively affecting the secured sales, revenues and profit, staff productivity and finally stability positive feedback.

The balancing negative feedback loop *"SM expenses"* is generated through SM staff expenses. Starting from stability, which positively affects the SM staff development, motivation and number (all of them are considered similar loops); those variables have positive effect on staff expenses, which in turn negatively affecting the SM staff productivity, which has positive effect on stability.

HR: OPERATIONAL LOOP

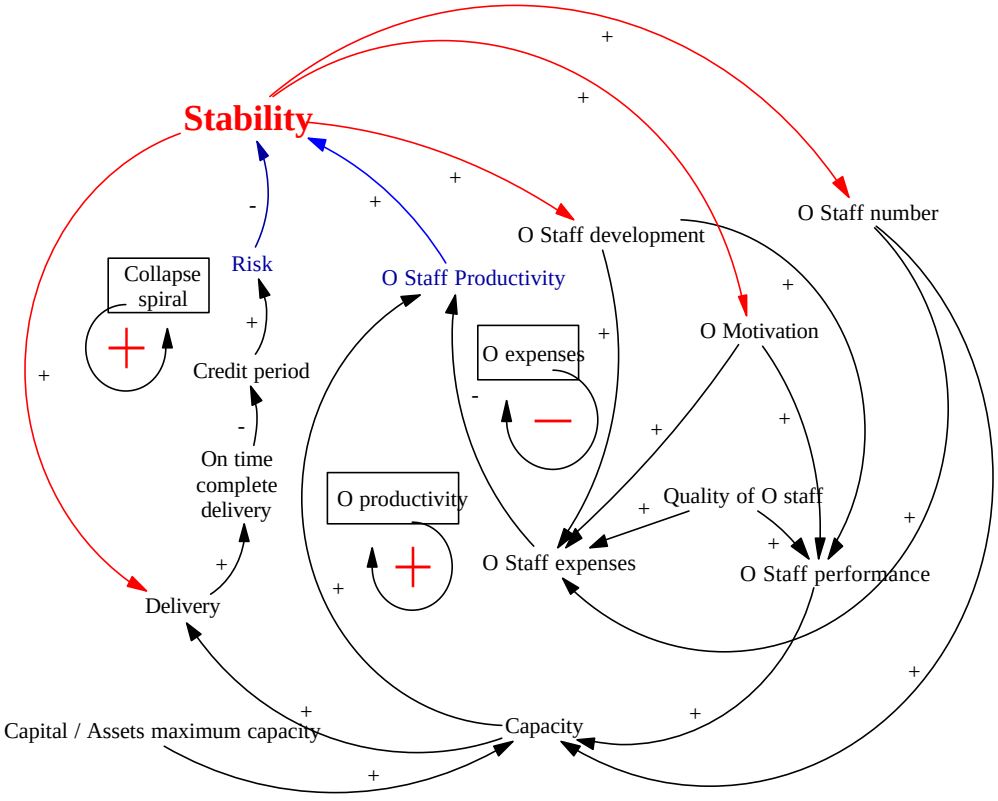

Fig. 4: HR operational loop

The effective output variables of this module is the O staff productivity, as the productivity increases, the stability increases. The productivity is a measure of operational staff expenditure leverage. It is the ratio of achieved output capacity to the total O staff expenses. The O staff productivity, O staff expenses, Caliper of the hired staff, motivation and development are similar in nature and effect to those in SM loop. The feedback from stability - as in SM loop- has positive relation to motivation,

development, and number of hired persons. In addition, from delivery point of view, it has positive relation to ability to deliver commitments, which in turn reduces risk.

There are 3 major feedback loops. First a positive feedback loop *"Collapse spiral"* through stability to delivery, on time complete delivery, negative to credit period which positively feeds to risk and finally risk negatively feeds to stability.

Another positive feedback loop *"O productivity"* –Which is similar to "SM revenue" in the SM loop- is through stability which positively affects the O staff development, motivation and number (all of them are considered similar loops) then positively affecting the capacity, staff productivity and finally stability positive feedback.

The balancing negative feedback loop *"O expenses"* –Which is similar to "SM expenses" in the SM loop- is generated through O staff expenses. Starting from stability which positively affects the O staff development, motivation and number (all of them are considered similar loops); those variables have positive effect on staff expenses, which in turn negatively affecting the O staff productivity, which has positive effect on stability.

OPERATIONS LOOP

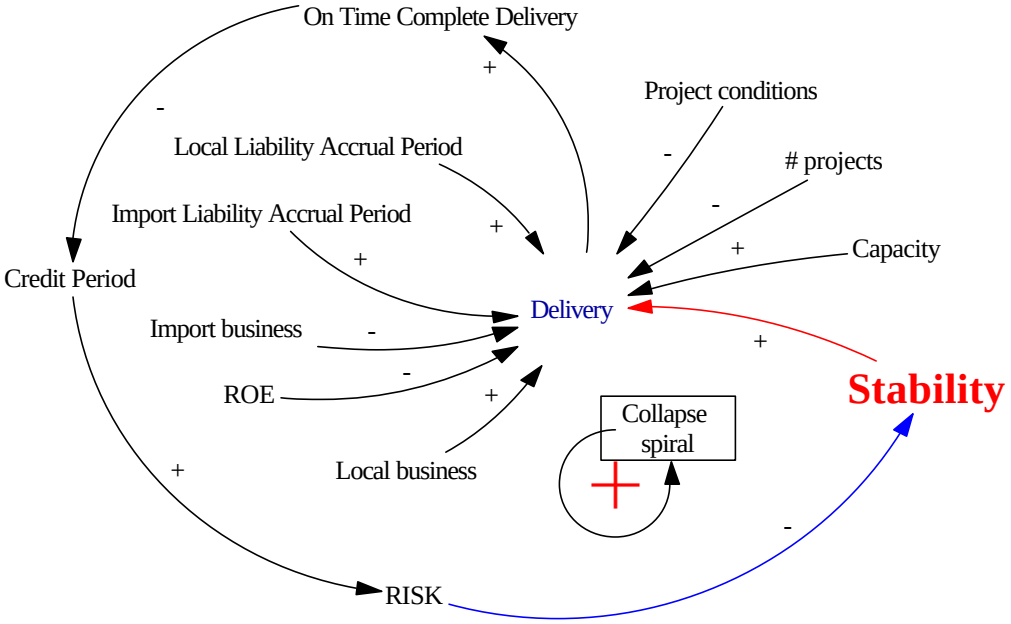

Fig. 5: Operations loop

The operational sub-model represents the most important block in the first order output layer. The inability to deliver commitments can seriously lead to fast death spiral in the short term. The variables affecting the ability to deliver (delivery) are influenced by the economic conditions, capacity and the supply chain conditions. The economic environmental status affects the delivery via the amount of import business relative to the total business and through the rate of exchange from foreign import currency to local currency (ROE). The impact of capacity is shown via the capacity positive effect, where as number of projects and project conditions both have negative effect.

The supply chain conditions is modeled simply as suppliers conditions in financial terms. The more available grace period from both local and foreign supplier, the more ability to deliver because of the decreased needed short term resources (basically cash).
The major feedback loop *"Collapse spiral"* is a positive feedback through stability to delivery then on time complete delivery, which negatively affects the credit period. The credit period has positive effect on risk, which in turn negatively affects stability.

The most dangerous scenario could happen is the collapse fast spiral when the SME gets into less deliver-ability situations, which causes on time complete delivery to decrease. Then credit period and risk increase leading to a decrease in stability, which further decreases the deliver-ability and the spiral continues till collapse.

RISK LOOP

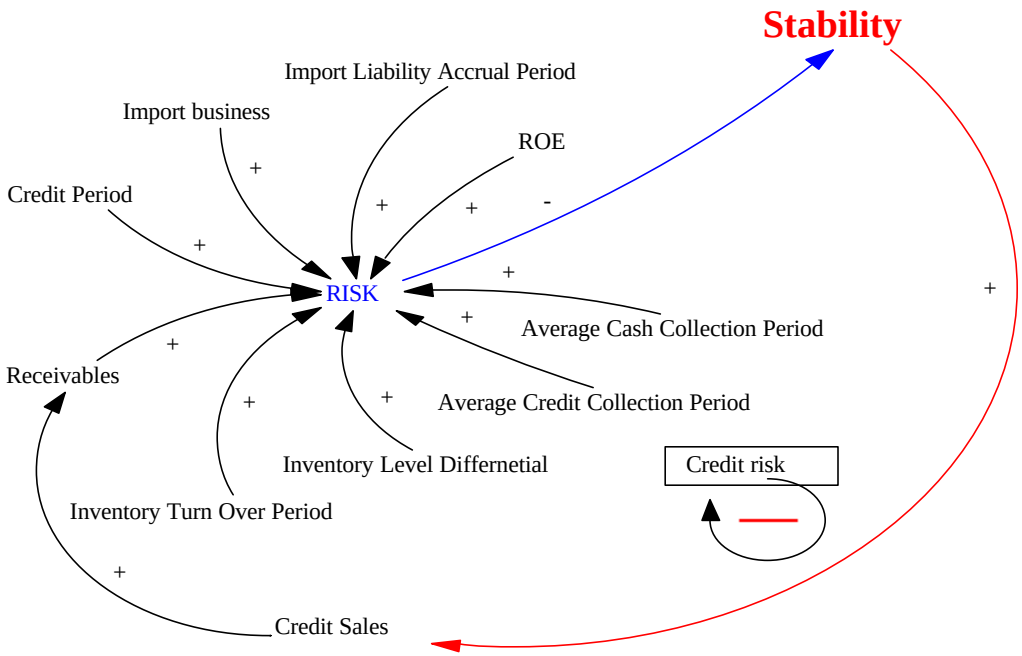

Fig. 6: Risk loop

Risk is influenced by three major factors: receivables, economic environment and inventory. Receivables are represented via the revenues (cash and credit) collection periods, the amount of outstanding receivables and credit period resulting from incomplete delivery. The economic environment associated risk is linked through the fraction import business, rate of exchange (ROE) and the time (import liability accrual period). Although it is desirable to have longer supplier grace periods from delivery point of view, it increases the risk associated with import business and ROE. The inventory effect on two ways. First, the inventory level differential: the positive effect of inventory rate of increase. Also the inventory turn over period has positive effect on risk due to risk of slow moving, expired items, …etc.

The balancing loop *"Credit risk"* exists from positive relation between stability and credit sales, which has positive effect to receivables. The receivables have positive effect on risk, which finally affects stability in a negative way.

CONCEPTUAL MODEL FOR THE ECONOMIC ENVIRONMENT

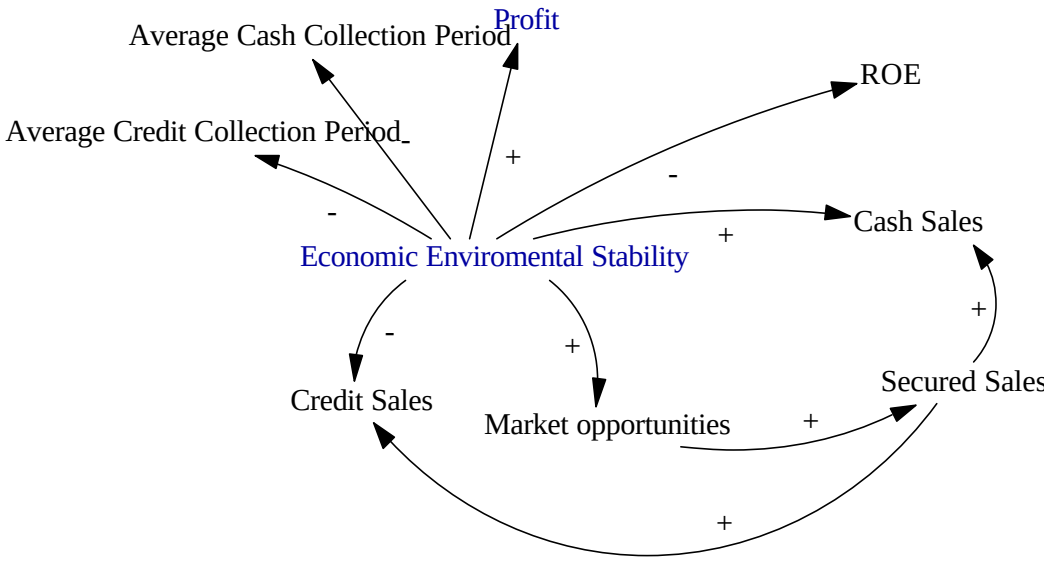

Fig. 7: The economic environment conceptual model

The economic environment stability acts as an exogenous factor affecting the model in various aspects. From the import business aspect, the economic stability negatively affects the rate of exchange, import barriers (However, the GATT makesel the import barriers effect negligible). It has a positive effect on market in terms of market opportunities, profit and cash sales. It has negative market effect in terms of credit sales and collection periods (cash and credit).

SUB-MODELS INTERACTION

The previous section describes the autonomous behavior of different building sub-models. However, interaction between those sub-models generates more sophisticated behavior shown in the following loops.

BALANCED CREDIT GENERATED RISK LOOP

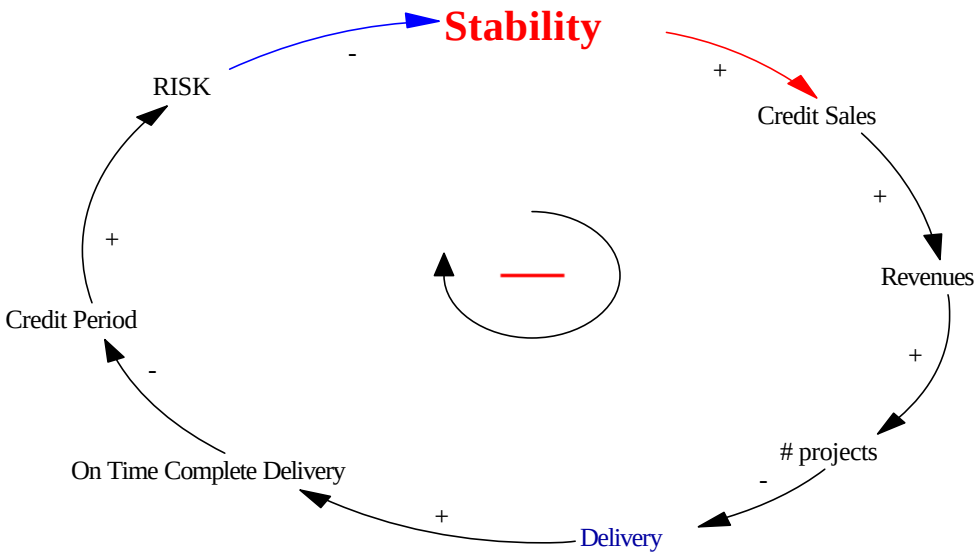

Fig. 8: Balanced credit generated risk loop

Stability positively affects credit sales, revenues and number of projects. Number of projects has negative effect on delivery, which transfers to the on time complete delivery. The on time complete delivery negatively affects the credit period which positively affecting risk. Finally risk negatively balances the stability.

BALANCED SALES – CAPACITY LOOP

This loop represents the balancing sales/capacity effect.

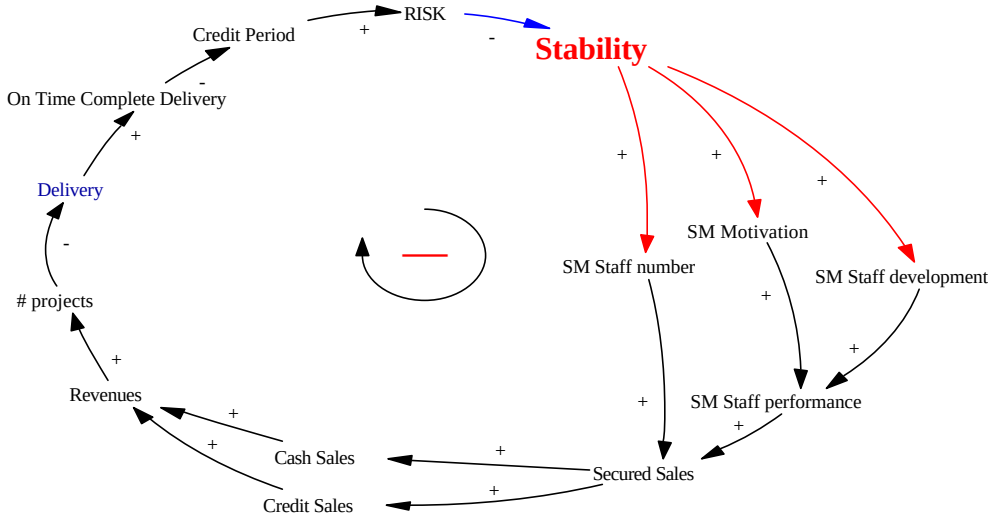

Fig. 9: Balanced sales-capacity loop

Stability positively affects SM factors (development, motivation and number), this positively affects secured sales, revenues and # projects. The # projects negatively affects the delivery and which is again negatively affecting the risk (through on time complete delivery and credit period). Finally the risk negatively balances the stability.

CAPACITY GENERATED RISK (CAPACITY FALLING SPIRAL)

This loop represents the falling capacity spiral. The danger of this loop is on the destructive effect once the capacity falls, it goes into a positive feedback spiral that can lead to business collapse.

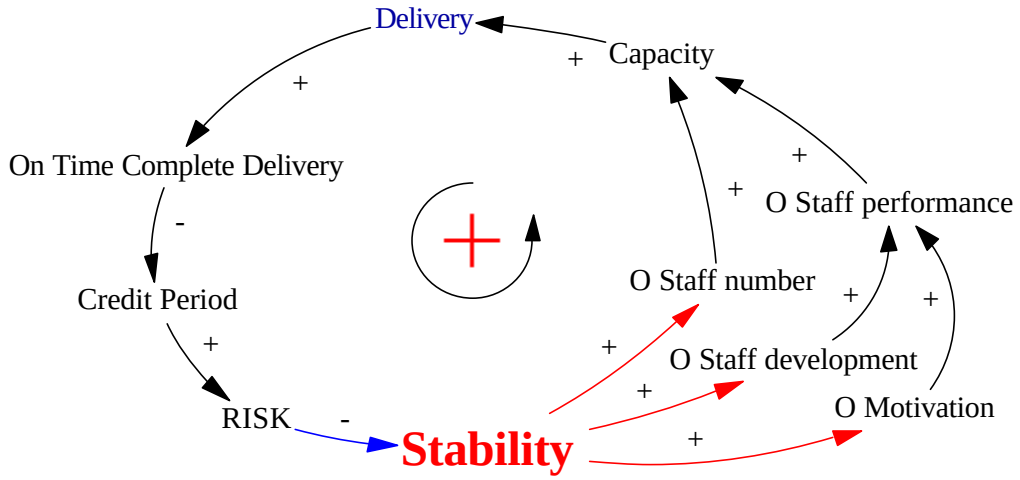

Fig. 10: Capacity generated risk loop (Capacity falling spiral)

Stability positively affects O factors (development, motivation and number); this positively affects capacity, delivery and on time complete delivery. This leads to negative effect on the risk (through on time complete delivery and credit period). Finally the risk negatively the stability continuing the positive feedback loop.
The complete causal loop can be seen in Appendix A.

MODEL CUSTOMIZATION

As seen throughout the text, the model is formulated in a generic form. However, it can be customized to match the specification of different SMEs with different business activities through the following variables: Local business, import business, local liabilities accrual period, import liabilities accrual period, secured sales, cash sales, credit sales, average cash collection period, average credit collection period, expenses (SM staff, O staff, internal, other).

MODEL Validation

The suggested model validation procedure consists of two steps: First, customization, in which the model customization parameters are set to fixed values which describe specific business or business class. Second validation at the level of customized business or business class.

CONCLUSION

From the analysis as well as the empirical observations during an economic transition (also in the start-up phase) in developing countries, it is evident that SMEs' short-term transient business response is as serious as the long-term strategic behavior. Providing some probable scenario, the developed tool can help assisting the business stability throughout different scenarios. It also can help in developing tactics and action plans for the SME to be businesswise prepared for such transitions.

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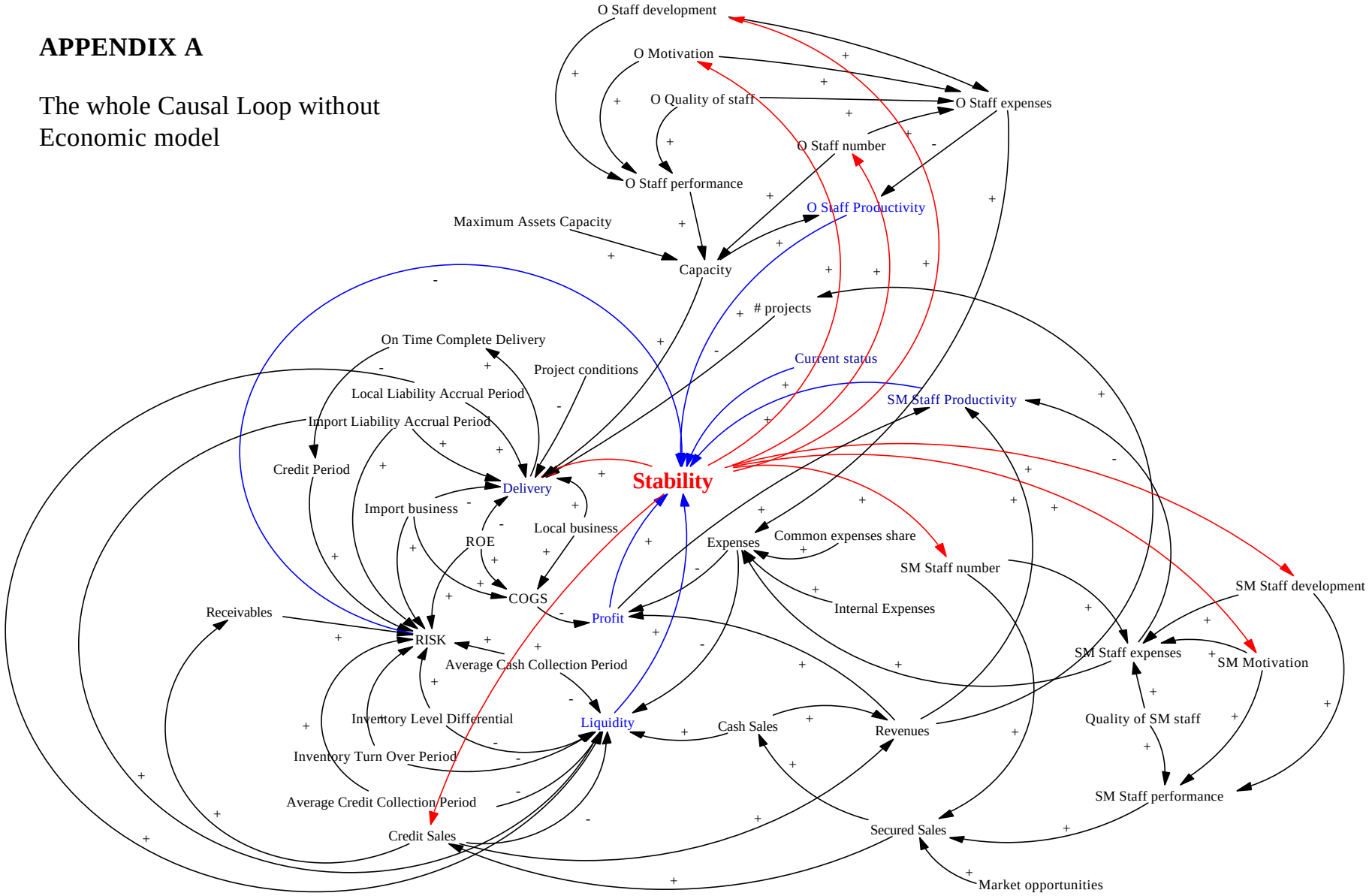
APPENDIX A

The whole Causal Loop without Economic model



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