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# Information Overload and the Internationalization Process Model: An Implementation Attempt

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**Abstract**

This article presents a theoretical equation set based on the information interactions that result in experiential learning. We attempt to link our equation set to the Uppsala Internationalization Process model in order to quantify information overload and operationalize the Uppsala model under longitudinal time series settings.

The internationalization process has generated an increase in the diversity and overall quantity of information, resulting in an increase of the variation and amount of information that a firm needs to process. This challenges a firm's capacity to simultaneously expand and learn.

Market knowledge is acquired essentially through current business activities, all of which proceed from a firm's market experience to generate experiential knowledge.

Market experience is situation-specific and therefore difficult to generalize. Nonetheless, firms tend to use general "failsafe proven courses of action" when confronted with new situations in an effort to reduce diverging, larger quantities of incoming and often discrepant information.

Information overload refers to situations where the quantity of information pending analysis and consideration compels a firm to revert to older and trusted information processing methods instead of seeking adaptive solutions, clearly adopting a short-term efficiency posture leading to suboptimal performance.

**Keywords:**

Information overload; Information slack; Experiential learning; Adaptive learning; Internationalization Process model

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## Introduction

In the present article we present a theoretical equation method based on the interactions of information required for a firm's internationalization and stemming from Herriot, Levinthal, and March's difference equation models for incremental experiential learning (1985). The method we present is an attempt to quantify the point beyond which information overload occurs when firms undergo internationalization.

We examine information overload as one of many causes of pain avoidance. We especially seek to provide a means to identify the border beyond which agents involved in business problem-solving would behave in a way congruent to agency theory's pain avoidance model (Jensen, 1998).

Problem-solving agents in business enterprises are individuals recognized as experts in their field who are capable of carrying out highly selective heuristic searches through large sets of information (usually in the form of "hill climbing"), especially when the observed information is dynamic and interrelated to other non-observed sets of data, such as in international trade (Simon et al, 1992).

In the process of growing, businesses progressively reduce their value maximization yet increase their efficiency (Jensen, 2001, p. 52). Increased efficiency acts a counter-weight to less-than-maximized firm value, where together a balance is usually reached in the form of ideal maximization. Naturally, various factors contribute to a firm diverging from ideal maximization. Agency theory (Jensen & Meckling, 1976) explains this divergence from a behaviorist perspective. Agency theory postulates that individuals are rational, resourceful, evaluative maximizers in most circumstances (Jensen & Meckling, 1994). When experiencing fear, individuals behave in a systematic, non-rational, pain-avoiding manner (Jensen, 1994) that negatively impacts ideal maximization by inhibiting problemistic search processes, where a motivated search is depressed because "existing solutions are as viewed as adequate" (Cyert & March, 2013 [1963], p. 120-122), indicating a shift towards lesser goals or lowering the acceptability level of existing goals. They also limit the search for problem solutions to the "neighborhood of existing policy" (ibid) to attenuate the symptom of the problem instead of addressing the cause as experienced in a simple-minded search and crystalize "biases reflecting unresolved conflict within the organization" (ibid) (Iyer & Miller, 2008; Wennberg & Holmquist, 2008; Lehman & Ramanujam, 2009).

Our central issue stems from the reality that "the way in which problems are represented has much to do with the quality of the solutions that are found" (Simon et al, 1992, p. 46). The impact of pain avoidance on the same problem representation "when people are faced with evidence or theories that threaten to change the lens through which they view reality, including not only the world around them, but their view of themselves" (Jensen, 1998, p. 44) generates disorderly action where "[…/…] action, however oriented to making choices in a way consistent with expectations, desire, or experience, may become dominated by the buzzing confusion in which it occurs. Order of presentation effects become important. Decisions become collections of problems and solutions linked by simultaneity more than causal association" (March & Shapira, 1992, p. 275).

Of the various internationalization models, the Internationalization Process Model (Johanson & Vahlne, 1977, 1990, 2003, 2006, 2009) proposes a dynamic model of incremental internationalization based on "*the interplay between knowledge development and increasing foreign market commitments*" (Johanson & Vahlne, 2006, p. 166). This model is also known in extant literature as the Uppsala Model. We refer to it as the IP model hereafter.

The IP model makes the assumption that market knowledge is acquired essentially through current business activities in markets where a firm is involved. This activity generates experiential market knowledge, which in turn allows international managers to identify business opportunities. It is also assumed to be the main mechanism contributing to the reduction of market uncertainty. In both senses, experiential knowledge is a driving force in the internationalization process. It must be noted that since 2006 the "country market" concept *"is no longer seen as a valid unit of analysis"* (Johanson & Vahlne, 2006, p. 166). Instead, the focus has been "*on the critical role of building and changing relationships" (ibid)*. This change in the model does not affect our approach, as we focus on the process of managing information specific to activities in different international markets. Furthermore, this specific information directly impacts experiential knowledge. Experiential knowledge proceeds from a firm's experience. Experience is situation-specific and is difficult to generalize to other circumstances (Johanson & Vahlne, 1990). Nonetheless, organizations will tend to use "failsafe proven courses of action" when confronted with new situations, very much the same way they will tend to prefer older technology in a short-term efficiency tradeoff (March & Weil, 2005).

According to the model, firms internationalize by working in markets they understand more easily, because they can perceive more opportunities as well as experience lower market uncertainty. As firms develop internationally, they enter markets with successively greater psychic distance.

Psychic distance results from differences in factors such as language, culture, and political systems, all of which disturb the flow of information between the market and the firm (Vahlne & Wiedersheim-Paul, 1973).

Expanding a firm's international market presence generates an increase in the difference and divergence of incoming information, as well as an increase in the overall quantity of information required for processing, which results in an increase of information variation and the amount of information the firm needs to interpret or understand. This situation challenges a firm's capacity to expand and learn simultaneously. We call "information overload" the moment when the mass of information that requires processing to make a decision compels the firm to resort to anterior, familiar, "old and trusted" information analysis processes, unadapted to the situation at hand. Consequently, the firm adopts a short-term efficiency posture leading to suboptimal performance in a time allocation conflict as well as an ease-against-effort tradeoff (Eriksson, Johanson, Majkgärd, & Sharma, 2000; Denrell & March, 2001; March, 2006).

This paper's research question is: how much information can organizations process while undergoing internationalization before reaching information overload?

The equations we present in this paper are based on formulae that measure the incremental experiential learning of organizations developed by Herriot, Levinthal and March at the 97th Annual Meeting of the American Economic Association (1985). Their work is based on an adaptive behavior in decision-making model, where choice is an accumulation of heuristic learning. It is defined as "*trial-by-trial monitoring of the success or failure associated with past adjustments*" (Herriot et al, 1985, p. 298). Their work is in the tradition of "*hill-climbing optimization techniques" (ibid)* and directly addresses *"ways in which learning occurs along several interacting dimensions" (ibid).*

We begin this paper by quantifying international market information interactions. We then measure internationalization information overload, suggest the operationalization of the IP model via our equation set, propose perspectives for applied research, and summarize our conclusions.

## International market information interactions

*Quantifying incremental internationalization situations*

The IP model is based on an iterative design leading to successive and incremental internationalization decisions that result in increased international market involvement. To meet our quantification requirements, we need to combine both the firm's increasing commitment in international markets and the mode of presence that it chooses for each international market. De Leersnyder (1986) proposes a tool that combines control of a firm's foreign market activity and international commitment and includes 20 different presence modes (Appendix A) under four generic control/commitment quadrants.

We will consider each quadrant as an internationalization situation. De Leersnyder's situations are export-oriented. They do not consider a firm's international procurement activities, such as production subcontracting. We complete our framework with two situations: first, no internationalization has taken place; and second, foreign production subcontracting is used to gain a cost advantage in the firm's local market.

In determining a firm's situation, we consider the firm's market focus, the country of origin of production or of main services, the importance given to unsolicited export orders, the market reference unit and a change in the structure of the firm's equity capital (Table 1).

The value for internationalization situation "s" used in the proposed measurements hereafter will be the number given to the internationalization situation, ranging from 0 to 5, as shown above.

| N° (value) | Internationalization situation ("s") |
|---|---|
| **0** | ***No internationalization***.<br>Firm focuses exclusively on its domestic market, where it produces.<br>Unsolicited foreign purchase orders may not be honored and are not followed up.<br>Market reference unit is the firm's home country. |
| **1** | ***Upstream internationalization***.<br>Firm focuses exclusively on its domestic market.<br>Firm will subcontract production or services abroad in search of a cost advantage.<br>Unsolicited foreign purchase orders are accepted but not followed up.<br>Market reference unit is the firm's home country. |
| **2** | ***Delegate and limit commitment***.<br>Firm focuses on its domestic market and begins market diversification with limited means.<br>Firm may subcontract production or services abroad in search of a cost advantage.<br>Unsolicited foreign purchase orders are followed up.<br>Market reference unit is the firm's home country. |
| **3** | ***Control and limit commitment.***<br>Firm focuses on foreign market diversification with limited means.<br>Firm's equity structure may change.<br>Unsolicited foreign purchase orders are followed up.<br>Firm may pursue directly to situation 5 from situation 3 markets.<br>Market reference unit is the firm's home country and/or home free trade agreement zone. |
| **4** | ***Delegate and commit.***<br>Firm focuses on minority equity foreign partnership schemes.<br>Firm may consider its domestic market as important as the foreign markets.<br>Firm's equity structure has changed.<br>Market reference unit is the firm's home country and/or home free trade agreement zone. |
| **5** | ***Control and commit.***<br>Markets in which the firm has reached situation 5 become the firm's domestic market.<br>Foreign shareholders may enter the firm's equity capital.<br>Market reference unit is the firm's business network. |

Table 1: Situations of internationalization according to incremental engagement and control.

## Situation increments

Moving from internationalization situation s to internationalization situation s+1 or s+2 is an incremental process described in the IP model (Johanson & Vahlne, 1977, 1990; Eriksson et al, 2000).

This incremental process, and more specifically the increment (Δ) between situations result in the expression Δs, where we are able to account for situation changes between increments. Previous does not imply sequential. That is, firms in situation 0 may move directly to situation 2 or 3 (Pedersen & Shaver, 2000), or firms may directly begin their internationalization at situation 4 or 5 (Bonaccorsi, 1992). Likewise, withdrawing from markets, although used here as a mechanical reversion to previous situations, constitutes an optimization of the firm's international activities (Pauwels & Matthyssens, 1999). As a consequence, Δs is always a positive integer.

Internationalization situations contain business activities. In the present paper, we refer to "business activity" as any form of international diversification in any given country/market, implemented in a planned and determined fashion. Consequently, operations in two different markets situated within the same country require at least two different presence modes and constitute two business activities. We are thus able to account for more than one internationalization mode combination (Benito & Welch, 1994; Benito, Petersen, & Welch, 2009).

We are unable to account for activities within international business networks, as these are of a transnational nature and rely on individual transactions between firms. The data that are presently available only account for goods crossing country or customs union borders.

Considering that single international business activities do not always follow the same situations nor tradeoffs as other single activities in the internationalization of a given firm (Shrader, Oviatt, & McDougall, 2000), we complete our expression by stating that a firm's total situation increment for all activities ($\Delta S_i$) corresponds to the average of each activity's situation increment ($\Delta \bar{S}_{i^*}$)where *"i*" means all international business activities,"*i**" means any single activity ($i^* \in i$) and "$n_{i^*}$" is the number of i* activities, as follows:

$$\Delta S_i = \Delta \bar{S}_{i^*} = \sum_{i^* \in i} \frac{(\Delta S_{i^*})}{n_{i^*}}$$

Equation 1

Furthermore, "*i**" should be understood as a business activity interacting with competitors in the observed market, the interactions of which "spill over" into neighboring industries and markets as well. Interactions are subsequently explained in section 2.4.

More generally, the asterisk in our notation should be interpreted as an indication of global interaction, as opposed to local isolation.

## Internationalization variables

Propositions of internationalization variables abound in the extant literature. We choose Albaum, Strandskov and Duerr's (2002) model of international market variables and we focus on the quantification of interacting variables, regardless of the controllable or uncontrollable nature of the same. These 25 variables are grouped under the following headings:

> Firm's marketing mix: price, channel, dealer support, credit, export structure, product modification (6 variables);
> Firm's characteristics: export volume; export competitiveness; type of export product; export experience; size (5 variables)
> Firm's domestic and foreign environment: economic forces, competition, technology level, distribution structure, geography and infrastructure, cultural forces, political forces (7 x 2 variables).

A firm does not have to address all 25 variables per market simultaneously when beginning internationalization. We identify two states in which each of the above variables can be: active or inactive. Two criteria are used to determine the state:

- Is the variable the same in all markets where the firm operates?

- Does the firm consider the variable to be “important” in the firm’s current situation?

By “important”, we mean whether the firm's appreciation of the variable is essentially supportive of the firm's sustainable competitive advantage, or if it constitutes a challenge, or threat, to the same.

For example, a firm in the luxury market may want to support high prices and maintain the same Euro or US Dollar equivalent (price variable) in all of its markets, regardless of its different internationalization situations. In this instance, the same-price criteria and subsequent price variable will be considered “important”. In comparison, a business-to-business supply scheme for a firm at situation 1 (upstream internationalization) will usually result in an export price set at the same level as domestic prices. The exporting firm will tend to ignore the price in the (foreign) market of destination. In this second instance, the price variable will be deemed “unimportant”.

If one given variable is the same in all of the markets where the firm is active, and if the firm considers that variable to be not important in that activity (*i**), the variable is said to be inactive. If one of these two conditions is not met, the variable is said to be active. Consequently, only active internationalization variables will be accounted for in determining the value of “*v*” (representing the total amount of active internationalization variables).

Proceeding in this way and by using ex post data, we can integrate and quantify the effects of psychic distance directly in *“v.”* We are also able to circumvent Pedersen and Petersen’s “shock effect” (2004), where managers tend to mistakenly expect, ex ante, for the marketing mix of adjacent countries to be very similar, responding with standardized presence modes. Any residual shock effect is corrected as time passes and psychic distance shortens.

Psychic distance has been defined as “*the sum of factors preventing the flow of information from and to the market. Examples are differences in language, education, business practices, culture, and industrial development*” (Johanson & Vahlne, 1977, p. 24). Therefore, the more a manager understands a given country/market, the shorter psychic distance will be, the more he will tend to customize the presence mode and the marketing mix, and inversely. The effects of short psychic distance will tend to inflate the value of “*v*” because of a large quantity of active variables. Long psychic distance will tend to deflate the value of “*v*” due to lesser amounts of active variables, a consequence of standardized responses.

We are also able to reasonably account for a firm’s information absorptive capacity (Vermeulen & Barkema, 2002) through the variations of “*v*” within a time frame such as $v_{t-1}$ to $v_t$. We expect for the variations of the value of “*v*” to be strongly and inversely correlated to the absorptive capacity of a firm. In dynamic terms, for a given set of country/markets, within a given time frame, the stronger a firm’s absorptive capacity, the faster the value of “*v*” will move toward 0 over a period of time.

## Information interactions

We consider the activation of a growing number of variables by a firm as it evolves from one internationalization situation to another as a given. The consideration that a firm will not resort to the same variables in all markets when in one situation is also a given. Finally, we assume that an active variable will not have the same importance in each market where it is being used. Consequently, a firm's internationalization situation will tend to determine the number of active variables, especially in the earlier situations of internationalization. Similarly, the difference in importance of the active variables from one market to another explains why the number of country/markets is not a factor, but an exponent, in determining the information interactions of a firm at internationalization situation s at a given time.

We introduce an information interaction variable, *I*, where the number of active internationalization variables, *v*, result from each internationalization activity, $i^*$. The number of country/markets, $n_m$, where the firm is conducting its internationalization is an exponent, as explained above. Hence, the following equation:

$$I = \left(\sum v_{i^*}\right)^{n_m}$$

Equation 2

Furthermore, it should be emphasized that the value of *I* is large and increases exponentially. In some instances, and due to large differences of scale, one may consider using logarithmic conversions for the values fed into the desired equation.

## Time

Time is a critical factor when attempting to resolve problems dealing directly with environmental uncertainty, activity conflicts and resource allocations (Hassard, 1991). Time is a key element of process-driven models of internationalization. Nonetheless, time does not often emerge in any significant way, nor does it regularly appear as a meaningful independent variable in extant literature (Eriksson, Johanson, Majkgärd, & Sharma, 2001).

Because of this paper's scope, time is used as an interval variable, not a dimension, with the intention that the results of our formulae may serve as independent variables for hypothesis testing under time-series settings.

## Measuring internationalization information overload

The internationalization decision process has been described as an endogenous process influenced by exogenous variables and both exogenous and endogenous stimuli. The endogenous process goes through cognitive, affective and behavioral phases, resulting in decisions for action (Roux, 1986). The IP model likewise describes the internationalization process as a series of incremental decisions in a behavioral theory setting involving state and change aspects of internationalization in a dynamic learning process.

## Performance as a measure of adaptive learning throughout time

We use the difference equation models for examining incremental experiential learning by economic actors, particularly organizations, as proposed by Herriot et al (1985). The proposed model of experiential learning is set in absence of competition together with a simple choice situation, where fixed resources are allocated among several independent and alternative activities. Each activity provides a return that is proportional to the allocation and competence of the system at that activity (Herriot et al, 1985, p. 298). This relatively basic model is completed by the dynamics of time taken as a continuum and measured in equal intervals, such as years. Time has been considered a silent variable under IP model settings (Eriksson et al, 2001), and we choose to render it explicit in order to serve as the base from which to measure changes in adaptive learning.

Consequently, total performance ($P_{st}$)at situation s and time t is measured in terms of capacity for each activity weighted by its competence ($C_{i^*}$), the allocation of time needed to understand each single activity ($A_{i^*}$) and the potential return from that activity ($R_{i^*}$), summed for all activities (Herriot et al, 1985, p. 298). We formalize this as follows:

$$P_{s,t} = \sum_{i^* \in A^{s^*}_{(i,t)}} C_{i^*} A_{i^*} R_{i^*}$$

**Equation 3**

Where

$$A^{s^*}_{(i,t)} = \left\{ i^* \in A^t_{(i)} : s(i^*) = s^* \right\}$$

**Equation 4**

and where (referring to table 1, p. 5)

$$s(i^*) \rightarrow \begin{vmatrix} 0 \\ \vdots \\ 5 \end{vmatrix}$$

**Equation 5**

Consequently, for a set, given performance (P), where competence (C) and return (R) are not a problem (such as a long experience under the present internationalization situation), a firm will increase allocations (A) in the form of time-consuming heuristic learning. On the other hand, where competence and return do present a problem (such as when confronted with a new internationalization situation), allocations for heuristic learning will be decreased (Denrell & March, 2001). Less heuristic learning, or reducing the main source for experiential knowledge, will then tend to be compensated with objective, general and market-specific knowledge through direct and indirect channels such as networks (Johanson & Vahlne, 1977, p. 28, 2009).

In the IP model, with learning leading to knowledge, the latter is considered "*to be vested in the decision-making system*" and the model "*does not deal explicitly with the individual decision-make*r" (Johanson & Vahlne, 1977, p. 26).

In this paper, we focus on the learning-related problems emanating from changes in quantities of market information consequential to an expansion of internationalization activities.

One complication exists in proceeding this way, as learning occurs in several dimensions simultaneously. We consider the following:

- Quantitative information changes leading to information overload and information slack, affecting competence, allocations and return estimations;
- Variations in problem-solving capacity, affecting competence and experience;
- Perceptions of risk, affecting goals, allocations and experience;
- Incremental learning, affecting all of the above.
-

Hence, competence and goals change at the same time as allocations and return estimations, each affecting the others, which in turn affect the outcome measured here as performance (Denrell & March, 2001).

## Allocations

Firms tend to allocate resources in a top-down fashion. Middle management must therefore make operating-level resource allocation decisions corresponding to executive-level resource allocation objectives. The sum of all operating-level allocations is different from the executive-level resource allocation for the total activity. As a result, a firm may face a deficit or an excess of resource allocations (Wiersema, 1983; Anderson, Lodish, & Weitz, 1987; Anderson & Richard, 1987).

In the following sections, we will examine the consequences of resource allocations stemming from a firm's international market activities and the influence of the resulting flow of information on the allocation-decision process.

The proposed allocation to the total activity (executive-level) is $A_{\bar{s},i,t}$ where *A,* at an average internationalization situation $\bar{s}$ for all activities *i* at time *t* is different from the sum of each allocation $A^*$ for each of the operating-level activities $i^*$, each at their own situation $s^*$, and at time $t$. We formalize this as:

$$A_{\bar{s},i,t} \neq \sum A^*_{s^*,i^*,t}$$

**Equation 6**

Determining the allocation for each operational-level activity is accomplished through a two-step process in which a proposition is first determined and the probability of proposing an increase in the activity is then identified. Operational-level activity increases

are based on past executive-level allocations ($A_{\bar{s},i,t-1}$).The probability of proposing an increase is based on past allocations, past performance ($P_{s,i,t-1}$) and past goals ($G_{s,i,t-1}$). The proposed allocation to each activity $A^*_{s^*,i^*,t}$ is determined as follows:

$$A^*_{s^*,i^*,t} = \left(A_{s,i,t-1} + \Delta I^*_{s^*,i^*,t}\right)\left(L^*_{s^*,i^*,t} - A_{s,i,t-1}\right)$$

**Equation 7**

where $\Delta I^*_{s^*,i^*,t}$ is the information interaction increment, *I*, between $I^*_{s^*,i^*,t}$ and $I^*_{s^*,i^*,t-1}$ ($\Delta I^*_{s^*,i^*,t} = I^*_{s^*,i^*,t} - I^*_{s^*,i^*,t-1}$,) and where $L^*_{s^*,i^*,t}$ is the learning limit for a proposed operating-level allocation at situation *s** of activity *i** at time *t*.

The learning limit results from the multiplication of the operating-level information variable *v** at situation *s** of activity *i** at time *t* ($v^*_{s^*,i^*,t}$), times the operating-level number of countries $n^m$ in which the firm is engaged at situation *s**, for activity *i** and at time *t* ($n^*_{s^*,i^*,t}$), raised to the power of the situation number, *S**, that activity, *i*, is in at time, *t*, with probability $1 - U_{s,i,t}$ and $U_{s,i,t}$:

$$L^*_{s^*,i^*,t} = \left(v^*_{s^*,i^*,t} \times n^*_{s^*,i^*,t}\right)^{S^*_{i^*,t}}$$

**Equation 8**

Given the difficulty in assessing an organization's learning, we assume that any change in the number of active information variables, v, is a signal that organizational learning has occurred:

$$\sum \Delta v^*_{s^*,i^*,t} \neq 0 \implies \sum L^*_{s^*,i^*,t} > 0$$

**Equation 9**

Where

$$\sum \Delta v^*_{s^*,i^*,t} = \sum v^*_{s^*,i^*,t} - \sum v^*_{s^*,i^*,t-1}$$

**Equation 10**

In addition to the above, any change in the number of countries in which the firm operates during the considered time period is a signal that the firm is willing to further pursue challenges to its knowledge-state ($\sum K^*_{s^*,i^*,t}$ ) at that time:

$$\sum \Delta n^*_{s^*,i^*,t} \neq 0 \implies \left(\sum K^*_{s^*,i^*,t+1} - \sum K^*_{s^*,i^*,t}\right) > 0$$

**Equation 11**

Where

$$\sum \Delta n^*_{s^*,i^*,t} = \sum n^*_{s^*,i^*,t} - \sum n^*_{s^*,i^*,t-1}$$

**Equation 12**

The probability $U_{s,i,t}$) of proposing an increase in allocations changes in response to experience (*E*) and the allocations adjustment made during the previous trial adjustment, the performance result of that trial $P_{s,i,t-1}$) and the goal of the same trial ($G_{s,i,t-1}$) is:

$$U_{s,i,t} = \left(U_{s,i,t-1} + \Delta\bar{S}_{i,t}\right) \times \left(1 - U_{s,i,t-1}\right)$$

If $A_{s,i,t-1} > A_{s,i,t-2}$ ; $P_{s,i,t-1} > G_{s,i,t-1}$

Or If $A_{s,i,t-1} < A_{s,i,t-2}$ ; $P_{s,i,t-1} < G_{s,i,t-1}$

**Equation 13**

$$U_{s,i,t} = \left(U_{s,i,t-1} - \Delta\bar{S}_{i,t}\right) \times U_{s,i,t-1}$$

If $A_{s,i,t-1} > A_{s,i,t-2}$ ; $P_{s,i,t-1} < G_{s,i,t-1}$

Or If $A_{s,i,t-1} < A_{s,i,t-2}$ ; $P_{s,i,t-1} > G_{s,i,t-1}$

**Equation 14**

The above equations define a variation on a standard stochastic learning model in which the direction of the variation is determined without stochastic variation. The two learning parameters $\Delta I^*_{s^*,i^*,t}$ and $\Delta I^*_{s^*,i^*,t}$ affect the rate at which adjustments in allocations are made (Herriot et al, 1985, p. 299).

## Information Overload and Information Slack

Moving from $A^*_{s^*,i^*,t}$ to $A_{\bar{s},i,t}$ involves satisfying the constraint that the sum of each operating-level activity allocation increase must not be superior to the eventually decreased executive-level allocation from $A_{\bar{s},i,t-1}$ to $A_{\bar{s},i,t}$. If this condition is not met, it is congruent to the operating-level allocation deficit emanating from the evolution of $\Delta I^*_{s^*,i^*,t-1}$ to $\Delta I^*_{s^*,i^*,t}$, or the firm's inability to cope with excess information given its configuration at $A_{\bar{s},i,t}$. This results from an information-related allocation difference *O* between the sum of operational-level allocations and executive-level allocations. This information-related allocation difference is contained in the sum of operational-level allocations ($\sum A^*_{s^*,i^*,t} \ni O_{\bar{s},i,t}$)

Consequently, the increment (Δ) of the sum of operational and executive-level allocations from the previous period to the following one are formalized:

$$\Delta \sum A^*_{s^*,i^*,t} = \sum A^*_{s^*,i^*,t} - \sum A^*_{s^*,i^*,t-1}$$

**Equation 15**

And

$$\Delta A_{\bar{s},i,t} = A_{\bar{s},i,t} - A_{\bar{s},i,t-1}$$

**Equation 16**

Then

$$\Delta \sum A^*_{s^*,i^*,t} = \Delta A_{\bar{s},i,t} + O_{\bar{s},i,t}$$

**Equation 17**

And

$$O_{\bar{s},i,t} = \Delta \sum A^*_{s^*,i^*,t} - \Delta A_{\bar{s},i,t}$$

**Equation 18**

The information-related allocation difference carries a positive or negative sign. A positive sign indicates an excess of information-related allocations, which impair the adaptive response of the firm at time *t*. This is called "information overload" ($O^o_{\bar{s},i,t}$). When the sign is negative, a fraction of the executive-level allocation has not been allocated to any single activity at the operational-level, leaving some headroom for learning and for preparing future activities. This is called "information slack" ( $O^\sigma_{\bar{s},i,t}$).

$$O_{\bar{s},i,t} > 0 \implies O^o_{\bar{s},i,t}$$

**Equation 19**

And

$$O_{\bar{s},i,t} < 0 \implies O^\sigma_{\bar{s},i,t}$$

**Equation 20**

In this article, we focus more on information overload ($O^o$ ). The implication of information overload is that it will act as a diminishing factor of the total expected potential return (*R*),

thus reducing the firm's present predictive capacity of a future return estimation. Information overload will also affect the perception of risk ($\tilde{\rho}$).

## Return

We propose associating a learning adjustment similar to the one used in equation 7 to the expected potential return (*R),* where $R_{\bar{s},i,t} = \sum R^*_{s^*i^*t}$, where experience (*E*) $E_{\bar{s},i,t} = \sum E^*_{s^*i^*t}$ and where information overload affects the return estimation as follows:

$$R_{s,i,t+1} = \frac{\left(R_{\bar{s},i,t-1} + \left(E_{\bar{s},i,t} \times \left(\Delta L_{\bar{s},i,t} - R_{\bar{s},i,t}\right)\right)\right)}{O^o_{\bar{s},i,t}}$$

**Equation 21**

In other words, given information overload, a firm's performance is reduced because of an excess of allocations. The subsequent inability to cope is due to the exponential nature of $I_{\bar{s},i,t}$, as well as the influence exerted by the presence of information overload over the potential return of activity in a market.

## Competence

It seems reasonable to assume that competency at carrying out an activity decreases with the passage of time and increases with allocations to that activity (Herriot *et al*, 1985; Levitt & March, 1995).
We complete the variant of a standard learning-by-doing model (Rieskamp, Busemeyer, & Laine, 2003) with "practical thinking" coefficients of a problem-solving capacity decrease ($\delta$) and increase ($\check{\iota}$). Practical thinking is described as problem-solving know-how resulting from the intimate knowledge of a given situation (Scribner, 1986).

$$C_{\bar{s},i,t} = \left[\left(1 - \delta_{\bar{s},i,t}\right) \times \left(C_{\bar{s},i,t} + A_{\bar{s},i,t} + O_{\bar{s},i,t}\right)\right] \times \left[\check{\iota}_{\bar{s},i,t} \times \left(1 - \left(1 - \delta_{\bar{s},i,t}\right) \times C_{\bar{s},i,t-1}\right)\right]$$

**Equation 22**

Consequently, competence at time t, as defined above, is controlled by the rate at which the firm's efficiency at an activity responds to the increase or decrease of practical thinking and information-related allocation differences. The interference of network-provided information in the above process is beyond the scope of this paper.

## Goals

Performance aspirations are assumed to adapt to past performance ($P_{\bar{s},i,t-1}$), previous goals ($G_{\bar{s},i,t-1}$) and present risk perception ($\tilde{\rho}_{\bar{s},i,t}$).
Risk perception has been described under the "commitment decisions" heading of the IP model (Johanson & Vahlne, 1977, p. 29-31), where existing market uncertainty and existing market commitment interact in determining the existing market risk situation. It is then compared to the firm's maximum tolerable market risk. The IP model further

suggests some courses of action according to the difference between maximum tolerable risk and the existing market risk situation. The model further proposes that as internationalization competence increases, psychic distance decreases, resulting in a reduction of the perceived maximum tolerable risk. Through the same process as in equation (22), above, the present perception of risk is defined:

$$\tilde{\rho}_{\bar{s},i,t} = \left[\left(1 - \delta_{\bar{s},i,t}\right) \times \left(\tilde{\rho}_{\bar{s},i,t} + A_{\bar{s},i,t} + O_{\bar{s},i,t}\right)\right] \times \left[\check{\iota}_{\bar{s},i,t} \times \left(1 - \left(1 - \delta_{\bar{s},i,t}\right) \times \tilde{\rho}_{\bar{s},i,t-1}\right)\right]$$

**Equation 23**

Following Heriot *et al* (1985), we make goals an exponentially weighted moving average of performance where present risk perception determines the relative weight attached to the relatively recent performance results:

$$G_{\bar{s},i,t} = \left(1 - \tilde{\rho}_{\bar{s},i,t}\right) \times \left(\left(G_{\bar{s},i,t-1} + \tilde{\rho}_{\bar{s},i,t}\right) \times P_{\bar{s},i,t-1}\right)$$

**Equation 24**

## Allocation consequences

If the information-related allocation difference ($O_{\bar{s},i,t}$) is close to 0, previous risk perception would tend to be the same, and the present goal would correspond to previous performance ($P_{\bar{s},i,t-1}$). If the firm faces information overload ($O^{o}_{\bar{s},i,t}$), present risk perception ($\tilde{\rho}_{\bar{s},i,t}$) would tend to be considerably higher than previous risk perception ($\tilde{\rho}_{\bar{s},i,t-1}$), which in turn would weigh on goals ($G_{\bar{s},i,t}$), adjusting them at a lower level than the previous timeframe. Performance ($P_{\bar{s},i,t}$) would also decrease because of the firm's inability to cope with excess information, which in turn generates more information overload, lowering performance and spiraling downwards in the following relationship:

$$P_{\bar{s},i,t} < P_{\bar{s},i,t-1} \Leftrightarrow O^{o}_{\bar{s},i,t} > O^{o}_{\bar{s},i,t-1}$$

**Equation 25**

In the case of information slack in *t*-1, the relationship is

$$P_{\bar{s},i,t} < P_{\bar{s},i,t-1} \Leftrightarrow O^{o}_{\bar{s},i,t} > O^{\sigma}_{\bar{s},i,t-1}$$

**Equation 26**

If the firm, in contrast, happens to be in an information slack situation ($O^{\sigma}_{\bar{s},i,t}$), the risk perception would tend to be lower than in the previous period, which would tend to increased performance, which, in turn, would tend to increase goals, spiraling upwards, as per the following relationship:

$$P_{\bar{s},i,t} > P_{\bar{s},i,t-1} \Leftrightarrow O^{\sigma}_{\bar{s},i,t} > O^{\sigma}_{\bar{s},i,t-1}$$

**Equation 27**

To conclude this point, information overload ($O^{o}_{\bar{s},i,t}$) is the consequence of an excess of allocations ($A_{\bar{s},i,t}$) impairing the adaptive response of the firm. Consequently, the information overload/slack inflexion point can be determined as follows (equations 18 and 19):

$$\left(\Delta \sum A^{*}_{s^{*},i^{*},t}\right) - \left(\Delta A_{\bar{s},i,t}\right) \approx 0$$

**Equation 28**

where equation 28 is under time series settings ($t - n \rightarrow t$) and where a positive value would indicate information slack, information overload would appear as a negative value. Generalizing, we posit that under the settings of the present equation set, an inferior performance of a firm at situation *s* and at time *t* compared to the performance of situation *s* and at time *t-1* is due to information overload, or an excessive amount of information that the actors managing a firm's internationalization must face. Adaptive allocations, estimations and competence are affected in such a way that internationalization managers may feel compelled to revert to time-proven, yet non-adapted, mechanisms, searching for short-term results, instead of shifting allocations in a way that the actors managing the different facets of a firm's internationalization have sufficient slack and incentives to handle organizational learning in a long-term perspective (March & Weil, 2005).

## Discussion

Under IP model settings, the information overload situation has direct implications in the "market knowledge" of the "state aspects" of the basic model (Johanson & Vahlne, 1977, p. 27).

A reduction in market knowledge translates into an increase of market uncertainty and a lower level of maximum tolerable risk in the commitment decisions of the change aspects of the IP model.

This situation is different from "scale increasing decisions" considered by Johanson & Vahlne. Nonetheless it leads the firm into "increasing its interactions and integration with the market environment" (Johanson & Vahlne, 1977, p. 30), thus sensibly increasing information overload, further reducing performance and increasing short-term "tunnel vision" reverting to time-tried but ill-adapted solutions (March, 2006).

Recent developments in the IP model have focused on business networks instead of country markets (Johanson & Vahlne, 2006). Regarding business networks, Johanson and Vahlne (2003) propose three types of business relationship learning, spanning from a simple arms-length customer supplier relationship to a fully integrated upstream and downstream business network in which "*learning serves as a base to further commit to the relationship*" (Johanson & Vahlne, 2003, p. 93-94). Extant literature argues that business networks act as information facilitators that help reduce "liability of outsidership" and "liability of foreignness" (Johanson & Vahlne, 2009) to the point that overcoming

market barriers under pure network case settings are considered irrelevant (Johanson & Vahlne, 2003, p. 92).

In the same that each firm is unique, so are the markets in which it evolves. Hence, same-industry variables cannot have an identical impact, value or consequence in more than one firm and market of a given industry. A firm in the process of internationalization actively partakes in more than one market, which leads to issues in managing the information influx, one aspect of which we have considered in this paper.

Given the significance of information in learning, and considering that learning drives further commitment to a relationship, as well as the uniqueness of a firm's activity from one market to another, it would appear reasonable to say that possessing primary market-specific information and variable relative-importance is critical for optimal performance.

Networks can easily provide secondary information and variable-relative importance from a partner firm's unique position and needs. Consequently, given the IP model, experiential learning and information overload settings, we can reasonably expect status quo reproducing behavior, including aversion to new or risky alternatives because of partner imitation (Denrell & March, 2001). This would be especially the case if the internationalizing firm is in an intermediate type of business network learning, where knowledge is usually shared with "*customers similar in size, technology, or cultural and institutional settings*" (Johanson & Vahlne, 2003, p. 93).

Given that market variables are ambiguous, their environment is turbulent, their information influx is interdependent and competence multipliers introduce path dependency, when information slack occurs, "*experiential learning can produce superstitious learning and converge to inferior alternatives*" (Denrell & March, 2001, p. 525) as well as suboptimal performance (*ibid*).

## Implementing the equation set

The difficulty of obtaining all required data from standard public datasets leads to mixed data collection methods and subsequent difficulties in determining proper analytic methodology.

This equation set is most easily and readily used under single case study and time-series settings.

However, given the necessary time-series detail, it can be used with databases held by government, international and financial institutions. Having access to such data would allow for the quantitative methods and hypothesis testing described in this paper.

## Operationalizing the IP model

The main building blocks of the IP model are commitment ($\gamma$), uncertainty ($\upsilon$), resource position ($\rho$) and risk approach ($\alpha$). From the "change aspects" of the IP model, we group

under the market commitment (μ) heading from the "state aspects" of the same model. Also included are experiential knowledge (κ), known as market knowledge of the "state aspects" (fig. 1).

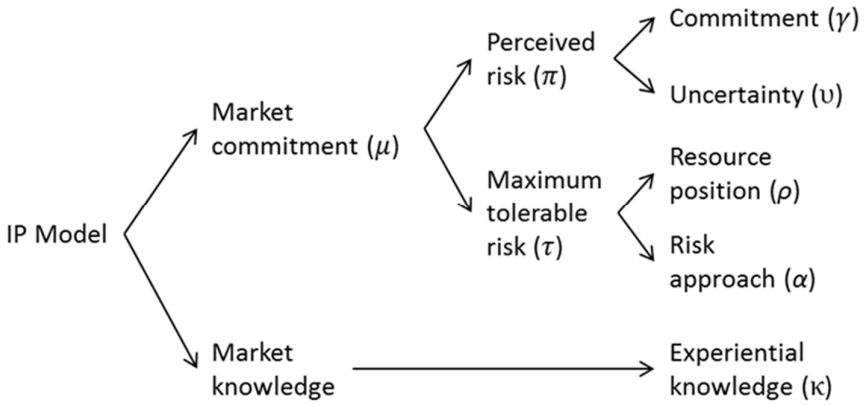


**Figure 1: Arborescence of IP model variables.**

The IP model has been erroneously considered a deterministic incremental model explaining foreign market understanding and foreign risk management, where market commitment is expressed as the dependent variable and market knowledge is the independent one (Johanson & Vahlne, 1990, 2006, 2009).

Furthermore, it appears that market commitment has not attracted much research, nor has the interaction between market commitment and market knowledge (Johanson & Vahlne, 2006, p. 167). Th e lack of research in this area may proceed from the difficulty of quantitatively operationalizing the IP model under the country/market settings of the original 1977 version, and the even more complex new network settings of the 2009 version.

Another explanation may stem from the dynamics of the model itself (Fig. 2), which conceptually preclude static data quantitative hypothesis tests, as all variables are related, making it impossible to directly generate a set of independent variables. Time series methods, however, do offer a solution, provided that the researcher has access to the appropriate databases for quantitative analysis, or the time to conduct in vivo qualitative research.

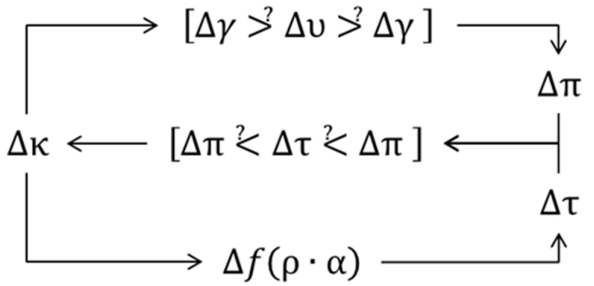


**Figure 2: Dynamics of the IP model**

Time, the silent variable, is implicitly included in the IP model "Δ". Consequently, by separating time from the value of Δ at specific intervals, and by producing alternate measures for the building blocks of the IP model, as long as we comply with time-series methods, we are able to propose an implementation instrument for market commitment (*M*) and experiential knowledge (*K*).

Below, Table 2 details the proposed correspondences between our set of equations and the IP model variables. We are encouraged in establishing this relationship because of the conceptual proximity of the learning processes described and measured in the first sections of this paper with the IP model's experiential learning. Under IP model settings, information overload and information slack become indicators of learning capacity, namely, the capacity to build trust and commitment, along with identifying and exploiting opportunities (Johanson & Vahlne, 2009, p. 1415).

| IP Model variables | Equation set variables | Equation N° |
|---|---|---|
| Moral commitment ($C$) | Past performance ($P_{\bar{s},i,t-1}$) | 3 |
| Uncertainty ($U$) | Present risk perception ($\tilde{\rho}_{\bar{s},i,t}$) | 23 |
| Perceived risk ($R$) | Goals ($G_{\bar{s},i,t}$) | 24 |
| Resource position ($\rho$) | Return ($R_{s,i,t+1}$) | 21 |
| Risk approach ($\alpha$) | Learning limit ($L^*_{s^*,i^*,t}$) | 8 |
| Maximum tolerable risk ($R^*$) | Probability of allocation increase ($U_{s,i,t}$) | 13 |
| Experiential knowledge ($K$) | Competence ($C_{\bar{s},i,t}$) | 22 |

**Table 2: IP model to equation set variable correspondence**

As stated earlier, there are major differences between the 1977 and 2009 IP models. Liability of foreignness and country/market are no longer considered valid units of analysis (Johanson & Vahlne, 2006). In 2009, they are replaced by the network concept highlighted in the 1990 paper. Liability of outsidership completes the new unit of analysis. "Opportunity" is presented as a new variable, and the meaning of "learning" evolves. The internationalization process is placed squarely within the framework of networks (Johanson & Vahlne, 2009).

Confirmatory quantitative research requires the use of large databases usually containing secondary data compiled by international agencies or government institutions, coupled with, or cross-referenced to smaller primary data databases. These databases list business activities within the political borders of countries. Consequently, quantitative research is limited to the 1977 IP model framework.

Conversely, research using the 2009 IP model is required to collect qualitative data in order to obtain information on transnational and informal organizations:

> "*The informal and subtle nature of relationships makes it almost impossible for anyone who is not personally involved to judge the scope of the investment that has gone into building it, or its value*" (Johanson & Vahlne, 2009, p. 1414).

The original IP model suggests the use of intensive longitudinal case studies. Our equation set allows for both quantitative and qualitative longitudinal work.

## Further research and conclusion

The experience necessary to evaluate market-dependent variables and predict outcomes in different markets is a learning process that develops over time. As such, time appears to be an underlying, silent variable (Sharma & Blomstermo, 2003). With this in mind, information overload and information slack can be considered from "absorption capacity" and "time-compression diseconomy" perspectives (Vermeulen & Barkema, 2002). Research is this direction appears to be promising.

The present set of equations addresses a simple choice situation regarding allocations among several alternative and independent activities linked to the internationalization of a firm in an IP model perspective.

Our next step in pursuing this line of research is to quantitatively use our equation set results as independent variables under time-series settings to establish their explicative power in the survival of internationalizing firms.

A project, currently underway, uses the French COFACE (international business insurance company) database for their "Prospecting Insurance" government-backed export promotion program. We invite research using export promotion databases from other countries.

We have examined the situation in which learning for one firm occurs simultaneously in several dimensions. By introducing time intervals, we are able to account for changes taking place through time. When used in a qualitative way, we are able to explain those changes and possibly predict future variations of performance, allocations, information processing capacity, returns, competence and goals. More generally, we are able to quantify and interpret a firm's situation according to its perceived risk and tolerable risk (stemming from the IP model). Finally, we are able to quantify the number of markets in which an internationalizing firm can be active in before reaching information overload. Corrective measures, although suggested, are beyond the scope of this paper and constitute an interesting research topic. An equally interesting topic would be that of verifying whether a "tolerance zone" exists around the overload/slack inflexion point of equation 28. This, and the consequences on the present equation-set would be of particular interest to government and financial organizations.

Considering information influx depends on a firm's foreign market exposure and that this exposure is a consequence of a firm's foreign market knowledge and commitment, the proposed set of equations can be used as indicators of international performance, per se.

Finally, the present set of equations constitutes a systematic effort to measure information overload, its consequences, and within stated limits, a method to operationalize the IP model.

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## Appendix A

De Leersnyder Grid

Delegate without investing.

The firm acts via international wholesaler; international broker; international procurement agent; import distributor; export agent; licensee; subcontractor for a foreign principal; piggy-back exports; franchising; license transfer.

Control the market without investing.

The firms acts via management contract; technical assistance schemes; direct exports.

Invest and delegate.

The firm acts via product-in-hand turn-key factory with equity shareholding; joint ventures; equity exports to minority-held subsidiaries or pup companies.

Invest and control.

The firm acts via foreign branch office; sales subsidiary; industrial subsidiary; integrated subsidiary.