Sector Analysis

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Abstract

In this paper, the framework introduced in *Vector Analysis* is extended to analyze sets of vectors.

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Outline

Topography 3
Modulation 4
Sectors 5

First-Order Principles (Profit) 7
Second-Order Principles (Statistics) 8
Third-Order Principles (Thresholds) 9
Fourth-Order Principles (Analysis) 10

Topography

Section 1: Composition

Let topography be defined as the set of subsets of compounds in an infrastructure.

Let A_t be the set of compounds of the Ath type in an infrastructure at time t, such that

$$A_t = [A_1 ... A_m] \quad (1.1)$$

Let B_t be the 1 x i matrix of the set of compounds in A_t that produce outputs at time t, such that

$$B_t = [B_1 ... B_i] \quad (1.2)$$

where $i \leq m$.

Let C_t be the 1 x r matrix of the set of compounds in A_t that are consume outputs at time t, such that

$$C_t = [C_1 ... C_r] \quad (1.3)$$

where $r \leq m$. From these definitions, it is possible for a given compound to belong to subsets B_t and C_t at the same point in time.

Let N_t be the i x I matrix of the set of outputs produced by the compounds in B_t, for I types of outputs.

Let n_t be the r x R matrix of the set of outputs consumed by the compounds in C_t, for R types of outputs.

Section 2: Structure

The structure of a topography can be expressed in a modified map or a set of matrices.

Algebraically, let b_t be the 1 x I matrix of the set of outputs produced by the compounds in B_t, such that

$$b_t = [B_t][N_t] \quad (2.1)$$

Let c_t be the 1 x R matrix of the set of outputs consumed by the compounds in C_t, such that

$$c_t = [C_t][n_t] \quad (2.2)$$

Using matrix notation, the number of units of output produced is given by

$$\sum_{g=1}^{i} \sum_{h=1}^{I} N_{gh} = \sum_{h=1}^{I} b_{1h} \quad (2.3)$$

For the Eth type of output, the number of units produced is given by

$$\sum_{g=1}^{i} N_{gE} = b_{1E} \quad (2.4)$$

Using matrix notation, the number of units of output consumed is given by

$$\sum_{j=1}^{r} \sum_{k=1}^{R} n_{jk} = \sum_{k=1}^{R} c_{1k} \quad (2.5)$$

For the Eth type of output, the number of units consumed is given by

$$\sum_{j=1}^{r} n_{jE} = c_{1E} \quad (2.6)$$

Modulation

Section 1: Composition

Let modulation be defined as a set of transitions undergone by a set of vectors.

Let an initiator be defined as a vector that initiates a set of transitions in a set of vectors via progression, syncronization, or regression.

Let a receiver be defined as a vector that is altered by a set of initiators.

The classification of a vector can vary depending on the set of modulations considered.

Let covalence be defined as an arrangement of a set of vectors where each vector is an initiator and a receiver with respect to every other vector in the set.

Section 2: Structure

Given these definitions, a modulation, *MD*, can be expressed as

$$MD = [x(E); co\ (y(F)); ... \\ z(G); fb(x(E))] \quad (2.1)$$

where x(E) is the identifier of the x^{th} vector pertaining to the E^{th} type of output.

Let pre-emptive modulation be defined as modulation by an initiator via progression.

Let concurrent modulation be defined as modulation by an initiator via syncronization.

Let cyclical modulation be defined as modulation by an initiator via regression.

Sectors

Section 1: Composition

Let a sector be defined as a set of modulations pertaining to a given set of vectors.

Let amplification (a) be defined as the modulation of the profit associated with a set of vectors.
Let tuning (tu) be defined as the modulation of the frequency of a set of vectors.
Let equalization (e) be defined as the modulation of the set of inputs required by a set of vectors.

Let locking (lo) be defined as the modulation of the replications of a set of vectors.
Let dampening (d) be defined as the modulation of the modulations initiated by a set of vectors.

The classification of a vector can vary depending on the set of modulations that define a sector.

Section 2: Structure

Using process notation, a sector can be expressed as a set of modulations, where each modulation, *MD*, is of the form

MD = [x(E); a-co (y(F)); ...
z(G); lo-fb(x(E))] (2.1)

Any given vector can be involved in more than one modulation at a point in time.

The structure of a sector can be summarized by 12 ratios:

R1 = i_t / m_t (r - 2.1)
R2 = r_t / m_t (r - 2.2)
R3 = i_t / r_t (r - 2.3)
R4 = I_t / R_t (r - 2.4)

R5 = $\sum_{h=1}^{i} b_{1h} / i$ (r - 2.5)

R6 = b_{IE} / i (r - 2.6)

R7 = $\sum_{k=1}^{R} c_{1k} / r$ (r - 2.7)

R8 = c_{IE} / r (r - 2.8)

R9 = $b_{1E} / \sum_{h=1}^{I} b_{1h}$ (r - 2.9)

R10 = $c_{1E} / \sum_{k=1}^{R} c_{1k}$ (r - 2.10)

R11 = b_{IE} / c_{IE} (r - 2.11)

$$R12 = \sum_{h=1}^{I} b_{1h} \,/\, \sum_{k=1}^{R} c_{1k} \qquad \text{(r - 2.12)}$$

First-Order Principles (Profit)

Let cost, C_t, be defined as the set of inputs utilized in a sector at time t, such that

$$C_t = c_t \quad (1.1)$$

Let revenue, R_t, be defined as the set of outputs by a sector at time t, such that

$$R_t = b_t \quad (1.2)$$

Let profit, π_t, be defined as the returns from a sector at time t, such that

$$\pi_t = R_t - C_t$$
$$= b_t - c_t \quad (1.3)$$

Where resources present in R_t or C_t are absent in the other matrix, empty columns can be inserted in the appropriate matrix to make the calculation possible.

Alternatively, let currency be defined as a resource used to measure the value of a set of resources. Using a currency, profit can be calculated using the per unit value of each resource involved in a process, such that

$$\pi_t = b_t Y_t - c_t Z_t \quad (1.4)$$

where Y_t is the I x 1 matrix of per unit prices that corresponds to b_t, and
Z_t is the R x 1 matrix of per unit prices that corresponds to c_t.

Let

$$\boldsymbol{\pi}_T = \sum_{t=1}^{T} \pi_t \quad (1.5)$$

for t = 1...T periods.

Second-Order Principles (Statistics)

Let mass, M, be defined as the value of the set of inputs and outputs associated with a sector at a point in time, such that

$$M_t = b_tY_t + c_tZ_t \quad (1.1)$$

Let velocity be defined as the change in the profitability of a sector, such that

$$V_t = [(b_tY_t - c_tZ_t) - (b_{t-1}Y_{t-1} - c_{t-1}Z_{t-1})]/t$$
$$= (\pi_t - \pi_{t-1})/t \quad (1.2)$$

Let g be growth, such that

$$g_t = (M_t - M_{t-1})/t \quad (1.3)$$

Let a be acceleration, such that

$$a_t = (V_t - V_{t-1})/t \quad (1.4)$$

Let P be momentum, such that

$$P_t = M_tV_t \quad (1.5)$$

Let F be force, such that

$$F_t = g_ta_t \quad (1.6)$$

Third-Order Principles (Thresholds)

Let $c_{t(min)}$ be the minimum set of inputs consumed at time t, and let $Z_{t(min)}$ be the corresponding set of per unit prices. At minimum mass, $b_t = 0$ and $Y_t = 0$, so

$$M_{t(min)} = c_{t(min)}Z_{t(min)} \quad (1.1),$$

$$V_{t(min)} = [(-c_{t(min)}Z_{t(min)}) - (b_{t-1}Y_{t-1} - c_{t-1}Z_{t-1})]/t \quad (1.2),$$

$$g_{t(min)} = (M_{t(min)} - M_{t-1})/t \quad (1.3),$$

$$a_{t(min)} = (V_{t(min)} - V_{t-1})/t \quad (1.4),$$

$$P_{t(min)} = M_{t(min)}V_{t(min)} \quad (1.5), \text{ and}$$

$$F_{t(min)} = g_{t(min)}a_{t(min)} \quad (1.6).$$

Let $b_{t(max)}$ be the maximum set of outputs produced at time t, and let $Y_{t(max)}$ be the corresponding set of per unit prices. At maximum mass,

$$c_tZ_t = \boldsymbol{\pi}_T - \sum_{t=1}^{T-1} c_{t(\min)}Z_{t(\min)} \quad (1.7),$$

so

$$M_{t(max)} = b_{t(max)}Y_{t(max)} + \boldsymbol{\pi}_T - \sum_{t=1}^{T-1} c_{t(\min)}Z_{t(\min)} \quad (1.8),$$

$$V_{t(max)} = [(b_tY_t - \boldsymbol{\pi}_T + \sum_{t=1}^{T-1} c_{t(\min)}Z_{t(\min)}) - (b_{t-1}Y_{t-1} - c_{t-1}Z_{t-1})]/t \quad (1.9)$$

$$g_{t(max)} = (M_{t(max)} - M_{t-1})/t \quad (1.10),$$

$$a_{t(max)} = (V_{t(max)} - V_{t-1})/t \quad (1.11),$$

$$P_{t(max)} = M_{t(max)}V_{t(max)} \quad (1.12), \text{ and}$$

$$F_{t(max)} = g_{t(max)}a_{t(max)} \quad (1.13).$$

Fourth-Order Principles (Analysis)

Given third-order principles, changes in the statistics of a sector can be expressed as a function of time, such that

$$M_t = tg_t + M_{(min)} \tag{1.1}$$

where $M_{(min)} = M_{0(min)}$.

Similarly,

$$V_t = ta_t + V_{(min)} \tag{1.2}$$

where $V_{(min)} = V_{0(min)}$.

From these equations,

$$\begin{aligned} P_t &= (tg_t + M_{(min)})(ta_t + V_{(min)}) \\ &= t^2F_t + t(g_tV_{(min)} + a_tM_{(min)}) + P_{(min)} \end{aligned} \tag{1.3}$$

where $P_{(min)} = M_{(min)}V_{(min)}$.