How People Contribute to Growth-Curves

Prof. Peter P. Robertson, M.D.

Prof. dr. Wouter Schoonman

Prof. Peter P. Robertson, M.D.

Affiliations: Monterey Institute of International Studies, Monterey, USA

Prof. dr. Wouter Schoonman

Affiliations: Psy Tech industrial psychology, Den Haag, The Netherlands and Saxion and Rotterdam Universities of Applied Sciences, The Netherlands

This is a working paper; version 2.2

humaninsight

Abstract

Research started originally at McKinsey and Company (Thomson, 2006) into success factors of about 1700 Initial Public Offerings (IPO). In many of the 70 companies in this research project that made it to a USD billion turnover, personality patterns in the founding teams could be positioned on opposite positions of the Growth-Curve.

This research made use of an ecological tool, the AEM-Cube® (Robertson, 2005). This tool relates three key characteristics of the contribution of personalities to Growth-Curves: first to what phase of a Growth-Curve a personality contributes, second whether the personality is attached more to either technological Growth-Curves or commercial Growth-Curves and third whether a person is focused on a specific part of a Growth-Curve or is focused on the integration of larger parts or even the whole of a Growth-Curve.

This approach makes it possible to construct Growth-Curves by aligned personalities in a relay kind of sequence. Matching their specific contributions to the successive phases of a Growth-Curve.
AEM-Cube perceptions generated by Silicon Valley-based observers about how Steve Jobs and Tim Cook aligned themselves to create a fruitful Growth-Curve or the original context of the founding team of Yahoo (Thomson, 2006) are used, amongst others, as examples.
Given the results from the research mentioned above and many other similar case-by-case examples of the relationship between the contribution of individuals and their appropriate relay like alignment to Growth-Curves, an obvious question is how stable these personality characteristics are over time. If there is longtime stability of these characteristics, this approach will open a route to a long term strategic human resources management, being able to create optimal conditions for every phase of a Growth-Curve encountered in the products, services or client relationships in organisations. It could also create an approach for individual career choices of individuals, matching their personalities with the types of functions, roles and assignments in organisations.

This article describes the basic statistical background of the AEM-Cube and the longitudinal research of all assessment and reassessment data, within a time range between 1 and 12 years, that could be extracted from the 30.000+ assessments available today.

The result will show that there is a high level of stability and that assessment and reassessment data do not differ more than about 10 percentiles over the years for the two factors that describe the direct contribution to the Growth-Curve. The third factor, describing the contribution to the integration of Growth-Curves differs about 15-20 percentiles, which was to be expected because this factor reflects in a certain way a personal development as a consequence of career development and was never hypothesised to be stable in the first place.

The conclusion is that the AEM-Cube can contribute to a long term strategic human resources management both from the organisation to optimise individual contributions to the strategic phases of growth, as well as from individuals to organisations to optimise their individual career paths.

Keywords: Organisational Ecology, Ethology, Cybernetics, Complexity theory, AEM-Cube, Growth-Curve, S-Curve

Introduction

The research on success factors of about 1700 companies that went public, originated at McKinsey and Company. The research was later continued by Thomson, as an independent consultant (Thomson, 2006). He found that in many of the 70 companies that made a Billion USD turnover, patterns of personalities within the founding teams could be positioned on opposite positions of the Growth-Curve.

David Thomson named this phenomenon 'the outside-inside dialogue', Charles O'Reilly (Stanford) and Mike Tushman (Harvard) named a similar phenomenon 'ambidextrous management' (O'Reilly, 2004) and Bob de Wit (Nyenrode) named the phenomenon 'strategic paradoxes' (De Wit & Meyer, 2010).

An example used in Thomson's book - Blueprint to a Billion - is the case of Yahoo. Thomson recognised that in many of the successful founding teams, a typical pair of founder personalities existed. He named them, rather intuitively, the Mr Outside and the Mr Inside and he defined the dialogue between them as critical for starting a Growth-Curve. He saw this Inside Outside duo as an asset for investors. Based upon the credibility the AEM-Cube tool received in the Hewlett Packard/Compaq merger (Robertson, 2005), it was used to assess a series of founding teams of those companies that 'made it to a billion' described in Thomson's book and supported his observations. Yahoo was one of them and the – typical - example is given below.

An assessment of the Yahoo founding team, like with most other teams in Thomson's research, was based upon the biographies and other data available about the founders and key members of the founding teams. An independent group of observers, aware of the AEM-Cube concepts and aware of the people involved, were asked to score the team members via a web-based questionnaire. Where possible, like in the Yahoo case, the results were checked against observers who knew both the team members well enough as well as they were proficient in the understanding of the AEM-Cube.
The first answer this assessment delivers is the position of the contribution of each individual to a Growth-Curve, also often called S-Curve (Modis, 1998).

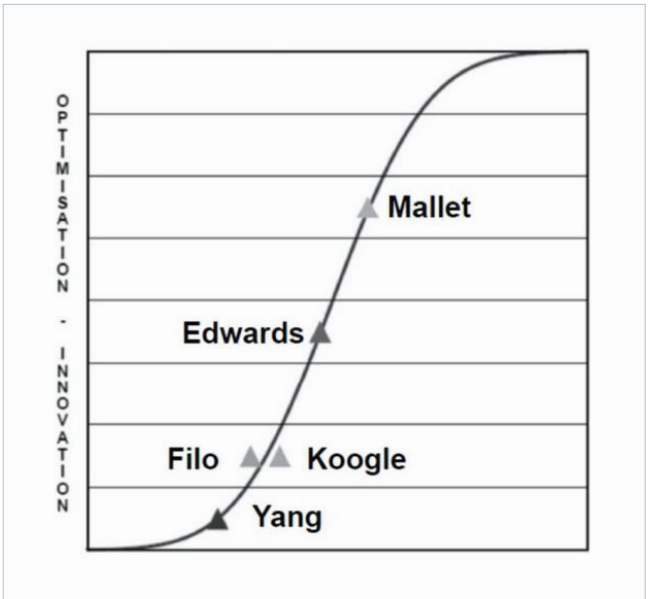

Figure 1. Key Founding Members of Yahoo

In the case of Yahoo, this profile shows that one of the technical founders, Yang, is perceived as contributing close to the earliest stage of a Growth-Curve. Filo (the other technical founder) and Koogle (who joined as CEO to develop the company) are perceived at about the first inclination point of the Growth-Curve, which is the position where the real upscaling is to take place. Koogle is known to be the builder of Yahoo. Filo and Yang were together the technological founders, for reasons that will become clear below, Mallet is positioned to contribute as COO in the second half of the Growth-Curve, where structuring activities like control of any kind (like financial, legal, organisational design and quality management to name a few) are the main contributions to make.

Edwards is also shown in this picture as she epitomises with her profile the operational contribution that is needed in the middle of any growth-process.

The key finding of this type of assessment, as illustrated by the example of the Yahoo team, is that in the founding teams in Thomson's research, team members were optimally aligned along with their contributions to a Growth-Curve. In general, the dialogue between people who contribute to the early stages as well as to the later stages of a growth-Curve, like between Mallet and Koogle, is called 'the outside-in-inside-out' dialogue and, more informal, because it is perceived so often as effective, the 'Golden Dialogue' or 'Mr/Mrs Outside - Mr/Mrs-Inside Dialogue'.

In order to expand this example to a broader insight into the dynamics of teams, it is appropriate to first explain the model of the AEM-Cube as a whole.

In the case of Yahoo, this profile shows that one of the technical founders, Yang, is perceived as contributing close to the earliest stage of a Growth-Curve. Filo (the other technical founder) and Koogle (who joined as CEO to develop the company) are perceived at about the first inclination point of the Growth-Curve, which is the position where the real upscaling is to take place. Koogle is known to be the builder of Yahoo. Filo and Yang were together the technological founders, for reasons that will become clear below, Mallet is positioned to contribute as COO in the second half of the Growth-Curve, where structuring activities like control of any kind (like financial, legal, organisational design and quality management to name a few) are the main contributions to make.

Edwards is also shown in this picture as she epitomises with her profile the operational contribution that is needed in the middle of any growth-process.

The key finding of this type of assessment, as illustrated by the example of the Yahoo team, is that in the founding teams in Thomson's research, team members were optimally aligned along with their contributions to a Growth-Curve. In general, the dialogue between people who contribute to the early stages as well as to the later stages of a growth-Curve, like between Mallet and Koogle, is called 'the outside-in-inside-out' dialogue and, more informal, because it is perceived so often as effective, the 'Golden Dialogue' or 'Mr/Mrs Outside - Mr/Mrs-Inside Dialogue'.

In order to expand this example to a broader insight into the dynamics of teams, it is appropriate to first explain the model of the AEM-Cube as a whole.

The AEM-Cube backgrounds

The AEM-Cube differs fundamentally from most existing psychological assessment tools, by the falsifiability of its purely cybernetical foundations. This means that if one of the three constituent concepts (paradigms or laws) it is based upon, would be proven to be false, the AEM model will be wrong also. Two of the three constituent concepts are the basic instinctive biological systems, found in human beings and other social animals: 'attachment' and 'exploration' (Lorenz, 1981). The third constituent concept is The Law of Requisite Variety of Ross W. Ashby (Ashby, 1956) who can be seen, with Norbert Wiener, as the founder of modern cybernetics (Pickering, 2010). Cybernetically all three constituent concepts can be defined in terms of cybernetical control, where attachment is a feedback-controlled system and exploration is a feedforward-controlled system. The law of Requisite Variety, which is the concept underpinning the vertical dimension, states that "if a system is to be stable the number of states of its control mechanism must be greater than or equal to the number of states in the system being controlled" (Ashby, 1956). This means for the human mind, as an emergent property of the dynamic interactions of the canonical structure of feedforward and controlling feedback loops in the brain ((Shepard, 2004) that the more complexity it can be part of, the more complexity it will be able to navigate. This vertical dimension is designed for measuring how people deal with the complexity in their environment, or, in other words, the ecosystem they are living in and are part of. Those, scoring "low" against the background of the norm group, are likely to be somewhat less integrated with their social ecosystem, which allows them "positively" to focus more on unique contributions to the system like being very creative, but might also "negatively" be perceived as self-centred.

The AEM-Cube was designed based upon the observation that all the processes creating the human mind as well as all the processes creating complex dynamic systems - like man-made organisations or natural ecosystems - can be described as being defined by combinations of feedback- and feedforward loops. These combinations are creating and can be described as emergent processes and, if stable, as attractors (Robertson, 2005).

The self-organising time-dependent shift from feedforward-control to feedback-control can be linked to the Growth-Curve or S-Curve (see for further explanation below figure 2). These Growth-Curves have characteristics in common, whether observed in nature, organisations, markets, products or services. This observation made it obvious to create a single frame of reference for seemingly so different systems as the human mind and organisational phases of growth (Robertson, 2012).

Feedforward-control can also be replaced by information-control and feedback-control by error-control (Pribram, 1976). This makes it easy to connect more information-driven topics like vision, mission and strategy to feedforward-control and more error-driven topics like financial or security management to error-control.
These direct links between human personality and time-driven processes - like the Growth-Curve - have been translated in a practical way to a three-dimensional model called the AEM-Cube (Robertson, 1999, 2003, 2005) The more cybernetical and scholarly phrasing above can be translated more practically, appealing to daily use in the executive and organisational lane.

In Figures 1, 2 and 3 below, the three key questions connecting the human mind with organisational processes are described in the language that evolved in the daily organisational practice. The three questions defining the AEM-Cube's relationship with the Growth-Curve are:

1. Where do people contribute optimally to the Growth-Curve?
2. Is the contribution focused on relationships or content?
3. Is the contribution integrating or differentiating?

The AEM-Cube is administered via a web-based questionnaire, on average within 10 minutes. In most cases, respondents fill out a self-perception and also receive a (combined) feedback-profile from co-workers or other people in their environment. As such, the AEM-Cube makes use of the so-called 360°methodology (Conway & Huffcutt, 1997).

Three main questions

The first question the AEM-Cube is likely to provide an answer for - "Where do people contribute optimally to the Growth-Curve?" - is scored by the right-left dimension of the AEM-Cube. The position on the plane of the AEM-Cube mirrors the contribution to the S-Curve position. In other words, a score to the right (the exploratory side) is related to feedforward-steering characteristics of a personality and is in sync with feedforward-steering characteristics as they are typical for the early stages of a growth-Curve. The more a respondent scores on the left-hand side of the AEM-Cube, the more this is related to feedback-controlling characteristics of a personality and in sync with feedback-controlling characteristics as they are typical for the later stages of a Growth-Curve.

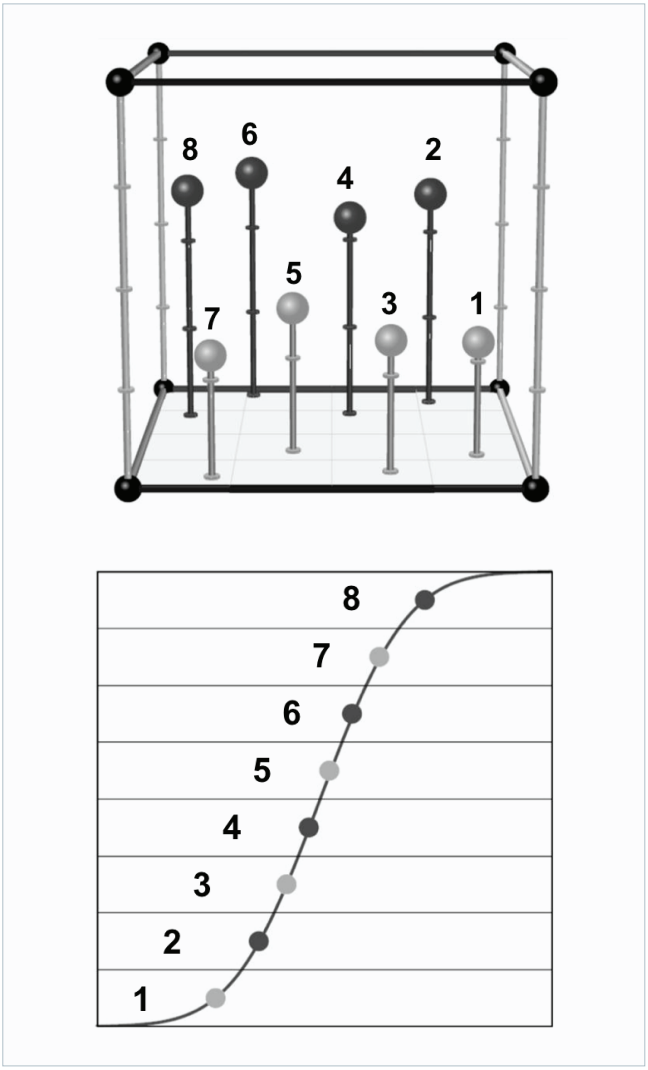

Figure 2. Optimal contributions to the Growth-Curve

The link between the Growth-Curve and the contribution of the human mind to the Growth-Curve is an essential and unique feature of the AEM-Cube approach. It is based upon shared cybernetical foundations.

The cybernetical foundations of the human mind can be probed from the neurophysiological (brain) as well the ethological perspective. The cybernetical foundations of the Growth-Curve can be probed directly from cybernetical considerations. With regards to the neurophysiological aspects of the brain, the fundamental unit of operation in the brain is itself a dynamic feedforward- feedback system. These units are "the elementary" building blocks of all processes in the brain (Shepard, 2004). The mind, being an emergent property of the dynamic networks (Sporns, 2010) created by these cybernetical units, is then overall controlled by several levels of cybernetical control as is, in general, the case in complex dynamic cybernetical systems (Brooks, 1999). In other words, this emergent mind is itself a cybernetical system which has been already postulated and developed since world war II by for example Ashby, Walter, Wiener and Brooks (Pickering, 2010).

With regards to the ethological aspects of behaviour, it is, amongst others, Lorenz' Nobel prize-winning work on ethology that deeply researched the nature of the exploration system in animals and humans (Archer & Birke, 1983; Lorenz, 1981). Two citations from Lorenz, chapter 6 ((Lorenz, 1981). Lorenz connects exploratory behaviour to information processing, which is basically the same as feedforward-control (Pribram, 1976). Herewith to citations of Lorenz (Lorenz, 1981):
"Being independent of any of the "common" motivations, exploratory behaviour acquires a kind of information that is in exactly the same sense objective as are the results of human scientific results".

"By responding to every single unknown object as if it were biologically relevant, these animals unavoidable discover those things which really are relevant. This endows them with the ability to adapt, through individual learning, to the most variegated biotopes". Both Lorenz and Archer point with their research to a strong relationship between information- or feed-forward control and this exploratory human instinct. Whereby Archer points out how fundamentally different the exploratory instinct is, compared to other human instincts (Archer & Birke, 1983).

The cybernetical underpinning of Growth-Curves is already understood for decades (Kefalas, 1978). This includes the dynamic gradual change from positive feedback (creating the first inflexion point) to negative feedback (creating the second inflexion point).

If there is only feed-forward behaviour a system reacts in a pre-defined way without responding to what the effect will be. Although feed-forward behaviour can happen throughout most of the Growth-Curve, it is obvious to be strongest at the beginning and the early phases because there is already something going into a direction, but with almost no feed-back, given the fact that feed-back can only exert influence if there is already something to modulate and if there is already a structure to do that very modulation.

In a feed-forward system, the control variable adjustment is not error-based. Instead, it is based on information about the process, especially where it is going. Feed-back control is error-based and feed-forward control is information-based (Pribram, 1976)

The cybernetical base underpinning the Growth-Curve makes it logical that during growth, which is a process of adding more error-control modulating and stabilising structure, it starts first with a process tilted towards feed-forward (information) control and ends with a process tilted towards feed-back (error) control.

It seems that most human beings and social animals do have a clear operating exploratory system in their early youth. The expression of this exploratory system differs between human beings in adult life. This is nature-based defined and nurture-based modulated. Some personalities remain strongly feedforward-controlled, i.e. they remain being very exploratory.

Depending on a variety of systemic factors (for example family system, education, social context), human beings adapt and develop in their personalities cybernetical characteristics between feedforward- and feedback control. These characteristics are very stable as will be shown later in this article.

Regarding the AEM-Cube Growth-Curve relationship along the exploratory-stability dimension, it can be summarised that the cybernetical make-up of both the brain, Growth-Curve and the human instinctive exploratory system is the foundation of this first dimension of the AEM-Cube.
The second question the AEM-Cube is likely to provide an answer for is: "Is the contribution of people focused on relationships or content?"
It is not that difficult to recognise two main patterns of Growth-Curves in organisations: one is the unique competency (Hamel & Prahalad, 1990), which is technical, or expertise-based, in short, content-based, and the other is customer, client, user-based, in short, relationship-based.

This practical division between content and relationship-based processes is based upon the human attachment system (Bowlby, 1969; Lorenz, 1981). This is an instinctive feedback-controlled system (similar to the food, temperature, blood pressure or sexual system), that searches for proximity with patterns it has defined, early in life, as familiar. These familiar patterns serve as a set point defining what is still familiar and what is not. If an individual encounters unfamiliarity or unknown factors, this attachment-system will define by its structure and experience whether an individual starts searching for the proximity of familiar patterns.

These patterns, individuals are attached to, are often other human beings (parents, family, friends). Lorenz (ibid) discovered that these patterns do not necessarily have to be the parents or other people, but can basically consist of any pattern, as long as enough time has passed to become defined as a familiar pattern early in life. Lorenz showed that animals can become attached, and can be made to attach, to other animals or even non-living objects. Bowlby (1969, 1973, 1980) also stated that full attachment towards non-human beings is possible.

In the late eighties and early nineties - at the National Aerospace Laboratory of the Netherlands (NLR) – observations were made during coaching, counselling, interviews and psychotherapy. In some cases, mental depression could, for example, be connected to have lost access to a software platform. This made a convincing, be it a quite practical, case for applying the concept of content attachment to human beings (personal communication).

In the AEM-Cube this resulted in a scale ranging from "content attachment to relationship attachment" to define characteristics of the attachment system of individuals. For all practical purposes, the content attached versus people-attached continuum has been translated in a preference for content versus a preference for people. The latter words give in the daily use of the tool an easier way to quickly understand the applicability of the concept. (Robertson, 2005).

Scoring at the front of the AEM-Cube is related to having more content attached characteristics and scoring at the back of the AEM-Cube is related to having more relationship attached characteristics. This is illustrated in Figure 2 above, where the odd numbers 1, 3, 5 and 7 are typically content attached positions and the even numbers 2, 4, 6, 8 are typically relationship attached positions.

The third question the AEM-Cube is likely to provide an answer for is worded as: Is the contribution of someone integrating or differentiating? In other words, what is the degree of Managing Complexity in an individual? Ashby's Law of Requisite Variety (Ashby, 1957) is used as a base for assessing the capacity to steer into complex environments.

In the use of the tool, words have been chosen that focus on an individual perspective versus a group perspective. This translates in a concept that runs from differentiating (= low Managing Complexity) to integrating (= high Managing Complexity).
People who score low on this vertical dimension are less focused on the whole ecosystem and more focused on their own contribution and people who score high on this vertical dimension are highly focused on the whole of the organisational ecosystem around them and the integration of their own contribution where that matters.

An easy way of explaining this vertical dimension, as reported by users, is to mention that the total length of the vertical dimension can be imagined as the length of a whole S-Curve. If one scores high on the vertical dimension then one can connect with all people who contribute everywhere on the S-Curve and as such communicate with 'the whole Growth-Curve in action'. If one scores low on the vertical dimension, one is focused on her/his specific contribution on that part of the Growth-Curve.

In Figure 3 below, the positions 1 and 3 are showing a short vertical dimension, which is for all practical purposes related to a more 'in-depth' focus on a specific phase of the Growth-Curve. Position 1 is related to positions at the start of a Growth-Curve. Position 1 could be related to a specialist inventor or expert strategic analyst. Position 3 could be related to a specialistaccountancy or assurance professional. Position 1 and 3 are then characterised by a focus on the job and less by integrating the job into the whole Growth-Curve. This is often positively associated with a high level of expertise.
Position 2 is an example of a position that is capable of integration of all people contributing along the Growth-Curve. This is a more generalist approach, connecting and integrating, and far less a specialist approach.

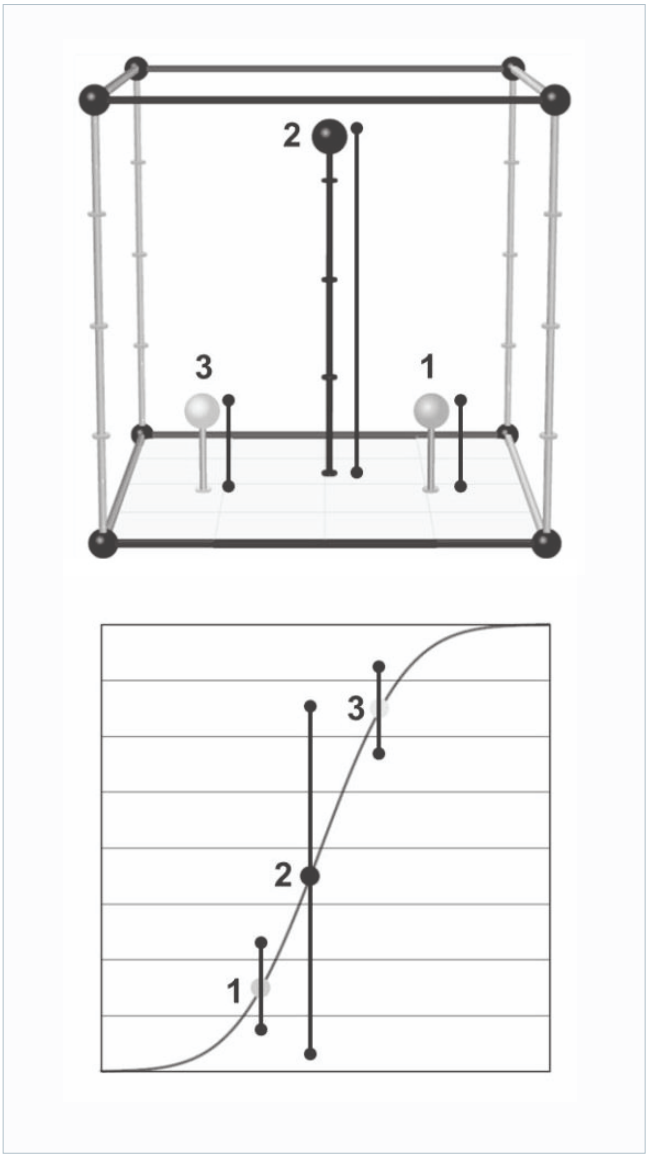

Figure 3. The vertical dimension - Managing Complexity - of the AEM-Cube

Whilst (as will be illustrated below) the position on the bottom plane both on the exploratory-stability dimension (right-left) as well on the content-relationship attachment-dimension (front-back) is stable during a lifetime, this vertical dimension can change during a lifetime. There is, however, not a necessary, mandatory or natural change from low Managing Complexity to high Managing Complexity. Although high Managing Complexity is important for aspects like overall performance, leadership, conflict resolution, the low Managing Complexity is essential for creativity, individual in-depth expertise and high skilled specialisms and crafts. There needs to be diversity in a team on this dimension like there is a need for diversity on both other dimensions.

After this brief overview of the key parameters measured by the AEM-Cube, we can illustrate the essence of Thomson's work with the continuing of the early founding context of Yahoo.

In Figure 4, the whole group of the early days is shown again in the full three-dimensional format. From this figure, it becomes clear that Yang and Filo are not only working in an exploratory way at the beginning of the Growth-Curve but also that they show up as scoring amongst the highest percentiles on content attachment and low on the vertical dimension, related to their specialist focus. This is a very typical position for people creating realistic exploratory and recognised innovative discoveries ready to become transformed in commercial value propositions. So far, no observations have been from the AEM-Cube database made during the last 17 years of high tech inventions not coming out of this right-front low vertical position.

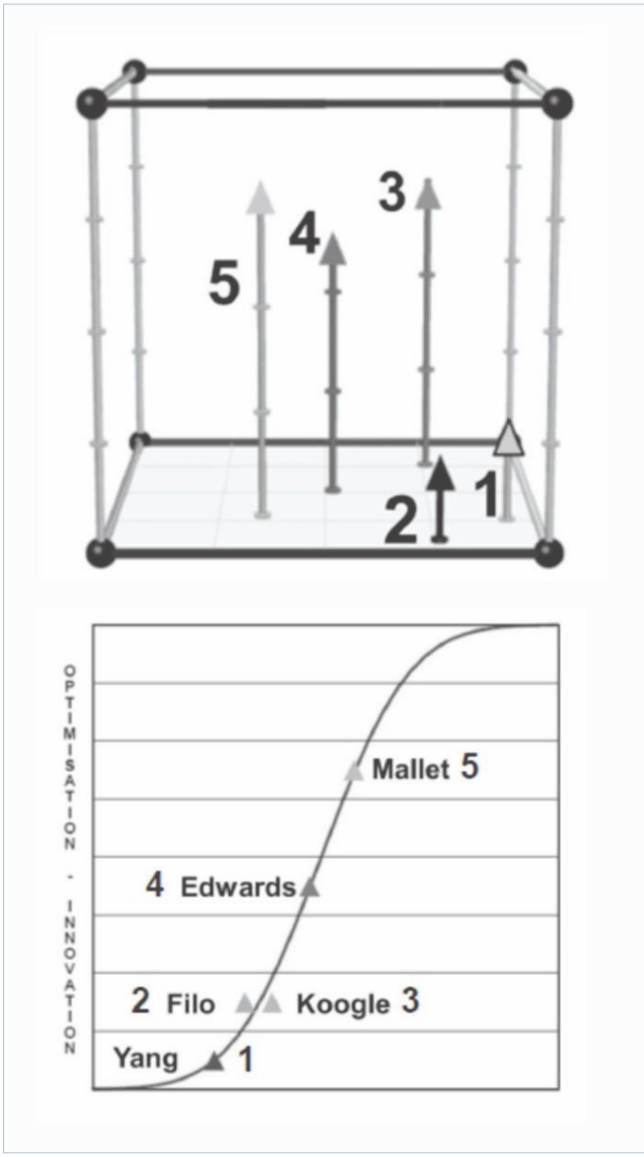

Figure 4. Classical Founding Team Dynamics (Example: Yahoo)

The two profiles are epitomising the research done by Thomson (ibid). They show Koogle and Mallet contributing to the early and later stages of the Growth-Curve, whilst Koogle shows up more on the exploratory commercial focused relationship side and Mallet more on the content focused stability (procedural, quality, governance focused) side of the AEM-Cube.

Both Mallet, as well as Koogle, obtained high scores on the vertical dimension, which reflects their connecting attitude creating a dialogue between the inside and the outside focus of the organisation.

Since this research was published, Yahoo stalled its growth (although it remained a strong firm). A hypothesis is that, since Yang became CEO, the focus might have been too much on technological exploration and less on turning innovation into real commercial value propositions.
For the latter, organisations likely need the dialogue embracing the whole Growth-Curve and not a specialist focus on one part of it.

A more recent example will illustrate this point even more clear. AEM-Cube profiles of Steve Jobs and Tim Cook were obtained at the time of the handover of the stewardship for Apple. A few people - outside Apple – scored the questionnaire with no more information than available for the public eye. Their profiles were confirmed by a group of people who are proficient with the AEM-Cube, but not closer to Apple. Although this example is mainly illustrative, outdated and not scientific (see disclaimer) it has shown during many lectures to be useful in explaining the dynamics of the AEM-Cube.

The perception of Steve Jobs is, as in the Yahoo case, on the familiar position where most of the real technological discoveries and innovations come from. The perception of Tim Cook is in a familiar position for an operational role. Both the perception of Steve Jobs as well as the perception of Tim Cook are scored strongly content attached, which should not surprise either. It seems to be a key condition to really develop a technological passion. Most important though is that they are observed to be connecting and in a continuous dialogue spanning the early and later stages of the Growth-Curve aligning the performance from idea to an asset.

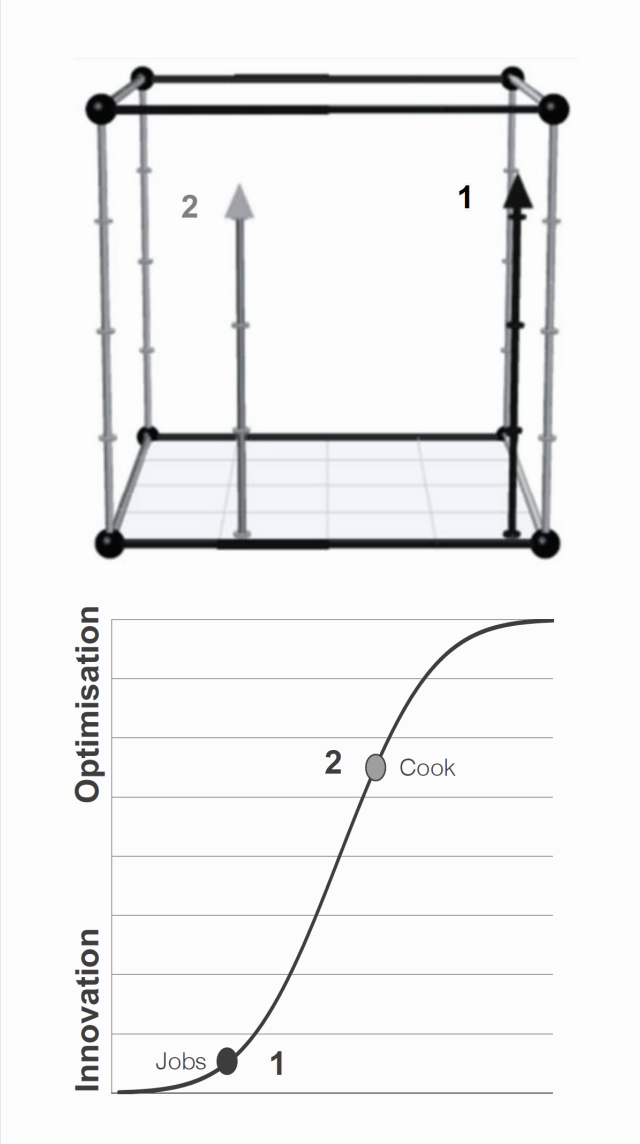

Figure 5. A highly functioning dialogue at Apple

Given the fact that now Tim Cook has the stewardship of Apple, the question arises what such a shift in leadership would do for the organisation. Although operational activities, customer, political and financial stakeholder relationships are appreciated better, governance is done with more stability, and that given the pipeline there is the proper execution of bringing good ideas with a strong brand to a healthy and willing market, it might be questioned whether this will maintain the real innovative power of Apple. Tim Cook is simply not that person (Kelly, 2012). So for the short term, i.e. a couple of years, his focus on the second half of the Growth-Curve might be very fruitful for shareholders in the first years of his remit, but they should expect probably a lower level of innovation if Cook is not capable of keeping the innovation going. It is probably a priority, but it does not seem to be his nature (Kelly, 2012). It seems appropriate to state here already a point that will be worked out in the applications mentioned in the conclusion, that someone's position on the Growth-Curve is not a judgement about someone's capacity to be a CEO. The message is, for any CEO, to align the contributions to the Growth-Curve with personalities that create together a working and sustainable growth path.

The examples show a relationship between personality and the Growth-Curve. Since the start of the development of the AEM-Cube, it has become evident that this relationship has a practical implication for connecting human resources directly to strategic growth-phases that exist in organisations.

A key question, however, is whether these personality patterns are stable or not. Simply stated: is a profile, like that of the perception of Tim Cook, capable of change into a more visionary, strategic contribution to the Growth-Curve, or is his operational strength the talent he brought, brings and will bring into the future?

Common sense is that these characteristics are stable: "an inventor will never become an accountant and an accountant will never become an inventor." The difference between these two personalities is basically their cybernetic make-up.

Theoretically, the characteristics of the attachment pattern should be most stable, being formed in life quite early (Bowlby, 1969). For the exploratory system, this is less evident. Most human beings express some level of exploratory (feed-forward-steering) behaviour and it seems that depending on the factors related to education, upbringing, family system, some express these characteristics all their life and others show more stability focused (feed-back-controlling) behaviour. Although, since the almost two decades the AEM-Cube is in use, it is common sense and daily practice to consider these characteristics to be stable.
Since, as of today, based upon more than ten years of data gathering, it is now possible to get a significant number of assessments and reassessments, to check this hypothesis about the stability of the personality patterns created by the attachment and exploratory instinctive systems.

Common sense is also that the vertical dimension can be changed by personal choices and development. Although a low vertical dimension is productive from a focus on specific competencies and specific in-depth contributions to a Growth-Curve, it is likely that people, once they get broader and larger responsibilities, should grow to a higher level of Managing Complexity and changing from a more specialist to a more generalist approach.

Based on the considerations above a key question to be researched is, whether the bottom plane of the AEM-Cube shows stable characteristics over time.

Statistical properties

Before approaching the question about the stability of the AEM-Cube profiles over time, this article will first introduce a brief introduction about the statistical basics of the AEM-Cube. Several data sets were statistically analysed, where the data stem from employees from many companies from mostly Anglo-Saxon countries. By combining several data sets with AEM-Cube data at the item level, a final sample was reached containing 7.983 Self-images and 21.605 Feedback images (in the text also called 'Other' assessments).

General statistics

In the following tables, some statistical and psychometrical properties of the tool are summarised. The current version of the AEM-Cube sports 12 items for the A- and E-scale and 24 items for the Managing Complexity scale.

The most prominent feature of all three scales is that almost the full range of possible scores per scale is visible (12 to 72 for the A- and E-scale and 24 to 144 for the M-scale). This means that respondents can make clear distinctions when describing their own behaviour or the behaviour of others. So, statistically speaking there is variability ('variance') which is the first prerequisite of any measurement tool.

When looking at the third and fourth moments (skewness and kurtosis) of the scales in the three groups, no strong deviations from a standard-normal distribution are observed (all values are in the -1.0 to +1.0 range). This is statistically attractive as many psychometrical or statistical methods assume such a standard-normal distribution.

Self (N = 7.983)	Attachment	Exploration	Managing
Average	52.4	30.0	115.2
Standard Deviation	8.8	9.4	12.2
Skewness	-0.4	0.6	-0.3
Kurtosis	0.1	0.3	0.3
Minimum	15	12	60
Maximum	72	68	144

Self (N = 21.605)	Attachment	Exploration	Managing
Average	48.8	34.1	109.0
Standard Deviation	10.8	11.8	17.4
Skewness	-0.4	0.5	-0.6
Kurtosis	-0.2	-0.2	0.6
Minimum	12	12	24
Maximum	72	72	144

Self (N = 29.588)	Attachment	Exploration	Managing
Average	49.8	33.0	110.7
Standard Deviation	10.4	11.4	16.4
Skewness	-0.4	0.6	-0.7
Kurtosis	-0.1	0.0	0.9
Minimum	12	12	24
Maximum	72	72	144

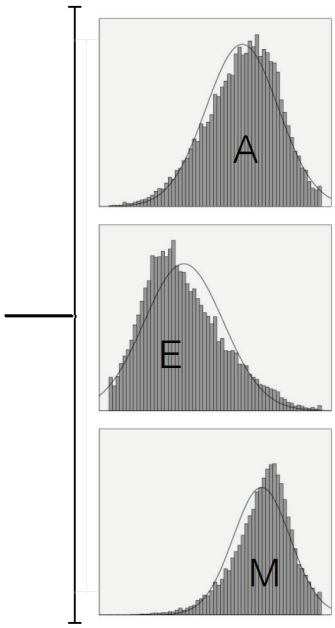

Table 1. AEM-Cube: Moments of the scales in full dataset in three groups

Although the Kolmogorov-Smirnov test statistic is significant for all three scales, this is due to the large sample size. These statistics are about 0.07. To see a graphical indication of the normality, see the next Figure. Herein the expected versus observed data for the first scale (Attachment) are plotted. As one can observe, the deviations between Expected and Observed scores are quite small.

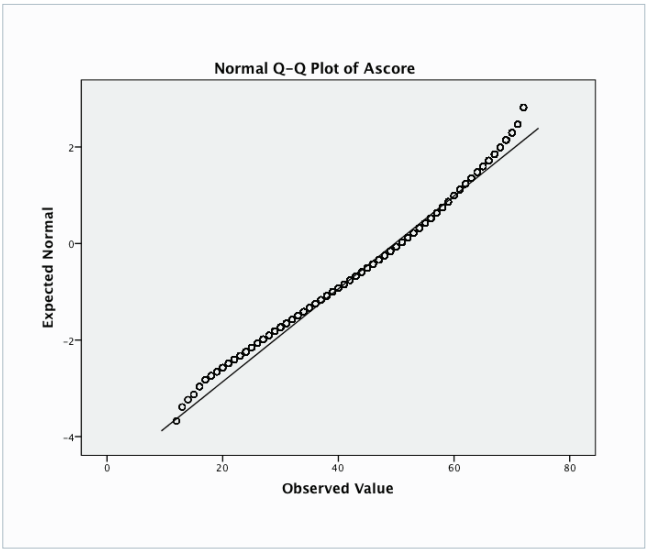

Figure 6. Expected versus observed data for Attachment scale (example)

Reliability of the scales

The next step in the analysis is to take a look at the reliabilities of the scales. Reliability is defined as 'internal consistency', meaning the degree the items that make up the scale indeed tap a common construct (Cronbach, 1951; Hofstee, 1966). In statistical terms, one would expect the items to correlate. Although there exist several methods to compute 'the' reliability of a scale, like splitting the items into two groups and comparing the total scores on these halves, the best measure here is Cronbach's alpha. This statistic tells us what the average correlation between all possible split halves of the items would have been. So, in most psychometrical texts this statistic is used. In Table 2 this statistic is shown for all three groups.

The table shows very strong alphas. In fact, the alphas demonstrate that the items of each scale are very closely related. One could argue that the alphas are too high, meaning that 'the same question is asked over and over again'. This leaves room for a considerable reduction in the number of items per scale.

The next step in test construction is to take a look at the latent structure underlying the instrument. The techniques most often used are called factor analysis, which comes in many different flavours (Thompson, 2004). The variant mostly used is principal components. In the table below the outcome of such principal components, analysis is shown (N = 29.588). The component extraction was forced to three factors, followed by a (orthogonal) Varimax rotation. The following table shows a very strong latent structure, which is conforming to the expectations. The table has been split and both halves are presented next to each other for layout reasons. The current representation is in a fact a condensation of a table that is in fact twice as long. Loadings smaller than | 0.40 | are omitted.

In 2006 a (smaller) data set was split into four subgroups (Self and Feedback plus odd or even row numbers of the respondents). On these four subgroups, the same principal component analysis was carried out, separately. It turned out that the solutions found in all groups were similar. So, the results as shown in Table 3 were cross-validated. For more details see Schoonman (2006).

Group	Attachment	Exploration	Managing	N
Self	0.88	0.92	0.88	7.983
Other	0.93	0.94	0.93	21.605
All	0.92	0.94	0.93	29.588
Items	12	12	24	

Table 2. AEM-Cube: Reliabilities of the scales in three groups

Item#	M	E	A	Item#	M	E	A	Item#	M	E	A	Item#	M	E	A
01	0.40			**13**	0.62			**25**	0.58			**37**	0.66		
02	0.62			**14**	0.68			**26**	0.52			**38**	0.67		
03	0.48			**15**	0.53			**27**	0.53			**39**	0.60		
04	0.55			**16**	0.49			**28**	0.54			**40**	0.65		
05	0.58			**17**	0.62			**29**	0.63			**41**	0.64		
06	0.60			**18**	0.67			**30**	0.41			**42**	0.66		
07		0.79		**19**			0.76	**31**		0.76		**43**			0.73
08		0.78		**20**			0.74	**32**		0.75		**44**			0.60
09		0.76		**21**			0.64	**33**		0.79		**45**			0.78
10		0.78		**22**			0.61	**34**		0.65		**46**			0.75
11		0.80		**23**			0.70	**35**		0.74		**47**			0.67
12		0.73		**24**			0.81	**36**		0.77		**48**			0.62

Table 3. AEM-Cube: Varimax rotated solution with three forced components

Test-retest stability of the scales

A subset of respondents filled in the AEM-Cube twice (N = 98). The interval between the two (Self) images varied between 1 and 12 years, with an average interval of 2.5 years. In the next table, the correlations between the two scores obtained on the two administrations are shown. Also, the average absolute score difference in percentiles is shown. The last rows show the percentages of respondents in three different score groups. These score groups are calculated as - low (absolute score difference in percentiles between 0 – 10)

- med (absolute difference between 11 – 20)
- high (absolute difference 20+)

This table makes it clear that the obtained scores are stable over time. Between 72 to 87% of the respondents will obtain a score at the second administration that is differing less than 20 percentile points compared to the first administration. The correlation coefficients tell the same story. The scores are rather stable in time. Managing Complexity has the lowest stability, which was the expectation, because, based upon the law of Requisite Variety, it can be influenced and increased by learning. To assess these changes more in-depth research is underway to connect the effect of leadership programs to changes on this scale (Pinckers, Vebego, the Netherlands to be published 2014).

Discriminant validity

The next step is to check the discriminant validity, e.g. the degree in which the scales are invariant or uncorrelated to each other (Campbell & Fiske, 1959). This is a desirable property of any multi-scale instrument. Discriminant validity is important as one does not want to have independent measures to be correlated. The table below

Retest group (N = 98)	Attachment	Exploration	Managing
Stability	0.83	0.81	0.73
Absolute score difference	10	11	13
Low difference	75	61	56
Med difference	12	25	16
High difference	13	13	27

Table 4. AEM-Cube: Stability in time (retest reliability)

shows the intercorrelations between the three scales, in both versions (Self-ratings above the diagonal (N = 7.983), Feedback ratings below; N = 21.605).

The scales have between 4 and 25% of the variance in common. As the problem mainly lies in the correlations between the A- and E-scale with the M-scale, one could consider reducing the number of items for the latter. This could be done by including in the shortened scale only those items that have low correlations with the total scores on the A- and E-scale. A positive side-effect would be the reduction of items in the M-scale which has now 24 items, whereas the A- and E scale has 12. It was shown elsewhere that the number of items could be reduced to 3 x 8 = 24 in total, without a loss of reliability (Schoonman, 2013a).

Self versus Other ratings

When comparing scores of Self-images with Feedback-images by means of the Students t-test (Ferguson, 1976), the following table arises:

Although the t-test is rather sensitive for type I errors (incorrect rejection of the null hypothesis) when samples become larger, significant differences are found when people rate themselves or when people rate others. In general, Self-ratings are higher on Attachment and Managing Complexity (some 5 points on each scale), whereas Self-ratings on Exploration are lower. However, if effect sizes (what is the practical meaning of significant differences) are calculated, this results in the following D-statistics (Cohen, 1992):

- Attachment: D = 0.16
- Exploration: D = - 0.17
- Managing Complexity: D = 0.17

These D-values fall in between the effect sizes 'small' and 'medium', so a certain effect of who is responding to the questions is visible. This justifies the use of the 360º methodology: in case no differences would be visible one source (rater) would suffice. To make the scores from different sources comparable, different norm groups (comparison groups) are used for both types of images in the instrument. More on norming issues can be found in Schoonman (2013b), page 50 and further.

Gender differences

From a small sample (N=199) done in the early stages of development at the Erasmus University of Rotterdam (Olde Bijvanck, 1997) the following outcomes regarding gender differences were expected:

- Women are slightly less exploratory than men
- Women are more people-attached than men
- Women score about equal on the Managing Complexity scale compared to men

Discriminant	Attachment	Exploration	Managing
Attachment		-0.21	0.33
Exploration	-0.26		-0.39
Managing	0.49	-0.42	

Table 5. AEM-Cube: Correlations between scales (discriminant validity)

Self - Other	t-value	Degrees of Freedom	Significance	Score difference
Attachment	29.9	17306	.00	3.7
Exploration	-31.5	17670	.00	-4.2
Managing	29.2	20149	.00	6.2

Table 6. AEM-Cube: t-test of differences between Self and Feedback ratings

Gender	t-value	Degrees of Freedom	Significance	Score difference
Attachment	-21.4	21035	.00	-2.7
Exploration	5.2	21176	.00	0.7
Managing	-9.2	21118	.00	-1.8

Table 7. AEM-Cube: t-test of gender differences

The table below shows the results of the t-test, computed over the total sample (Male N = 19.042; Female N = 10.546). Again, the differences are significant, but, when looking at the average score difference (last column in Table 7) the differences are of no practical relevance. The effect sizes (Cohen, 1992) are minimal.

The sample group consists mostly of working people: self-employed, or at small businesses and large corporations. Hardly unemployed or housewives/men make part of the sample.

Figure 7 Gender differences in total sample

The data suggest that there is no real difference between male and female respondents. But the differences, although small, look aligned with the expectations. This holds true at least for the norm group population where the male/ female ratio is 2:1. As mentioned above, we are observing here a working population.

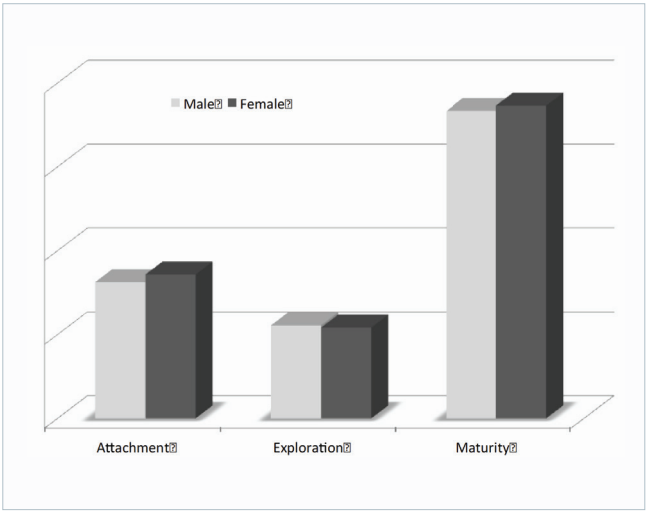

Figure 7. Gender differences in total sample

Educational differences

Some psychometrical tools are sensitive to the educational level of the respondents, or indirectly with cognitive abilities (Jensen, 1980). Often this is not desirable, as a measurement of one aspect should be as invariant as possible from other individual characteristics. For this reason, the next analysis was carried out. From the majority of the respondents, the educational background level is known (N = 3.672 = 12% missing at a total of 29.588). The educational backgrounds are divided into seven levels. These levels were condensed into three groups: low, medium and high. The next table shows the average scores on the scales in these groups.

It is clear that these differences are negligible, so the conclusion can be drawn that the instrument is invariant concerning the educational level of the respondent.

Education	Low	Medium	High
Attachment	49.9	50.1	49.7
Exploration	34.0	32.9	32.6
Managing	110.5	111.4	110.6
N	3018	10814	12084

Table 8. AEM-Cube: Average scores in three educational levels

Summary of statistical basics

To summarise the statistical analyses carried out thus far :

- The internal structure of the instrument, as shown by the distribution of scores, internal consistency (reliability) and latent structure is well within psychometrical standards. - The discriminant validity of the AEM-Cube is satisfactory but could be further improved by reducing the number of (certain) items of the M-scale. This would reduce the common variance with the other two scales and would, at the same time, increase the practical value of the instrument.

- The stability of the scores in time is a remarkable property of the instrument. In a time interval of about 2.5 years, scores on the three scales do not differ more than 20 percentiles for the majority of respondents. This might show that the concepts being measured indeed have an ecological (or biological) foundation, founded in early life.

- The instrument looks invariant concerning gender and educational level. This is an attractive feature as no separate norming with its problems have to be applied. Concerning differences between Self and Feedback assessments, small to medium effects were found. This implies that the current separate norming should stay in place.

Conclusion

There is now increasing evidence that it is possible to construct a valid tool, like the AEM-Cube, that is capable to describe human personalities based upon a falsifiable cybernetical foundation. In other words: three non-psychological concepts can describe a coherent set of personality characteristics. The use of the concepts in this combination is unique in the field of (organisational)-ecology (where they probably belong best) and even more so in the field of psychology.
A practical consequence from this cybernetical approach is that personality can be described in a frame of reference that might be aligned to basically any complex living system, or in other words any ecosystem. Hence, for example, the connection with the Growth-Curve.

The statistical foundation of the model is aligned with generally accepted norms. The practical applications seem to be a spin-off from this solid base in a rather non-linear fashion. The link with the Growth-Curve, which surfaces since the last decade as one of the most practical spin-off concepts is falsifiable based upon the fact that both Growth-Curves as well human personalities can be described as a dynamic mix on a continuum from feedforward-controlled characteristics to feedback-controlled characteristics. The 'popularity' of this concept in daily practice, and the way the Growth-Curve concepts connect the concepts was rather unforeseen, but in hindsight, as so often, obvious.

To support the common-sense and fast-growing anecdotic evidence (Robertson, 2005; Thomson, 2006) it will be necessary to aggregate the existing and future material into a batch of data for further analysis (see also the discussion below).

Most standing out is the result that over time these cybernetical characteristics of human personalities do not change significantly.
For this article, the focus is mostly on the 'bottom-plane' of the AEM-Cube and it has become clear that the positions are overtime very stable. This was expected, based upon the foundational ethological concepts and the coaching and counselling observations of thousands of managers.

Practical applications of the AEM-Cube can be observed now developing themselves in the following fields:
- Career and Talent Coaching. If it is known to what phase of any Growth-Curve someone contributes to, it is likely best practice to coach people towards that optimal contribution in life. Research is underway with a cohort of MBA students to investigate the usefulness of this approach as support of their career strategies (Miller & Robertson, MIIS, to be published). Other individual approaches in the field of counselling and mentoring are explored in the USA, UK and the Netherlands by small cohorts of experts.

- Investor-Start up cooperation. Based upon the start-up research in the USA (Thomson, 2006) and case by case studies in the Netherlands and the UK patterns of the most effective alignment of team members along the Growth-Curve are being discovered. This is one of the promising fields much research will be focused on (see discussion below)

- (Top) Management Teams. Management teams have in general to deal with a strategic context that can be framed in terms of the always moving Growth-Curve. Matching the team alignment toward the ever-changing strategic context seems to be one of the most obvious applications of the AEM-Cube approach. This does not mean automatically changing people. If a team is, in terms of the AEM-Cube divers enough, there should often be enough resources to cope with a changing environment.

- Strategic Human Resources Management. There are now several companies exploring and improving the AEM-Cube profile as a standard dataset in their HR database to create an optimal strategic team alignment whilst creating teams or changing teams by succession. In this situation, if people need to change assignments or jobs, an AEM-Cube profile history is already available.

- A critical note is to be made about using the AEM-Cube for external recruitment. It is attractive to mention this option. Research has been done in the Netherlands (GITP) showing the AEM-Cube method as solid as other methods, but like any other approach, it should only be used in professional settings and as part of a multi-level assessment where more tools, assessments and interviews are used. With the limits guarding this professional and ethical background the AEM-Cube is used already for more than five years in recruitment at GITP, Netherlands.

The AEM-Cube likely has the potential to contribute to a long term strategic human resources management both from the organisation to optimise individuals contributions to the strategic phases of growth, as well from individuals to organisations to optimise their individual career paths and their individual contributions to growth.

Correspondence

Peter P. Robertson: probertson@hi-int.com

Acknowledgements

Richard M. Robertson, MSc. Affiliation: Nyenrode Business University, Breukelen, The Netherlands

Disclaimer

The business examples shared in this article are used for educational purposes. Factual data are highlighted in the context of this purpose and the writers do not take responsibility for any other use of these data. The Apple and Yahoo case is now outdated and lost their relevance beyond the educational, which is the purpose of this article. The Yahoo case is unchanged since its publication in Thomson's book (see reference in the text). The picture was not published in the book, but the text in that book is referring to this case.

For Apple, the data are illustrative, but not created by people from within: observations were outside-in and generated based upon what the public eye can see. The number of participants showed a statistical consistent picture, solid enough to use for educational purposes, but by no means useful for further interests. The authors do not take any responsibility for use of these cases for other purposes than the educational purpose stated above.

References

Archer, J., & Birke, L. (1983). Exploration in Animals and Humans. United Kingdom: Van Nostrand Reinhold Co.

Ashby, W. R. (1956). An Introduction to Cybernetics (Internet (1999): http://pcp.vub.ac.be/books/IntroCyb.pdf ed.). London: Chapman & Hall.

Ashby, W. R. (1957). An Introduction to Cybernetics. London: Chapman & Hall. Bartram, D. (2004). EFPA Review model for the description and evaluation of psychological tests (Vol. 1.0). Brussel: EFPA.

Bowlby, J. (1969). Attachment and Loss (Vol. 1. Attachment). New York: Basic Books. Bowlby, J. (1973). Attachment and Loss (Vol. 2. Separation, Anxiety and Anger). New York: Basic Books.

Bowlby, J. (1980). Attachment and Loss (Vol. 3. Loss). New York: Basic Books. Brooks, R. A. (1999). Cambrian Intelligence. Cambridge: MIT Press.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. Psychological Bulletin, 56, 2, 81-105.

Cohen, J. (1992). A power primer. Psychological Bulletin, 112(1), 155-159. Conway, J. M., & Huffcutt, A. I. (1997). Psychometric properties of multisource performance ratings: a meta-analysis of subordinate, supervisor, peer, and self-ratings. Human Performance, 10(4), 331-360.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika(16), 297-334.

De Wit, B., & Meyer, R. (2010). Strategy Synthesis. Resolving strategy paradoxes to create competitive advantage. Andover: Cengace Learning.

Ferguson, G. A. (1976). Statistical analysis in psychology & education (4th ed.). Tokyo: McGraw-Hill.

Hamel, G., & Prahalad, C. (1990). The core competence of the corporation. Harvard Educational Review, 68(3), 79-93.

Hofstee, W. K. B. (1966). Models in split-half reliability. Nederlands Tijdschrift voor de Psychologie, 21, 521-529.

Jensen, A. R. (1980). Bias in mental testing: New York: The Free Press.

Kefalas, A. G. (1978). Managing A Steady-State Firm. A Cybernetic Framework. Current Topics in Cybernetics and Systems. In J. Rose (Ed.), Current Topics in Cybernetics and Systems -Proceedings of the Fourth International Congress of Cybernetics & Systems 21–25 August, 1978 Amsterdam, The Netherlands (pp. 86). Berlin Heidelberg: Springer Verlag

Kelly, H. (2012). How Apple has changed under Tim Cook. Retrieved October 4, 2012, 2012, from http://www.cnn.com/2012/10/04/tech/innovation/apple-tim-cook/index.html Lindley, P., Bartram, D., & Kennedy, N. (2008). EFPA review model (update) (Vol. 3.42). Brussel: EFPA.

Lorenz, K. (1981). The Foundations of Ethology. New York: Touchstone Books. Modis, T. (1998). Conquering Uncertainty: Understanding Corporate Cycles and Positioning Your Company to Survive the Changing Environment. New York: Mc

Graw-Hill. O'Reilly, C. A., Tushman, M.L. (2004). The ambidextrous organization. Harvard Business Review, 82(4), 74-81.

Olde Bijvanck, D. (1997). Afstudeeropdracht: De AEM-Cube. Rotterdam: Erasmus University. Pickering, A. (2010). The Cybernetic Brain. Chicago: The University of Chicago Press. Pribram, K. H., Gill, M.G. (1976). Freud's 'Project' Re-assessed. London: Hutchinson & Co.

Robertson, P. P. (1999). The AEM-Cube; a management tool, based on ecological concepts, in order to profit from diversity. Paper presented at the 43rd meeting of the International Society for the Systems Sciences, Asilomar Conference Center, Pacific Grove, California USA.

Robertson, P. P. (2003). Ontsnappen uit S-catraz (Always Change a Winning Team). Schiedam: Scriptum Management.

Robertson, P. P. (2005). Always change a winning team. Singapore: Marshall Cavendish. Robertson, P. P. (2012). Why Top Executives Derail; A Performative-Extended Mind and a Law of Optimal Emergence. Retrieved from http://dx.doi.org/10.2139/ssrn.2097240 website: http://ssrn.com/abstract=2097240

Schoonman, W. (2006). The AEM-Cube revisited. Some statistical exercises. Den Haag: Psy Tech.

Schoonman, W. (2007). The AEM-Cube constructs. Some notes on construct validity. Den Haag: Psy Tech.

Schoonman, W. (2008). The AEM-Cube constructs. In search of construct validity. Den Haag: Psy Tech.

Schoonman, W. (2013a). Full Data Analysis of AEM-Cube. Den Haag: Psy Tech. Schoonman, W. (2013b). Mensen beoordelen. Voor HR-professionals (Vol. 2). Amsterdam: De Witte Ridders.

Shepard, G. M. (2004). The Synaptic Organization of the Brain. New York: Oxford Unversity Press, Inc.

Sporns, O. (2010). Networks of the Brain. Cambridge: The MIT Press.

Thompson, B. (2004). Exploratory and confirmatory factor analysis. Understanding concepts and applications. Washington: American Psychological Association.

Thomson, D. G. (2006). Blueprint to a billion : 7 essentials to achieve exponential growth. Hoboken, N.J.: John Wiley & Sons