

Fluid Dynamics and Outliers

Outstanding Performance of High-Tech Companies

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Contents

- 1. Research Topic**
- 2. Relative litterature**
- 3. Methodology**
- 4. Findings, Results and expected Added Value**
- 5. Conclusions for future Research**

1- RESEARCH TOPIC

Technological differentiation and performance of spinoffs?

- That was the entry point.
- Many well defined predictors of new venture performance were already explaining why technological companies are growing (from Nelson and Winter to Porter and to Klepper).
- But all the considerations on predictors of performance were based on a number of variables and large statistic samples (i.e. bell curves everywhere!).

What about extreme values?

- An outlier is not always a statistical aberration (extreme and rare events)!
- We were not satisfied with the traditional answers to the question raised, for 3 combined reasons:
 - Common analysis models are just ignoring extreme values!
 - In the clusters surveyed some companies were performing exceptionally well.
 - We had the intuition that non linear behaviour in fluid dynamics could mirror some kinds of performance in industry.

Refined question

- What enables a High-Tech company to perform outstandingly?
- What makes Outliers in performance?
- Outliers as defined by Malcolm Gladwell (2008). Very large and exceptional values compared to « standard » phenomena of a similar nature.
- We then discovered Outliers everywhere!



2- RELATED LITERATURE

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7



Inviting various academic sources of knowledge and connecting them

- Reference Theoretical framework: Disruption theory (as defined by C. Christensen, I.D. 1997).
- Other theoretical landmarks used:
 - In management and biology: Evolutionary theory (Nelson and Winter, 1982); S. J. Gould (the Full House, Hen's teeth and Horse's Toes, Ever since Darwin); Darwin (The Origin of Species 1859).
 - in other scientific fields: Fractal theory (maths); Extreme Values Theory (maths / statistics) + Skewed curves and Wild Chance concept! (maths / probabilities).
- About microfluidic technologies and inkjet: Previous available academic knowledge and the works of Ford and of Garnsey on the English cluster.

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8



Relevance of the Research Question

- From the literature survey:
 - We noticed biases to explain outstanding growth. They were coming from oversimplification, from the permanent use of secondary data, and from mere duplication of data.
 - We also often noticed a lack of quantification: Quantification was not homogeneous (sample).
- The result was a very fuzzy qualification for outstanding performance: « rapid growth » (Hambrick and Crozier), « sustainable growth » (Baldwin).

3- METHODOLOGY

Methods used for this research

The evidence was based on 7 main approaches:

- A Case study detailing the anatomy of the 2 European microfluidic technologies' clusters.
- Considerable discussion about the topic with colleagues, other teachers and students.
- Data Base extractions about SMES in the clusters.
- As an investigator, I had access to a situation previously inaccessible to scientific observation (revelatory cases theory).
- Interviews with more than 37 people (CEOs, managers and experts) in France and abroad.
- The collection and reading of 7 thesis on the technology, 11 papers on technical data, many videos on technical topics.
- The original taxonomy of companies used by Cooper and Gimeno-Gascon (marginal survival, failure, high growth).

Being creative in methodology

- Comparing 2 samples of companies virtually the same with the exception of one single company to make the Disruption appear.
- Showing the King Kong effect and its result in outstanding performance through the accurate evaluation of value capture for various high-tech companies.

4- FINDINGS, RESULTS AND EXPECTED ADDED VALUE

Far from immaculate statistical procedures sealed off from the real world

- The 20th century was the heyday for statistics related to bell curve and linear evolutions.
- The 21st. century could be the century of triumph for maths and concepts applied to disruption and outliers : « orphan » diseases, black swan events, protected species, allergies....
- This is a matter of research about exceptional and unexpected values for a particular variable, or for a rare event .

From performance to hyper Growth

- **Principle:** In the case of extreme values, the best tool is not a gaussian approach! So we have to look closer to the reality. Not relying on «episteme» only, but on «techne» too!
- **A Chaotic process applies well to outliers in performance:**
 1. **Extreme values.**
 2. **Extreme sensitivity to initial conditions: Slight differences leading to huge differences!**
 3. **Primacy of variation within complex systems (Bush and Ladders / Gould).**

372

- **3** Portfolios of managerial results (3 slides).
- **7** Images of findings to illustrate the results (7 slides).
- **2** portfolios of mathematical backgrounds.

3 Portfolios of Managerial Results (1/3)

What we have shown:

- In microfluidics the technological evolutions are not linear.
- The variation in performance of the companies surveyed.
- The lineage in the 2 clusters.
- DOD was not disrupting CIJ.
- The 2 European clusters were not independent in their development.
- The parent company impacts exceptionally on the French cluster's overall performances. Hence the concept of Outstanding Performance.
- A fractal approach of technological innovations reveals their complexity. To conclude efficiently, consideration must be given to the appropriate layer among the technological strata.

3 Portfolios of Managerial Results (2/3)

- Predictive elements about outliers (hyper growth): exceptional value capture.
- Translation through a synthetic unic criterion: EBITDA !
- A new vision of EBITDA: The old dated (not a disruptive concept) EBITDA as an advanced indicator of outstanding performance.
- EBITDA as an « attractor » and an « invariant measurement unit »
- Outstanding profitability due to exceptional recurrence (then all other strategic criteria are secondary).
- Perfect match between a sub-technology and an application.

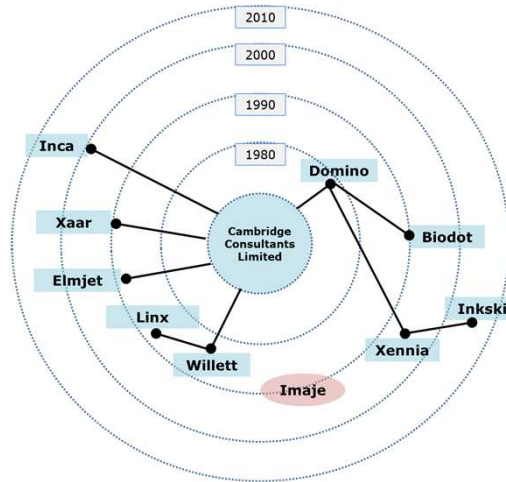
3 Portfolios of Managerial Results (3/3)

- Elaboration of a performance scale based on the level of disruption.
- A new version of history: e.g. the market share of laser vs inkjet was not constant over the years.
 - Outstanding performance is not a question of market: On the same market one new tech. was outstandingly performing (ink jet CIJ); the alternative one, not (laser CO₂).
 - Outstanding performance is not a question of technology (GPT).
- In industrial ink jet: OP is specific to CIJ.
- Intrinsic and extrinsic value of the findings: true for inkjet AND true in sectors other than inkjet.

7 Images of findings (1/7) Variation in performance of companies (e.g. English cluster)

Companies	# of employees > 100 after 5 years	# of employees after 10 years > # of employees after 5 years	Technology
Xennia	No	No	DOD
Imaje	No	YES	CIJ Single nozzle
Inca Digital	No	No	DOD
Biodot	No	No	DOD
Xaar	No	No	DOD
Elmjet	No	No	CIJ multi nozzle
Videojet	Yes	YES	CIJ Single nozzle
Linx	No	YES	CIJ Single nozzle
Domino	Yes	YES	CIJ Single nozzle

7 Images of findings (2/7) Lineage in the English cluster



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21

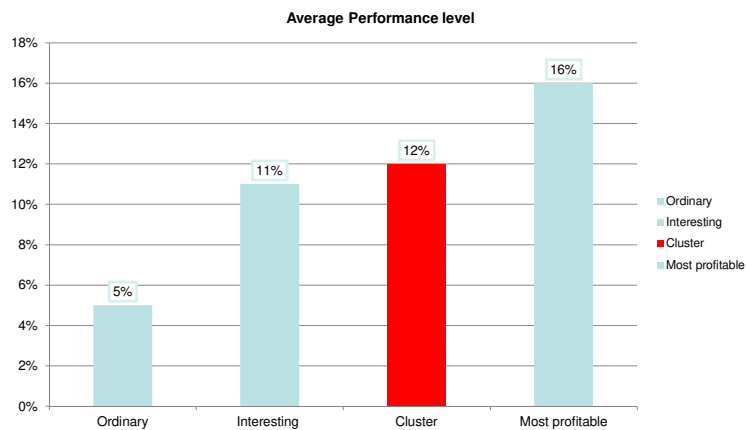
7 Images of findings (3/7) Layers among the technical strata

Level of disruption (layers)	Level of Application (layers)
activity	Coding
Sector	Agro-Food
Product Family	Dairy Products
Item	Secondary Packaging
Substrate	Porous
Speed	Low Speed

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22

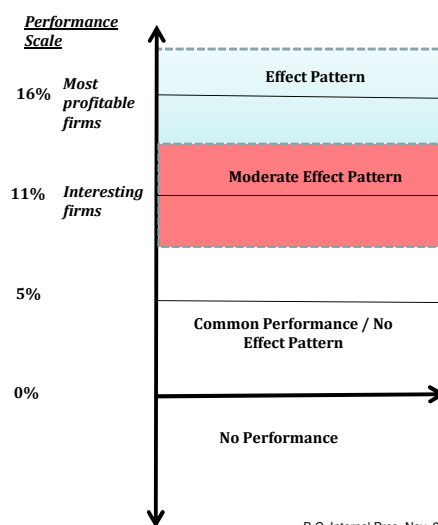
7 Images of findings (4/7) Bringing out the disruption effect on performance



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23

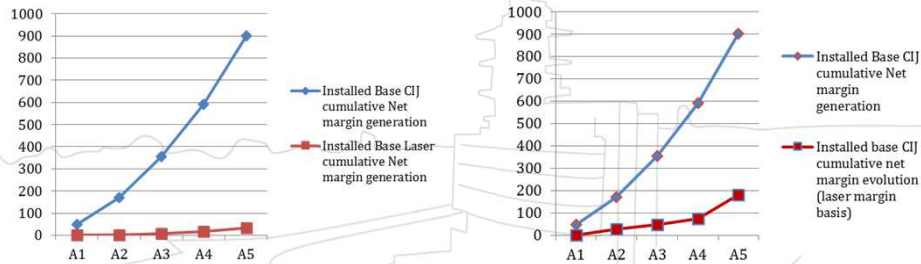
7 Images of findings (5/7) Disruption / Performance



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24

7 Images of findings (6/7) Creative Methodology



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25



7 Images of findings (7/7) Models for installed base evolution CIJ (inkjet) vs CO₂ (laser)

$$T_n = 16n^3 + 48n^2 + 6n + 4$$

$$T_{4n+1} = A + (3M + S) \times n$$

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26



Lucky chance!

- The reasoning applying to outliers in performance and to turbulent fluid dynamics behaviour are the same!
- The same « kind » of uncertainty impacts the Navier-Stokes equations and the performance of hyper growth high-tech companies.
- 2 dynamic systems relying on the same theories.

What this presentation title is suggesting!

2 Portfolios of Mathematical Backgrounds (1/2)

- Statistical pillars: Law of large numbers / central limit theorem / gaussian distribution (from Bernouilly to Lyapounov).

Studying a large number of small independant contributions.

- Other statistical pillars: Lévy alpha-stable distribution / uneven distributions / Cauchy process (from Pareto to Paul Lévy).

When the standard deviation of each term is not neglectible any more compared to the standard deviation of the sum!

I.e. when extreme or rare events are dominating.

2 Portfolios of Mathematical Backgrounds (2/2)

- Updated statistical tools associated with « Black Swan » events: Extreme values theory / Wild chance (from Gumbel to Mandelbrot).

Sometimes the priority is to directly characterize the extreme values.

Method: Understanding first the nature of the random variable at stake and its interdependent components (stress tests, ...).

5- CONCLUSIONS FOR FUTURE RESEARCH

Our Answer

- Outstanding Value Capture (i.e. OP) appears for a specific techno / application dyad. It refers to distinctive conditions for outstanding re-buy (recurrence).
- In the case of European ink jet clusters, Outliers in Performance are generated by CIJ / Applications couples, and by them only.

Further work about O.P.

Many issues are still pending, like:

- Identifying and characterizing O.P. in sectors and fields other than microfluidics
- Explaining O.P. in such trendy cases as Nespresso , Apple or Nike.
- Figuring out other forms of exceptional recurrence and other levers for this recurrence, different from the ones we discovered.

Further work about chaotic dynamic systems

- One goal is to overcome the frustrating concept of chaos!
- Another goal is to contribute to the work on random systems and infinite dimensional systems; i.e. on the borderline between chaos and order.
- These systems are, per se, extremely stimulating and difficult. They are also booming fields of research.