The data-driven model of technology-based new ventures growth

Maksim Malyy[a*] and Zeljko Tekic[b]

[a] *Skolkovo Institute of Science and Technology, Moscow, Russia*

[b] *HSE University, Graduate School of Business, Moscow, Russia*

**Presenting author: maksim.malyy@skoltech.ru*

This study proposes and tests a novel data-driven approach for describing technology-based new ventures' (TBNVs) growth trajectory. Due to its conceptual character with very limited empirical evidence, the organizational life cycle (OLC) theory cannot serve as an accurate instrument for operationally identifying TBNVs evolution phases and transition points. However, that is a remarkably important task, directly influencing the process of new venture development. For instance, one of the common mistakes is to manage a TBNV as a regular mature company during the early stage of its development, i.e., to employ bureaucratic procedures, blur resources to unnecessary operations, or hire high-cost top management. The opposite is also true: to sustain the growth, developed organizations should not, for instance, have an uncertain hierarchy or unclear responsibilities. As a result, this discrepancy often leads to bankruptcy and the close of a venture despite the promising of the initial idea.

We introduce a fresh view of the OLC theory while applying the public big data instrument – Google Trends – as a source of information about TBNVs' growth dynamics. Previously, it was shown that TBNVs valuations and GT dynamics are positively and strongly correlated (Malyy et al., 2021) making it possible to use TBNVs' GT data as their growth proxy. We employ a sample of 246 US-based TBNVs, fit the selected analytical models to TBNVs' GT data, and compare the outputs with various quality-of-fit measures. The results demonstrate that set against the other growth models, S-curves (in particular, the logistic model) provide a more accurate description of TBNVs growth dynamics by five out of six taken measures. In addition, 78% of cases show a stronger link to the S-shape by the results of cross-validation analysis, which is known to be frequently used to examine the model's forecasting power (Kuhn and Johnson, 2013). In other words, these results suggest that S-curve models have the higher power not just to describe but also to forecast TBNVs growth dynamics. Finally, we applied configurational analysis and found that 17 out of 21 configurations lead to the S-curve models. From this fact, we can infer that the S-shape of the growth

trajectory is not exclusively driven by the particular TBNV quality or combination of qualities and can be generalized to the out-of-sample companies.

Although the common S-curves outperform other growth models, they have limited applicability if used to determine the trend-changing points of the curve, i.e., beginning of the growth, stagnation, or decline. Due to their intrinsic autocatalyticity (Phillips, 2007), it is not possible to identify the tipping point preceding the accelerated growth, which is known to play an extremely crucial role for a commercial organization or a particular product (Gladwell, 2000; Phelps et al., 2007; Phillips, 2007). Therefore, further, we employ the advanced model with an S-curve growth part, which has the theoretical (but so far, not empirical) potential to identify this tipping point under the innovation/imitation paradigm (Bass, 1969; Phillips, 2007): the Bass new product diffusion model. We fitted this model to the previous step TBNVs GT data and calculated coordinates of the tipping point, as well as the coordinates of the other meaningful points (Brdulak et al., 2021; Orbach, 2016). Visual observation of the obtained results made us conclude that in all given cases, the Bass model provides an accurate fitting and trustworthy tipping point preceding the accelerated growth start of the TBNVs GT curves.

According to these findings, we propose to use Bass's new product diffusion model as the model describing TBNVs evolution. It relatively accurately explains the growth dynamics of new ventures and can provide analytical division on three phases: (1) absence of growth, (2) accelerated growth, (3) de-accelerated growth ending with saturation. These three phases can be aligned to the existing OLC concepts. For example, according to some of the previous OLC concepts, the first phase may relate to the "startup" or "inception," the second to the "scaleup" or "growth," and the third to the "exit" phase or "maturity" (Miller and Friesen, 1984; Picken, 2017; Scott and Bruce, 1987). Since the proposed model is driven by the empirical data of TBNVs and, thus, directly linked to real life, each phase of the curve can be undoubtedly related to the particular period in company evolution with its specific state and combination of characteristics (i.e., leadership, innovativeness, openness, structure, etc.). Consequently, states of the companies can be precisely analyzed that will make it possible to develop better and growth-dependent managerial practices.

The achieved results significantly contribute to both academia and practice. They bring value to a retrospective analysis of TBNVs, provide an ability to directly compare growth trajectories of various TBNVs, and solve the existing in the OLC field ambiguity while extremely increasing the practical utility of OLC concepts. Also, the proposed tipping points may provide a solid theoretical backing for a vague practical term of the *product/market fit* (Andreesen, 2007; Göthensten and Hellström, 2017) by bringing a precise theoretically-backed instrument for the identification of this event. That may be further employed to develop concrete practices, methodologies, and frameworks.

References

Andreesen, M., 2007. Product/Market Fit [WWW Document]. Stanford Univ. URL https://web.stanford.edu/class/ee204/ProductMarketFit.html

Bass, F.M., 1969. A New Product Growth for Model Consumer Durables. Manage. Sci.

Brdulak, A., Chaberek, G., Jagodziński, J., 2021. BASS Model Analysis in "Crossing the Chasm" in E-Cars Innovation Diffusion Scenarios. Energies 14, 3216. https://doi.org/10.3390/en14113216

Gladwell, M., 2000. The Tipping Point: How Little Things Can Make a Big Difference, 1st ed. LITTLE, BROWN AND COMPANY, New York.

Göthensten, V., Hellström, A., 2017. Finding product-market fit. University of Gothenburg, School of Business, Economics, And Law.

Kuhn, M., Johnson, K., 2013. Applied Predictive Modeling, Applied Predictive Modeling. Springer New York, New York, NY. https://doi.org/10.1007/978-1-4614-6849-3

Malyy, M., Tekic, Z., Podladchikova, T., 2021. The value of big data for analyzing growth dynamics of technology-based new ventures. Technol. Forecast. Soc. Change 169, 120794. https://doi.org/10.1016/j.techfore.2021.120794

Miller, D., Friesen, P.H., 1984. A Longitudinal Study of the Corporate Life Cycle. Manage. Sci. 30, 1161–1183. https://doi.org/10.1287/mnsc.30.10.1161

Orbach, Y., 2016. Parametric analysis of the Bass model. Innov. Mark. 12, 29–40. https://doi.org/10.21511/im.12(1).2016.03

Phelps, R., Adams, R.J., Bessant, J., 2007. Life cycles of growing organizations: A review with implications for knowledge and learning. Int. J. Manag. Rev. 9, 1–30. https://doi.org/10.1111/j.1468-2370.2007.00200.x

Phillips, F., 2007. On S-curves and tipping points. Technol. Forecast. Soc. Change 74, 715–730. https://doi.org/10.1016/j.techfore.2006.11.006

Picken, J.C., 2017. From startup to scalable enterprise: laying the foundation. Bus. Horiz. 60, 587–595. https://doi.org/10.1016/j.bushor.2017.05.002

Scott, M., Bruce, R., 1987. Five stages of growth in small business. Long Range Plann. 20, 45–52. https://doi.org/10.1016/0024-6301(87)90071-9