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Special purpose vehicles for sustainable finance of innovation in Romania - the case of intelligent robotic systems

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ABSTRACT

The intelligent robotic systems IRS integrates artificial intelligence (AI) and intelligent autonomous control based on special features like: decision making, multispectral sensorial information, advanced monitoring and execution capabilities. There is an impressive rate of success of IRS projects that benefits from the Industry 4.0. The design of strategies for IRS financing is very important for Romania, because the governmental funding is far from the critical mass and the access to capital market is insufficient. In this contribution the interest is to design special purpose vehicles (SPV) for sustainable finance of innovation in the case of IRS, adapted to Romanian emerging market, like venture capital financing (VCF) or thematic exchanged traded funds (ETF).

Keywords: Intelligent robotic systems (IRS); venture capital funds (VCFs); exchange traded funds (ETFs); implied liquidity mechanism (ILM)

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1. Introduction

Modern robotics is situated at the intersections between mechanical, electronically control engineering, computer science, multispectral sensors, decision making engineering, in a context dominated by artificial intelligence. In Industry 4.0 we can see a democratization of the knowledge and a better technology transfer, that could be beneficial for Romanian projects in this field. [1-5].

Nowadays, there exists a diversity of types of robots, from fixed robotic industrial manipulators, wheeled robots, biped/ humanoid type robots/ multi-legged robots, aerial, terrestrial, underwater robots, bio- inspired micro/ nano- robots. The modularity, scalability and the capacity to integrate the emerging features of Industry 4.0 (AI, CPs, HMIs, VR/ AVR) offer new perspectives for the development of the modern intelligent machines in emerging markets. They benefits from the new opportunities and challenges offered by the disruptive progress in in meta- sensing, cognition, machine learning, reasoning under risk and knowledge based control KBC, with impact in developing advanced autonomous, and communication capabilities [13-15].

The intelligent robotic systems (IRS) are characterized by embedded artificial intelligence AI and intelligent autonomous control and they are also equiped with special features like: decision making capabilities, multispectral sensorial information, monitoring capabilities of execution. The actual interest is focused on

developing the following capabilities: cognition (recognition and tracking), perception- action, advanced planning, sensing, control and action. IRS belongs to intelligent hierarchical systems with Saridis architectures (three levels: organizational/ learning, decision- making, acquisition, analysis and feedback, coordination of soft/ hard components, execution with hardware controllers and sensorial devices) and response to the main types of problems in advanced robotics (the logic problem or the functional control for coordination events, and the geometric problem for the dynamic control). Beyond Saridis paradigm, there exists also other types of architectures (Meystel- multi- resolution architecture; Albus- referential architecture; Brooks- Arkin behavioral architectures) [15].

The recent developments in IRS offers an extended set of tasks (formulating strategic objectives, obstacle avoidance, mission/ trajectory planning, mapping) with impact on the diversification of typical missions and applications: industrial (loading, manipulators, assembly), medical (surgery telerobotics, pharmaceutical automatization, special manipulators), smart- assistance (PwSNs), search and rescue, military and space, socialization. All these features are beneficial for new entrants from the emerging markets. The main problem for Romania, as an emerging market, is related to the strategies for the design of the strategies for financing all these innovative projects in the field of intelligent robotic systems IRS.

In the next sections are analyzed different types of special purpose vehicles (SPVs) for IRS projects in emerging markets. Venture capital funds (VCFs) are interesting instruments for financing innovation. VCFs are dedicated for early stage projects, but there is an interest also on implementing next round financing.

with high risk and modest probability of success). For Romanian projects VCFs represent special purpose vehicles SPVs with better capabilities comparing to strategic alliances (limited only for R&D licensing, in which the big firms finance the project for royalty payments as fractions of future sales).

The second option is ETF financing in the context that this innovative industry represents now 2,3 trillion $ in assets in US and 3,2 trillions globally, or over 5% from the total global market capitalization. Even more interesting is the fact that the ETF trade volume is situated over 19,5 trillion/ year (US 86%, China 7%, EU 3%, Japan 2%, Canada 2%) with an important impact on market operationally.

2. Innovative venture capital financing of Romanian projects in the field of intelligent robotic systems

Regarding the first option for choosing a SPV for projects in advanced robotics and artificial intelligence, VCFs represents a good solution for implementing innovation. VCFs represents 35-45% of high technology market and it is an efficient solution in filling the gap especially for early stage projects (with high risk and modest probability of success). For Romanian projects VCFs represent special purpose vehicles SPVs with better capabilities comparing to strategic alliances (limited only for R&D licensing, in which the big firms finance the project for royalty payments as fractions of future sales).

2.1. The VCF concept

Venture capital/ venture capital funds (VC/ VCF) represent financial intermediars that invests (usually with focus on minority stakes) in private portfolio companies (with focus on funding the internal growth), with an active role in monitoring and helping its portfolio- companies, with the objective to maximize its return after strategic exits (IPO or sale) [8,12,13].

Venture capital funds VCFs represent a sub- class of private equity funds (PEFs), better focused on innovative and risky projects. In this case, the main focus of the SPVs is oriented in maximizing the return, usually express by the equivalent internal rate of return (IRR) and the value/ investment multiples [14,15].

There are different types of portfolio firms: early- stage (projects with products on tests or pilot production), expansion (plant expansion, improved products) and late- stage (firms are profitable; this type could also include mezzanine investing and future initial public offerings IPOs).

The classic term of venture capital (VC) was firstly proposed by General Doriot (1946) but the official recognition was expressed later, by the Small Business Act (1958) and the building of Small Business

Investment Companies SBIC. The next step was represented by the limited partnership, the actual structure, with a manager acting as general partner GP (compensated by management fees and carried interest) and investors as limited partners LPs. After 1985, the interest of pension funds to participate in VC partnerships determined a rapid growth of this innovative instrument. The actual interest of VCFs is oriented on ITC and healthcare.

2.2. The analysis of the performances and the mechanics of VCFs

In order to understand the performances (expressed by the tirade risk- return- liquidity), first of all, it is necessary to adapt the Capital Asset Pricing- model (CAPM) to SPVs like VCFs/ PEFs. In the conventional CAPM model, the cost of capital (or the expected return for an asset) at equilibrium, is equal to sum between the risk free rate and the return of the market (beta), multiplied by the market premium. It could be also expressed in other version focused on the extra-return of the asset and abnormal returns (alpha). In the literature, VC- individual participations are considered high risky, but VC funds benefits from diversification. The recent literature suggest that abnormal returns alpha > 0 and the risk is less than the market, beta < 1. In order to estimate the costs of VCFs, the CAPM should be extended to include other factors. In Fama- French model are included additional factors for size and value. For VCFs is more important the estimation of the liquidity risk. In this case it is possible to use the Pastor-Stambaugh model in which the liquidity factor reflects the returns associated to illiquid assets.

The VCF investment process begins with the deal flow (sourcing), followed by first screening (using the business plan proposed by the candidate firm (the GP analyze the market test and management test) and the design of the preliminary contracts (there exists a considerable rate of selection and rate of acceptance). Next, it follows the term sheet (amount raised, price per share/ original price, closing date, pre- money and post-money valuation, capitalization, dividends, liquidation preferences, protective provisions, redemption rights) and the corrections regarding the VCF- investor rights.

2.3. Strategies for implementation in emerging markets

The main elements for VCF implementation in emerging markets are expressed by:

- the expected exit valuation (the forward looking value at exit)
- target performance (usually the return is expressed by the internal rate of return, IRR)
-expected retention
-total valuation and final recommendation

In Romanian market the use of VCFs could be very difficult in the actual context of the capital market status, and it is not well adapted to scalability, modularity and the features of retail investments. In this case, the next section is dedicated to the alternative of this innovative instrument, namely exchange traded funds (ETFs).

3. The exchange traded funds alternative for financing projects in the field of intelligent robotic systems- the mechanisms for flexible adaptation to Romanian capital market

The second option for a flexible SPV adapted to the Romanian capital markets is represented by exchange traded funds (ETFs). The modern ETF financing could be better adapted to innovative industry represents now 2,3 trillion $ in assets in the case of US and 3,2 trillions globally, or over 5% from the total global market capitalization. Even more interesting, is the fact that the ETF trade volume is situated over 19,5 trillion/ year (US 86%, China 7%, EU 3%, Japan 2%, Canada 2%) with an important impact on liquidity and market operationally.

The ETF alternative for financing Romanian projects in the field of intelligent robotic systems is a better alternative because of the characteristics and mechanisms that offers flexibility and adaptation. The ETF innovation is a disruptive technology that offers a democratization of the investment process (opening a new access for retail investors at special investment strategies like index funds, futures, options, swaps, commodities

with low transaction costs). Comparing to mutual investment funds MIF, the ETFs offers a better efficiency via versatility, liquidity, with impact of scalability and modularity of different types of portfolios. In fact ETFs represents the basic portfolio building blocks for both retail (lower costs, easy to use) and institutional investors (innovative management of portfolio tools, transparency) [16].

3.1. Global ETFs for financing innovative technologies- the case of thematic ETFs

The use of ETFs in financing high technology sectors could be expressed by different approaches inspired from the US technology markets:
a) indicial technology portfolios: Technology select sector SPDR Fund XLK (oriented 72% on large-caps from S&P 500 index); Vanguard Technologies VGT (this index tracks MSCI Information Technology but contains also mid- caps and new techs elements); iShare US Technology IYW, tracks DJ Technology Index:
b) smart- beta (outperform/ lower volatility) tech: First Trust FXL, Guggenheim
c) small caps: PowerShares S&P PSCT
In the case of emerging markets, there exists only 75 ETFs (called EM-ETFs) with 120 bil assets (5% total assets). We can see three generations of EM-ETFs:
a) first movers EM-ETFs (for example: EEM, VWO, BRIC- ETF)
b) second generation EM- ETFs: EM-Dividend (DEM; DSG)
c) next Gen EM-ETFs (this is our proposal for thematic IRS projects in emerging markets, inspire3d from the US markets and adapted to frontier and emerging markets).
In the US capital market, there are some dedicated or thematic ETFs for projects in the field of artificial intelligence, blockchain and robotics, as investment vehicles equipped with accessibility, transparency and low fees. ROBO Global Index that reflect the trend of advanced robotics industry was the first benchmark for other thematic ETFs like: Global X Robotics & Artificial Intelligence Thematic ETF- BOTZ (sept 2016), ROBO Global Robotics Index ROBO ETF (2018), NASDAQ Nextgen Economy (BLCN), Innovation NextGen Protocol (KOIN). All these ETFs anticipate a strong interest of retail investors.

3.2. ETF mechanics and the strategy for implementation in Romanian capital market

The main features of ETFs are: standardization of products (with impact on liquidity), transparency of portfolio elements (with impact on diversification), exchange listing, lower costs, diversity. It is also important to note that the implied liquidity build the flexibility to utilize efficient creation mechanisms.
The main arguments for choosing ETFs could be simple express by the tirade fast- good- cheap. ETFs are not only low cost and democratic instruments. The actual financial technologies based on artificial intelligence, will improve this trend of cost reduction and growing the efficiency. The liquidity of ETFs is also appreciated by institutional investors (efficient access to new products and instruments in which the knowledge of the management is reduced or expensive) but also the retail investors (with implications on number of trades, volumes and transaction costs). The transparency is represented by daily transparency and small- lag reporting. The diversification of portfolios is a major advantage offered by ETFs both for retail but also institutional (there are always segments of market with lower information and expertise) and it is also related to the easy asset allocation. In this case ETFs action as stock pickers instruments and are broad and precise. ETFs offer standardized investments at different levels of conventional (equities and bonds) but also alternative assets with reduced liquidity (for emerging markets bonds could be considered semi-illiquid investments). The simplicity of using ETFs in all types of investments is also remarkable, an aspect important in the case of emerging markets. Even if ETF investments are considered in the literature as passive instruments, we should note that they offer an impressive flexibility, both on long and short term via simple portfolio adjustment mechanisms; in addition, ETFs could be mixed with derivatives like financial options, case in which they offer a unique simultaneous access both for beta (market return) but also for alpha (excess return). ETFs are in fact versatile instruments capable to offer solution in active management of portfolios; in the acse of institutional investors

they offer the advantage of anonymity in transactions, with interest implications especially in the case of IRS project financing in emerging markets.

3.3. ETF mechanics and the strategy for implementation in Romanian capital market

In order to understand the entire life cycle of ETF- financing, we are focused on the mechanisms of creation and exit strategies. For all types of investors it is important to understand the overall ETF mechanics and the implied liquidity mechanism (ILM) contribution. Learning ETF mechanics is important in understanding the dynamics in different events on markets especially for the case of Romania as an emerging market. The concept of emerging ETF ecosystem (E-ETF-E) is expressed by the relations between buyers and sellers via ETF as a liquidity provider, with focus on the active roles of authorized participants (APs) and market makers (MMs) as principal arbitrageurs and guarants of quotations in the management of liquidity). More important, this ecosystem of ETFs offers the safety aspects (ETF is fully asset backed with zero counterparty risk- a quality situated at the opposite of the majority of derivatives).

The implied liquidity mechanism (ILM) is essential in understanding the strategy for providing liquidity in ETFs. The architecture of ETF enable the trading of portfolio elements but also the ETF itself. There are two distinct types of trading and it results opportunities for arbitrage (from the spread between the portfolio and the ETF itself) with interchange of liquidity. The trading volume (related to the transactions in the past) is different from the potential ETF liquidity (an estimate of trading in the future). ETF liquidity has in fact four elements: the liquidity of the underlying elements of portfolio, the average volume, the related derivatives (options, futures, swaps based on ETF) and other trading vehicles (correlated but different).

Based on ILM results a natural flexibility of rotation of sub- portfolios, with direct impact on the integration of ETFs in financing innovation in the field of intelligent robotic systems IRS. In this case, ETFs represents remarkable instruments that could be easily implemented in emerging markets like Romania.

The process of financing innovation in IRS based on ETF is a novelty in the case of emerging markets. This innovation regarding the design and implementation of strategies for this type of financing of IRS projects, is based on the benefits of the institutional advantages of using ETFs in emerging markets:

-cash equalization vehicle- ETFs are versatile investments in order to keep money in stock markets and to reduce the cash in order to align to the benchmark (interim beta); capability to rebalance sub-portfolios with reduced rolling (continuous buy and sell) costs;

-adjustment effective mechanism for a versatile portfolio rebalancing;

-efficient access for flexible portfolio adaptation/ completion;

-liquidity and flexibility for a better control of risks and for low cost- operational cash flows

-ETF shorting capabilities/ hedging market risk (a difficult aspect in the case of emerging markets)

-instrument for tactical (very short) moves

-instrument easy to understand for retail portfolio allocation

We also justify this innovative solution based on the ETF factors that could be very useful in the case of Romanian emerging market:

-exposure and holdings- the architecture of the index as a determinant of the performance; index replication strategy (full or optimized)

-total costs (managerial fees, costs of tracking index, trading costs, taxes)

-a better liquidity management (trading volume, implied liquidity via creation- redemption processes off-exchange)

-a better risk management (standard deviation, downside deviation, closure risk)

-a better regulatory structure.

4. Conclusions

In the world of technology, there is a strong interest for all domains of modern robotics, from defense (unmanned aerial/ ground/ underwater vehicles, robotic armament) to security and surveillance, manufacturing (new generations of assembly line, advanced automation, intelligent 3D/ 4D printers), healthcare (nanorobotics and applications in biotech, surgical and other medical robots, pharmacy automation), logistics, consumer. The dynamics of the rate of success of projects in the field of robotics and artificial intelligence is impressive and it benefits from capabilities like cognition (recognition and tracking), perception- action, advanced planning, sensing, control and action at all the levels in the Saridis architectures (organizational, coordination of soft/ hard components, execution and response). This dynamics and features express optimism in a domain with high risk and failure rate, also for Romanian IRS projects.

The Industry 4.0 revolution, changed the game in all technology markets, and emerging countries could hope to realize a real technological catching-up. The main problem of Romanian emerging market is expressed by the undercritical mass of governmental allocations for the research and innovation in IRS projects. There are a lot of interesting projects without any chance to be financed in the actual context of Romanian capital market. In this case it is necessary to develop special purpose vehicles SPVs capable to select the specific technical features, better adapted for sustainable finance of innovation in Romanian projects in the field of IRS.

The robotic revolution is characterized by a disruptive growth potential. There is a critical need to develop strategies and SPVs dedicated for the opportunities in emerging markets. The architecture of SPVs should be focalized both on performance but also on qualitative aspects like the mechanisms for increasing liquidity, the creation of natural self- stabilizing mechanisms, exit protocols. Beyond the scalability and modularity of investments it is also important to integrate in this equation the active participation the access of retail investors in this robotic revolution.

Future research directions should analyze the practical ways of implementing SPVs like VCFs and ETFs in Romanian capital market.

In the case of VCFs it is interesting to analyze different decision- making processes for prospecting, screening, and analyzing the set of portfolio candidate- firms, and solutions for implementing the strategies for adding value (GP- monitoring activities) or mixed exit strategies (initial public offering IPOs mixed with sales to strategic actors). In the case of ETFs future work should be dedicated to mechanisms specific for emerging markets like: the way to realize an alignment to a benchmark (interim beta), the adjustment mechanism for portfolio rebalancing, the hedging aspects and education issues for the education of retail investors.

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