The Underlying Complexities Impacting Accelerator Decision Making - a Combined Methodological Analysis.

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Abstract— Business accelerators play a key role in the initial critical stages of assessment of commercial viability, offering mentorship provision of funding and protection of intellectual property for product development and refinement. However, little is known about the decision making criteria and detailed analysis of the underlying criteria and interdependencies between the key factors used by accelerator organisations to fund start-ups. This study focusses on the decision making criteria utilised by a leading £21M accelerator programme, largely funded by the European Regional Development Fund for initial stage funding and intellectual property protection for product and innovation commercialisation. We incorporate a multi-methodological interpretive based approach based on Day's 'Real-Win-Worth' framework to develop the interrelationships and ranking between the factors. The results highlight the significance and weighting attached to the factors associated with the technical competency of the proposer and evidence of demand existing for the product. We propose a new framework that models the key factor interrelationships offering additional insight to accelerator based decision making.

Index Terms— Accelerator, start-up, decision making, innovation.

MANAGERIAL RELEVANCE STATEMENT

This paper considers a leading UK accelerator programme which is the first in the UK to be predicated on an OpenIP policy. The working model of the accelerator is one where management of both in-bound and out-bound IP is core to the accelerator's approach, particularly in the health-care and medical sector. By employing a combination of both Interpretative Structural Modeling and the Analytical Hierarchy Process - pair-wise comparison methods, this study applies the Real Win Worth framework to provide new insight into the inter-relationships and relative ranking of the selection criteria used in the management decision making process undertaken by this OpenIP accelerator at the initial disclosure stage. The criteria used to select the entrepreneurs and start-up companies are multifaceted, but the underlying theme is one that relies on an assessment of the characteristics of the entrepreneur, judgment on the proposal and the market potential. Additional factors can apply such as political legitimacy and the funder's expectations for return on investment. The findings of this study are of direct relevance to the academic community but also offers new insight to inform practitioners and industry management on the "lived in" decision making that underpin accelerator selection processes.

INTRODUCTION

The positive impact from start-up businesses via the creation of jobs, technical innovation, exchange of ideas and developing solutions to problems, has proved to be critical to the growth of economies throughout the world [1][2]. However, the high failure rate of fledgling businesses within the critical first 12 months and subsequent five years [3] highlights the significant challenges for start-ups as they struggle with the numerous logistical, financial, social, human and technological complexities necessary for business viability [4][5][6]. The availability of public funding has led to a rapid increase in the number of business incubators and accelerators that are available to support start-ups within the critical early stage period. Reports highlight that annually, up to £30 million is spent on UK incubators and accelerators via the provision of public funding from UK and EU sources [7]. In the US during the 2005–2015 period, accelerators raised $19.5 billion funding for more than 5,000 U.S. start-ups [8], highlighting the key contribution from this model of stimulating and supporting start-up growth.

Accelerators and incubators effectively support start-ups early in the business cycle during the initial fragile phase of growth to help firms, access required funding, grow faster and increase the chances of avoiding failure [9]. Historically, the incubator model has tended to nurture start-ups by supporting and buffering them from potentially harsh business environments during the critical early stages to give them room to grow, whereas the more recent accelerator structure tends to speed up market interactions with limited duration help and provide seed funding and mentoring for start-ups to adapt quickly and learn [10]. This migration from a traditional incubator-based model to an accelerator-based infrastructure, has led to an emergence of a new entrepreneur ecosystem where early stage start-ups can gain better traction and longevity within the market place [11]. Accelerators tend to offer limited-duration programs of support that help cohorts of start-ups launch and build their ventures, providing limited amounts of seed capital and infrastructure in exchange for small equity stakes in the business [12]. The structure, governance, aims and focus of accelerators varies widely, but it is generally agreed that the fixed-term and cohort-based aspects of accelerator programs are the primary distinguishing features separating accelerators from other start-up support models such as incubators [13][14].

The proliferation of accelerators has been significant over the last decade, with global estimates of over 3000 programs in existence highlighting the focus on assisting start-ups in this critical early stage [15]. Although the success of leading, well-funded, high profile and selective accelerator organisations such as TechStars and Y Combinator have been widely documented, studies have questioned the overall potential status bias and efficacy of accelerators as well as their ability to speed up the development of start-ups [12][16]. Although accelerators posit the significant contribution they can make to the start-up organisation, often advertising that they can "accelerate your business", "help gain traction through deep mentor engagement, rapid iterations cycles and fundraising preparation" [17], few studies have researched their ability to do so [12].

This questioning of the contribution to success from accelerator programs has led to researchers concentrating on two key themes of accelerator focused research. The first has focused on the quantitative evidence that accelerators have potentially contributed to the overall success of start-ups. This specific strand of research has generally utilized case study approaches to either posit the contribution to success from accelerator programs [18][19] or question the efficacy element developing a discourse as to whether accelerators force start-ups to close down earlier and more often [12] [20]. The second theme of accelerator research tends to focus on the selection criteria and process. The highly selective nature of the leading accelerators with figures of just 3% for applicant admissions, highlights the significant weight attached to the initial gate decision making process and associated criteria, but also suggests a potential preference to the "elite" applications that could potentially yield high returns further on in the business lifecycle [11]. Researchers have identified this second theme as an immature research area, with studies highlighting that little is known about the criteria for selection, that existing research has incorrectly viewed the accelerator model as a largely homogenous concept and that the underlying decision making process seems to exhibit significant variance along multiple design features [11][12]. This is particularly true for within programs predicated on the OpenIP principle proposed by Chesbrough [41].

This study aims to fill this gap by addressing two key research questions. Firstly - what are the key interdependencies and criticality ranking between the individual decision-making criteria used in deciding to fund start-ups for an accelerator based on an Open IP and Open Access paradigm? Prior studies have surprisingly tended to omit offering a more detailed analysis of the interrelationships between the decision-making factors and to offer potential unique insight to any causal influence or priority. Secondly, what influence do Key Performance Indicators (KPIs) have at the crucial initial stages within the decision-making process? Previous studies have inferred that accelerators tend to rely on an informal and perhaps subconscious set of decision criteria and that these criteria may change during the key stages of the decision-making process [11][21]. Accelerators may either have funding targets or specific criteria relating to growth targets or job creation that may be key factors that influence whether to admit a start-up to an accelerator program.

To answer these research questions, this study focusses on a £21M accelerator program established in 2016, primarily funded by EU structural funds to provide business support for start-up organisations [22]. Due to the multi-dimensional nature of the problem and limitations of a single method perspective, this research incorporates a combined interpretive method approach utilizing: Interpretive Structural Modelling (ISM), pairwise judgment elements of the Analytic Hierarchic Process (AHP) and Real-Win-Worth framework to identify the key interdependencies, ranking and assessment of decision criteria. This study aims to contribute to the wider accelerator focused literature by offering a unique and detailed analysis of the factors at the first and subsequent decision stages to develop a key theoretical contribution and thorough understanding of the criteria implicitly used by the decision makers - Technology Transfer Officers (TTOs) in selecting proposals for commissioned initial triage review and subsequent commercialisation. This research aims to fill the key gaps in the literature by offering unique perspective using this program as the case for analysis. To our knowledge, this is the first study to analyze an ERDF accelerator program utilizing a mixed interpretive method approach using ISM and AHP incorporating the Real-Win-Worth framework.

The remaining sections of this study are organized as follows: The literature review section discusses the relevant accelerator focused aspects of the literature and provides the background, supporting infrastructure and underlying processes to the accelerator case study. This section also details the selection of the factors that form the decision-making criteria used by the TTOs. The Methodology section discusses the ISM and Pairwise Comparison Methods (PCM) and the key elements of the underlying implementation process for each. The Results section sets out the findings of both the ISM and PCM processes, highlighting the key observations and outcomes. The Discussion section analyses the results in the context of the accelerator case study and Real-Win-Worth framework. The study Conclusions are outlined in the final section.

LITERATURE REVIEW

A. Identification of the Selection Criteria

The identification of selection criteria implicitly used for first disclosure screening was drawn from the literature via a comprehensive review of a range of studies that focused on established good practice. This highlighted numerous factors covering the qualities of the company/proposer, novelty and originality of the proposal, through to environmental and political factors. Studies have identified the business background of the proposer and their family background as important factors [23]. Marvel [24], for example, considered how new or incremental innovation speed was influenced by the various personal characteristics of an entrepreneur such as self-leadership, age, gender, educational level and family background.

The relationship between a company's organisational dexterity and the quality of its inventions were highlighted in Wang et al [25], where they identified 23 separate company attributes. Kim et al [26] considered the criteria used by institutions in committing resources through a textual analysis of keywords within evaluation narratives, somewhat aligning with McMullen and Shepherd's 'Entrepreneurial Action' framework [27]. This approach assessed feasibility – acquired knowledge of the product's characteristics and potential as well as attributes of the entrepreneur such as willingness to handle the perceived risk for a given level of understanding of the product. The qualities of a good technology transfer office to support invention disclosure within academia were assessed in Xu et al [28], where factors such as strong tacit knowledge across disciplines and management of university license income via royalty share agreements, were identified as key. Sengupta and Ray [29] reviewed university research and Knowledge Transfer (KT) activities and the importance of ambidexterity within universities to commercialize research. Significantly, this review was informed by Higher Education - Business and community Interaction Survey (HEBCIS) data, which provides an annual snapshot of UK university-industry engagement.

Giuri et al [30] considered best practice within leading universities across the EU, identifying a distinctive approach to ascertaining IP potential, validating technologies and incentivizing for commercialisation. Belitski et al [31] reviewed the factors influencing commercialisation of university academic research in three post-Soviet transition economies. One issue they identified is the perceived level of bureaucracy and lack of TTO expertise. Czarnitski et al [32] analysed how the German government ostensibly improved its 2002 Intellectual Property Rights (IPR) policy for university staff and altered entrepreneurship within the academic community. These findings indicated that the implementation of an IP ownership model required careful consideration of the local cultural context in order to stimulate entrepreneurial activity in the academic community. Muscio et al [33] similarly considered the Italian university policies for spin-off support within academia. Their work confirmed the need for clear rules on spinoff creation, including monetary incentives, academic involvement in new ventures and the distribution of benefits from entrepreneurial activity between a university and its staff. The Muscio findings highlighted the clear interdependence between the various aspects of academic knowledge transfer. Sixty US based universities were analysed by Baglieri et al [34] over a ten year period. The study highlighted the variability in performance of universities in the context of commercialising knowledge, noting that knowledge of the factors affecting a university's performance was limited unless the interrelationships between these influencing factors was better understood. Factors such as trust and willingness to share IP were identified as important in a number of studies [35] [28]. Exposito et al [36] identified a range of variables that characterise a company's capacity to exploit innovation. Yin and Luo's [11] comprehensive analysis of criteria applied by incubator and accelerator units generated 30 factors applicable at initial screening and subsequent selection stages, each of which were categorized according to Day's Real-Win-Worth model [37]. The Day model was selected for this study as its characteristics were closely aligned with the accelerator A case study and provided a framework for exploring the interdependencies and ranking of TTO decision-making. The Day model classifies selection criteria according to:

- Is the product clearly described and is there evidence of demand? (REAL)
- Are there positive attributes of both the product and the proposer that increase confidence? (WIN)
- Does the proposal satisfy the strategic aims of the funder? (WORTH)

In order to identify which criteria are used- either implicitly or explicitly - by the accelerator TTOs at the first disclosure phase, we followed an approach similar to that used in Saarijarvi et al [38] and Yin and Luo [11]. The 30 identified criteria within Yin and Luo and the factors identified by Marvel [24] were reviewed by an expert panel taken from the accelerator's practitioners with an average of approximately 10 years' experience. This process generated a condensed set of 12 criteria that represented the decision-making process at first disclosure and covered aspects of the product, entrepreneur, market opportunities and the strategic agenda of the principal funder - EU Structural Funds. Yin and Luo identified other criteria that they claimed were less relevant at the initial screening stage. For example, Capital Availability was considered to be more important for the subsequent stages. An additional 13th factor, S13:'Capability of company to raise finance', was also included in the AHP pairwise comparison analysis in order to clarify its relative importance at the initial first disclosure stage, and to confirm consistency with Yin and Luo's work.

EU Structural Funds mandate the achievement of eight Key Performance Indicators (KPIs), which are primarily intended to improve the infrastructure and economic capacity of underperforming regions of the EU. The KPIs are listed in Table 1.

Table1: EU Structural Fund Key Performance Indicators

KPI1	Number of Patents Registered for Products (PPS)
KPI2	Enterprises Receiving Non-Financial Support
KPI3	Employment Increase in supported enterprises
KPI4	Private Investment matching public support for RD&I Projects
KPI5	University contribution
KPI6	Number of new enterprises supported
KPI7	Number of enterprises supported to introduce new to market products
KPI8	Number of enterprises supported to introduce new to firm products
KPI9	Number of enterprises cooperating with supported research institutions

Although not explicitly forming the decision criteria used by the TTOs, these KPIs reflect the success criteria and outcome measurements of the accelerator. Table 2 lists the set of factors that comprise the condensed set of selection criteria.

Table 2: Condensed set of Selection Criteria used for first disclosure analysis.

#	**Factor Name**	**Description**	**Day Category**
S1	Evidence of demand exists for the product	Is there prima facie evidence from the proposer that demand exists for the innovation? Includes KPIs 7 and 8	REAL
S4	Product concept is sufficiently clear and detailed enough to progress to next stage	Has the fundamental concept been described in sufficient detail to explain its value?	REAL
S5	Product prototyping is sufficiently developed and mature as indicated on the TRL scale.	The concept has progressed from concept to a physical prototype. Refer to TRL Definition [69].	REAL
S2	A value proposition exists and the product can deliver new benefits	The proposal contains a new idea or solution that offers something new that other existing products do not currently have. Includes KPI 1	REAL
S6	Product development team are sufficiently technically competent	Considers the purely technical and scientific competences within the proposer's team	WIN
S7	Processes are in place for the organisation to consistently listen and respond to customer demands	Considers whether the proposer's team has competence in engaging with the intended customer base which could lead to informing how the product is developed	WIN
S9	There exists an understanding and acceptance of royalty or equity share arrangements	Has the proposer understood and accepted that engagement with the accelerator programme will lead to some sharing of IP typically through royalty payments or an equity stake.	WIN
S10	Trust has been established between a proposer and TTO	Has a working relationship been established so that both parties have a level of confidence and trust in each other?	WIN
S11	Willingness for proposer to allocate time for SME commercialisation	Conflates characteristics such as commercialisation leadership and enthusiasm of the proposer to commit time for business development.	WIN
S12	Ability for proposer to allocate time for SME commercialisation	Examines the practicalities of the proposer's normal work situation and asks whether they have the time capacity to commit to the commercial and business.	WIN
S3	Proposal demonstrates favourable market demographics, growth potential and potential size	Is there evidence yet on the future growth in sales based on an analysis of likely target customer type?	WORTH
S8	Potential exists for the creation of new jobs	This is a judgment made by the TTO as to whether there seems to be an opportunity for new job creation, which is a key funder KPI.	WORTH

KPI3 is explicitly included in the factor list within table 2 - via: S8) potential exists for creation of new jobs. This reflects the strategic and political priorities from key stakeholders and underlying influence of market expansion factors. The remaining KPIs are not explicitly included in the factor list due to their fulfilment through the disclosure and support process or are subsumed within the 12 criteria in the context of underlying influence. The selection criteria within table 2 has been re-ordered to reflect the groupings aligned with the Real-Win-Worth framework.

B. The accelerator case study

The rationale for selecting the accelerator case study (*termed accelerator A*) was that it is, to the authors' knowledge, the first and currently only UK programme funded under EU Structural Funds that is predicated on Open IP principles. It is based in a region which has struggled in its transition from its dependency on large industry to a knowledge-based economy [39]. In this context the role of the Technology Transfer Office and the experience of the TTOs is regarded as central to the process of entrepreneurial support [40]. Judgments by the TTO team for selecting proposals at first disclosure stage were therefore based on nuanced cognitive assessments that reflected the University's lead role in IP appropriation and deal-making with potential third-party organisations and funding bodies. This Case Study therefore provided a unique opportunity to analyze the interrelationships between the decision-making factors at first disclosure and address the two research questions. Following Chesbrough's exposition [41] of OpenIP principles, the philosophical foundation of accelerator A was influenced by Bradleys' Alternative Technology Transfer Model [42], informed by Gibb and Hannon's work [43] on the 'Entrepreneurial University'. Accelerator A emerged from discussions between university, industry, and government on how to address and implement a smart specialization framework for stimulating and supporting the knowledge economy [44][45]. As a result, accelerator A is focused on the priority areas of Life Sciences and Health as well as supporting smart specializations in energy and ICT [46]. Over 25% of accelerator A activities involve NHS health Boards, with a further 50% of projects coming from medical and health-care related academics. Accelerator A also facilitates deal making with third party companies and venture capitalists that mitigate a start-up's limited capacity for taking an early stage proof of concept through to a regulatory-compliant, market-ready product. This defining characteristic provides a focused infrastructure for commercialisation that distinguishes it from all antecedent EU structural funds targeted at the UK economy and makes it an appropriate choice for this research [47][48].

This study considers the decision-making process within the accelerator at the first disclosure stage to the TTO team, where the allocation of seed funding is first considered. Although the program evaluates prospective start-ups via a continuous operational model in alignment with its stronger risk-management protocols, it is taking a more robust approach to its time-limited support, with typical timescales now averaging approximately ten months. The approach to incubator space has also matured from the previous ‘Build it and they will come’ model [49], to a more considered case-by-case approach utilizing the broader university estate. The current first disclosure stage decision-making process is informed by prior TTO experience and influenced by the EU KPI targets. This process seems to align with Yin and Luo [11], where the study notes that a formal model can, post hoc, assist decision makers in articulating the implicit reasoning behind their decisions.

METHODOLOGY

The literature has referenced a number of pairwise based interpretive methods to provide structure and process to the identification of interrelationships between factors. Consistent amongst the range of interpretive methods is the use of expert participants to provide contextualized perspective and expert judgement on the extent of factor interrelationships [50][51]. The choice of appropriate methods is however, somewhat restricted with existing studies utilizing a limited range of approaches. The prior literature has utilized a number of interpretive based methods such as: Analytic Hierarchic Process (AHP), Analytic Network Process (ANP), Delphi technique, Graph Theoretic and Matrix approach (GTMA), Decision Making Trial and Evaluation Laboratory (DEMATEL), Interpretive Structural Modelling (ISM), Pairwise Comparison Method (PCM) and Interpretive Ranking Process (IRP). Each of these methods prescribe alternative approaches to the interpretation problem and exhibit advantages as well as inherent limitations in their methodologies. The ISM method was selected due to the following:

- systematic and repeatability of process,
- graphical representation of outputs,
- no requirement for expert participants to have knowledge of the underlying ISM process,
- ability to translate real life complexity to participant driven cognitive models,
- use of transitivity and reduction in need for relational queries.

Recognizing that although ISM exhibits the required factor interdependency attributes, there are inherent factor ranking limitations within the method [52]. AHP was selected to generate the required ranking element of the experts' perspectives on factor interrelationships. This use of AHP focused on the PCM element as outlined in Saaty [53] due to the method's ability to offer a structured yet non-complex process that yields an objective measure on subjective TTO judgements made at the first disclosure for a commercial proposal. The PCM approach attempts to replicate the real-time cognitive challenges that a TTO faces when assessing a new proposal. The method forces judgements to be made between factors, whereas a simple Likert based approach on each factor in turn, can sometimes mask the discrimination process [54][55], thereby, not delivering the required level of granularity.

A. Interpretive Structural Modelling (ISM)

Initially proposed by Warfield [56], ISM has its roots in discrete and finite mathematics and is a structured pairwise interpretive based methodology. The method offers a visual representation of complexity via a systematic process of structural modelling using interconnected matrices. ISM provides a structure and process via the application of a model that can impose order on the complexity of relationships between elements. The method is interpretive in that the expert group judgment decides whether and how elements are related [57]. The ISM process has proven to be a valuable technique able to transform poorly defined mental models of systems into clear structured well-defined structures [58]. The literature has extensively utilized ISM to identify interdependencies between sets of variables or factors portrayed via a directed graph or digraph model [59][60]. ISM provides a structured pairwise derived process to enable an expert participant group to synthesize an objective hierarchy of factors in the assessment of the extent of factors interrelationships [61][62].

The ISM methodology requires the use of an expert participant group who have extensive knowledge of the subject matter. The expert group provides an overall consensus view on the interrelationships between a set of factors [59][61][63]. As highlighted in Fig. 1 the initial expert view on the factor interdependencies are subsequently processed via the mandated steps in the ISM methodology to formally identify the dependent links between each of the factors.

The key steps within the ISM process are as follows:

Step 1: Identify the key factors (variables) that form the basis of the ISM analysis. These factors are developed and validated from the relevant literature and validated by the expert group.

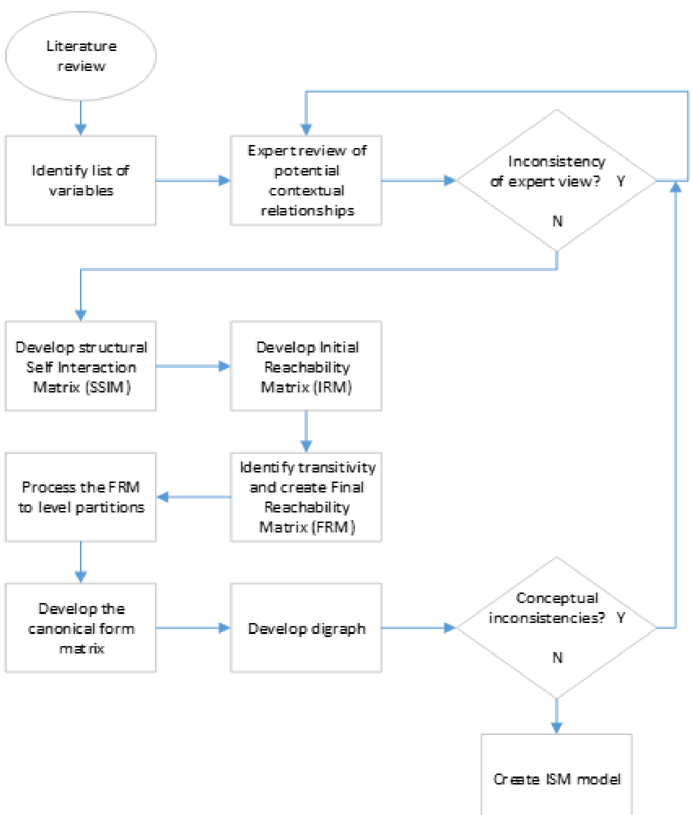

Figure 1: ISM process (Hughes [52])

Step 2: Develop the Structural Self -Interaction Matrix (SSIM), M, based on experts' view on extent of contextual relationships between the factors.

M = $\begin{bmatrix} a12 & \cdots & a1n \\ \vdots & \ddots & \vdots \\ an1 & \cdots & ann \end{bmatrix}$ where ai,j, denotes the i-th row and j-th column within matrix M.

The SSIM is populated using the V, A, X, O notation using the following criteria: [V]: variable i will help to achieve or have influence on variable j; [A]: variable i will be achieved or influenced by variable j; [X]: variable i and variable j will help achieve or influence each other; [O]: variables i and j are not related.

Step 3: The SSIM is transitioned to the Initial Reachability Matrix (IRM) using a binary notation in adherence to the following rules:

• if the (i,j) relationship within the SSIM is V, then the equivalent (i,j) entry in the IRM becomes: 1 and the (j,i) entry becomes: 0;

• if the (i,j) relationship within the SSIM is A, then the equivalent (i,j) entry in the IRM becomes: 0 and the (j,i) entry becomes 1;

• if the (i,j) relationship within the SSIM is X, then the equivalent (i,j) entry in the IRM becomes: 1 and the (j,i) entry also becomes 1;

• if the (i,j) relationship within the SSIM is O, then the equivalent (i,j) entry in the IRM becomes: 0 and the (j,i) entry also becomes 0.

Step 4: The IRM is transitioned to the Final Reachability Matrix (FRM) by including transitive relationships. Transitivity is denoted by the following:

If A is connected to B (A → B) and B is connected to C (B → C) then a transitive relationship exists between A and C (A → C).

Transitive relationships are highlighted in the FRM by inserting “1*” at each of the transitive relationship references.

Step 5: Within this step, the level partitions are processed from the FRM for the reachability and antecedent sets for each element within the matrix [56]. The reachability set R(Pi) consists of the element itself and all other interconnected elements which it may help to influence. The antecedent set A(Pi) consists of the element itself and other elements which may influence it. Level partitioning may entail a number of iterations. Where the reachability set R(Pi) and the intersection set R(Pi) & A(Pi) match for each iteration, the specific element in the matrix is denoted with "I". This process is repeated for all levels within the partitioning process until all R(Pi) and R(Pi) & A(Pi) matches are identified.

Step 6: This step entails the development of the canonical form matrix. The canonical form is structured to represent the ordered view of the level partitions based on the level partition iterations from the previous step. The canonical matrix can be modified at this stage to include the driving and dependence power figures by summing the binary values for each factor against each axis.

Step 7: Although not a mandated element of the ISM process, a number of studies develop a MICMAC analysis diagram [64][65][66]. The MICMAC is translated from Multiplication Applique a un Classement (Cross impact matrix-multiplication applied to classification). The MICMAC visually represents the key factors and their influence within the full spectrum of driving and dependence power interdependencies. The MICMAC diagram has four distinct quadrants as follows:

- Independent – often termed – key factors, this quadrant identifies variables that have weak dependency power but strong driving power.

- Linkage – this quadrant identifies variables that are identified as exhibiting strong dependency power as well as strong driving power. As such, these variables are categorized as unstable as any action on these variables will have a corresponding effect on other variables and feedback on themselves.

- Dependent – this quadrant identifies the factors that have strong dependence power but also exhibit weak driving power.

- Autonomous – variables within this quadrant are identified as having low levels of interdependency and are relatively disconnected from the system. As such, they have weak driving power and weak dependence, therefore, low impact.

Step 8: The final step within the ISM model is the development of the digraph. This is a visual representation of the hierarchy of factor relationships. The digraph is developed from the canonical form with the structure portraying the key driving power factors at the base and the factors with the highest levels of dependency at the top of the digraph.

B. AHP Pairwise Comparison Method

For this study, the AHP PCM model was selected as it facilitates a deeper analysis into the decision-making process than the simpler binary PCM model. Although methods such as Likert scoring could be implemented, studies have highlighted the potential problem of low variance between each factor being considered [67]. The PCM forces respondents to choose between each pair of criteria being considered. A Pairwise Comparison matrix is then generated using the AHP model [53]. Each of the accelerator TTOs was asked to select which criterion were more important than others within the matrix, based on the judgment scale shown in Table 3. Subsequent processing yielded a set of weighting factors that represented the relative ranking of the 12 selection criteria used by the TTOs at first disclosure stage.

Step1:

Generate Pairwise Comparison Matrix {Aij}: For each pair of criteria, the TTO team estimate by how much the ith criterion is more important than the jth using the nine-point AHP scoring scale shown in Table 3.

Table 3: AHP 9 point scale used for Pairwise Comparison. Scores 2, 4, 6 and 8 used as intermediate values.

1	i^{th} criterion is **equally important** to j^{th} criterion
3	i^{th} criterion is **moderately more important** than j^{th} criterion
5	i^{th} criterion is **strongly more important** than j^{th} criterion

7	i^{th} criterion is **very strongly more important** than j^{th} criterion
9	i^{th} criterion is **extremely more important** than j^{th} criterion

In the AHP model, the $\{A_{ij}\}$ matrix is a reciprocal matrix, where $A_{ij} = 1/A_{ji}$.

Step 2:

Solve the eigenvalue problem:

$$\{A_{ij}\}\ \{w_i\} = \lambda_{max}\ \{w_i\} \quad , \qquad (1)$$

where λ_{max} is the principal eigenvalue and $\{w_i\}$ is the corresponding eigenvector that generates a normalized set of weights, representing the relative ranking of the selection criteria. These 'weighting coefficients' can provide an insight in to the prioritization of values during the accelerator's decision making process. Equation 1 is solved using MATLAB [68].

C. Results analysis interviews

Interviews were held with TTO participants in alignment with the "inconsistency of expert view" element of the ISM process and supported within aspects of the interpretive methods literature, notably Saarijarvi [38]. This step was utilized to clarify a number of the inter-methodological inconsistencies and to provide additional clarity to specific aspects of interpretation of the results.

4. Results

A. Interpretive structural modelling results

The expert participant group utilized for this research comprised of the accelerator TTOs who play a significant role in the assessment of commercial viability for new products and inventions. The TTOs are responsible for the assessment and identification of Intellectual Property (IP) and are the decision makers on whether to fund any innovation application through the accelerator process. In alignment with step 2 in the ISM process as presented in Fig. 1, the expert group were tasked with identifying the extent of the relationship between the factors based on the (i) and (j) structure presented in the SSIM. Depending on the perceived influence and extent of relationships for all of the factors in turn, the matrix was populated using the V, A, X, O notation. The SSIM is presented in Fig. 2. The 1:1 relationships (e.g. 12:12), are left blank.

Factors (i,j)	12	11	10	9	8	7	6	5	4	3	2	1
1.Established demand exists for the product	O	V	O	O	V	O	X	X	X	A	X	
2.A value proposition exists and the product can deliver new benefits	O	V	V	O	V	X	O	V	V	X		
3.Proposal demonstrates favourable market demographics, growth potential and potential size	O	V	X	O	V	X	O	A	A			
4.Product concept is detailed enough to progress to physical prototype	O	X	X	O	V	X	A	V				
5.Product is sufficiently developed and mature as indicated on the TRL scale	O	V	V	X	V	X	A					
6.Product development team are sufficiently technically competent	O	V	V	O	O	O						
7.Processes are in place for the organisation to consistently listen and respond to customer demands	O	O	V	X	O							
8.Potential exists for the creation of new jobs	O	V	O	O								
9.There exists an understanding and acceptance of royalty share arrangements	O	V	A									
10. Trust has been established between a proposer and TTO	O	X										
11. Willingness for proposer to allocate time for SME commercialisation	O											
12. Ability for proposer to allocate time for SME commercialisation												

Figure 2 Structural Self-Interaction Matrix (SSIM)

From the completed SSIM, the V,A,X,O notation for each of the (i,j) relationships is translated to a binary form within the IRM as denoted in step 3. The results of this step are presented in Table 4.

Table 4 Initial Reachability Matrix (IRM)

Elements	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	0	1	1	1	0	1	0	0	1	0
2	1	1	1	1	1	0	1	1	0	1	1	0
3	1	1	1	0	0	0	1	1	0	1	1	0
4	1	0	1	1	1	0	1	1	0	1	1	0
5	1	0	1	0	1	0	1	1	1	1	1	0
6	1	0	0	1	1	1	0	0	0	1	1	0
7	0	1	1	1	1	0	1	0	1	1	0	0
8	0	0	0	0	0	0	0	1	0	0	1	0
9	0	0	0	0	1	0	1	0	1	0	1	0
10	0	0	1	1	0	0	0	0	1	1	1	0
11	0	0	0	1	0	0	0	0	0	1	1	0
12	0	0	0	0	0	0	0	0	0	0	0	1

The IRM is translated to the FRM as presented in Table 5 that represents step 4 in the ISM process.

Table 5 Final Reachability Matrix (FRM)

Elements	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1*	1	1	1	1*	1	1*	1*	1	0
2	1	1	1	1	1	1*	1	1	1*	1	1	0
3	1	1	1	1*	1*	1*	1	1	1*	1	1	0
4	1	1*	1	1	1	1*	1	1	1*	1	1	0
5	1	1*	1	1*	1	1*	1	1	1	1	1	0
6	1	1*	1*	1	1	1	1*	1*	1*	1	1	0
7	1*	1	1	1	1	0	1	1*	1	1	1*	0
8	0	0	0	1*	0	0	0	1	0	1*	1	0
9	1*	1*	1*	1*	1	0	1	1*	1	1*	1	0
10	1*	1*	1	1	1*	0	1*	1*	1	1	1	0
11	1*	0	1*	1	1*	0	1*	1*	1*	1	1	0
12	0	0	0	0	0	0	0	0	0	0	0	1

The FRM includes all transitive relationships that are characterized by 1* notation. Factor 12) Ability for proposer to allocate time for SME commercialisation is identified by the expert group as not to exhibit any interrelationship with any other factor in the matrix. As such it is marked as “0” for all (i) and (j) instances.

Within partitioning, the factors are assessed based on the reachability and antecedent sets for all factors in the FRM based on their (i) and (j) references. The reachability set R(Pi) consists of the variable itself and all other variables which it may help to achieve. The antecedent set A(Pi) is developed from the variable itself and other connected variables which may help in achieving it. Table 6 denotes the level I partition.

Table 6 Level Partitions I

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
1	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,9,10,11	1,2,3,4,5,6,7,9,10,11	
2	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,9,10	1,2,3,4,5,6,7,9,10	
3	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,9,10,11	1,2,3,4,5,6,7,9,10,11	
4	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,8,9,10,11	I
5	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,9,10,11	1,2,3,4,5,6,7,9,10,11	
6	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6	1,2,3,4,5,6	
7	1,2,3,4,5,7,8,9,10,11	1,2,3,4,5,6,7,9,10,11	1,2,3,4,5,7,9,10,11	
8	4,8,10,11	1,2,3,4,5,6,7,8,9,10,11	4,8,10,11	I
9	1,2,3,4,5,7,8,9,10,11	1,2,3,4,5,6,7,9,10,11	1,2,3,4,5,7,9,10,11	
10	1,2,3,4,5,7,8,9,10,11	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,7,8,9,10,11	I
11	1,3,4,5,7,8,9,10,11	1,2,3,4,5,6,7,8,9,10,11	1,3,4,5,7,8,9,10,11	I
12	12	12	12	I

The factors identified within this partition: S4) Product concept is sufficiently clear and detailed enough to progress to next stage, 8) Potential exists for the creation of new jobs, S10) Trust has been established between a proposer and TTO, S11) Willingness for proposer to allocate time for SME commercialisation will be positioned at the top of the ISM digraph. The factor S12) Ability for proposer to allocate time for SME commercialisation has no interdependent relationships, as such it is positioned at level I within the partitioning. The subsequent partitioning within tables 7 and 8 show the partitions for the remaining two levels.

Table 7 Level Partitions II

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
1	1,2,3,5,6,7,9	1,2,3,5,6,7,9	1,2,3,5,6,7,9	II
2	1,2,3,5,6,7,9	1,2,3,5,6,7,9	1,2,3,5,6,7,9	II
3	1,2,3,5,6,7,9	1,2,3,5,6,7,9	1,2,3,5,6,7,9	II
5	1,2,3,5,6,7,9	1,2,3,5,6,7,9	1,2,3,5,6,7,9	II
6	1,2,3,5,6,7,9	1,2,3,5,6	1,2,3,5,6	
7	1,2,3,5,7,9	1,2,3,5,6,7,9	1,2,3,5,7,9	II
9	1,2,3,5,7,9	1,2,3,5,6,7,9	1,2,3,5,7,9	II

Table 8 Level Partitions III

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
6	6	6	6	III

All matches between the reachability set R(Pi) and intersection set R(Pi) & A(Pi) are removed for each subsequent iteration.

Level II of the partitioning lists the following factors: S1) There exists an established demand for the product, S2) A value proposition exists and the product can deliver new benefits, S3) Proposal demonstrates favourable market demographics, growth potential and potential size, S5) Product prototyping is sufficiently developed and mature as indicated on the TRL scale [69], S7) Processes are in place for the organisation to consistently listen and respond to customer demands, S9) There exists an understanding and acceptance of royalty or equity share arrangements. These factors will be positioned within the middle section of the digraph. Table 8 contains the final iteration of the partitioning showing 6) Product development team are sufficiently technically competent as the sole element of the level III construct. This factor would be positioned at the base of the ISM digraph.

The canonical form displayed within table 9 presents a matrix structured to reflect the reachability set R(Pi) definitions and level partition results. Validation can be performed on the reachability set R(Pi) against all instances of “1” for each (i) and (j) element within the matrix. The dependence power values are developed from the sum of the (i) and (j) elements along the y axis and the driving power the (i) and (j) values across the x axis. The MICMAC diagram presented in Fig. 3 illustrates the positioning of the factors within the four quadrants: independent, linkage, dependent and autonomous.

Table 9 Canonical Form with driving and dependence powers

Elements	4	8	10	11	12	1	2	3	5	7	9	6	Driving Power	Reachability Set: R(Pi)
4	1	1	1	1	0	1	1	1	1	1	1	1	11	1,2,3,4,5,6,7,8,9,10,11
8	1	1	1	1	0	0	0	0	0	0	0	0	4	4,8,10,11
10	1	1	1	1	0	1	1	1	1	1	1	0	10	1,2,3,4,5,7,8,9,10,11
11	1	1	1	1	0	1	0	1	1	1	1	0	9	1,3,4,5,7,8,9,10,11
12	0	0	0	0	1	0	0	0	0	0	0	0	1	12
1	1	1	1	1	0	1	1	1	1	1	1	1	11	1,2,3,4,5,6,7,8,9,10,11
2	1	1	1	1	0	1	1	1	1	1	1	1	11	1,2,3,4,5,6,7,8,9,10,11
3	1	1	1	1	0	1	1	1	1	1	1	1	11	1,2,3,4,5,6,7,8,9,10,11
5	1	1	1	1	0	1	1	1	1	1	1	1	11	1,2,3,4,5,6,7,8,9,10,11
7	1	1	1	1	0	1	1	1	1	1	1	0	10	1,2,3,4,5,7,8,9,10,11
9	1	1	1	1	0	1	1	1	1	1	1	0	10	1,2,3,4,5,7,8,9,10,11
6	1	1	1	1	0	1	1	1	1	1	1	1	11	1,2,3,4,5,6,7,8,9,10,11
Dependence Power	11	11	11	11	1	10	9	10	10	10	10	6		

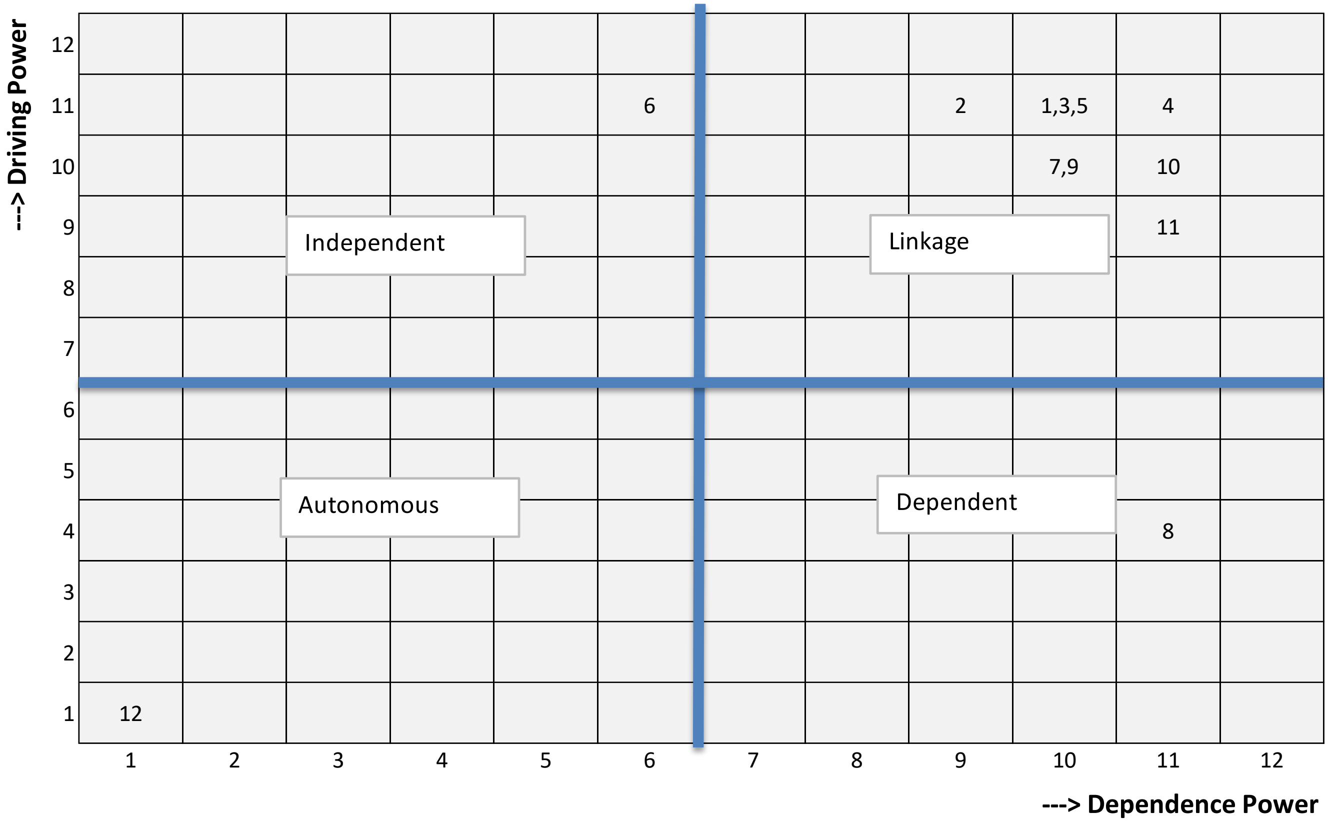

Figure 3 MICMAC Diagram

Fig. 3 highlights the clustering within the linkage quadrant with a significant number of the factors located in this area. The linkage quadrant denotes strong driving power and high levels of dependency between the factors. The factor S6) *Product development team are sufficiently technically competent* is located within the independent quadrant exhibiting high levels of driving power and therefore, influence on other factors within the model. The factor S8) *Potential exists for the creation of new jobs* is located within the dependent quadrant. The location of this factor highlights the relatively low levels of driving power and significant dependence power. As the factor S12) *Ability for proposer to allocate time for SME commercialisation* has been identified as exhibiting no interdependent relationships, it is located in the bottom left of the MICMAC in the Autonomous quadrant.

The digraph presented in Fig. 4 represents the final step in the ISM process where each of the factors are structured around their interrelationships in the context of their driving and dependency power. A number of observations can be highlighted from the digraph.

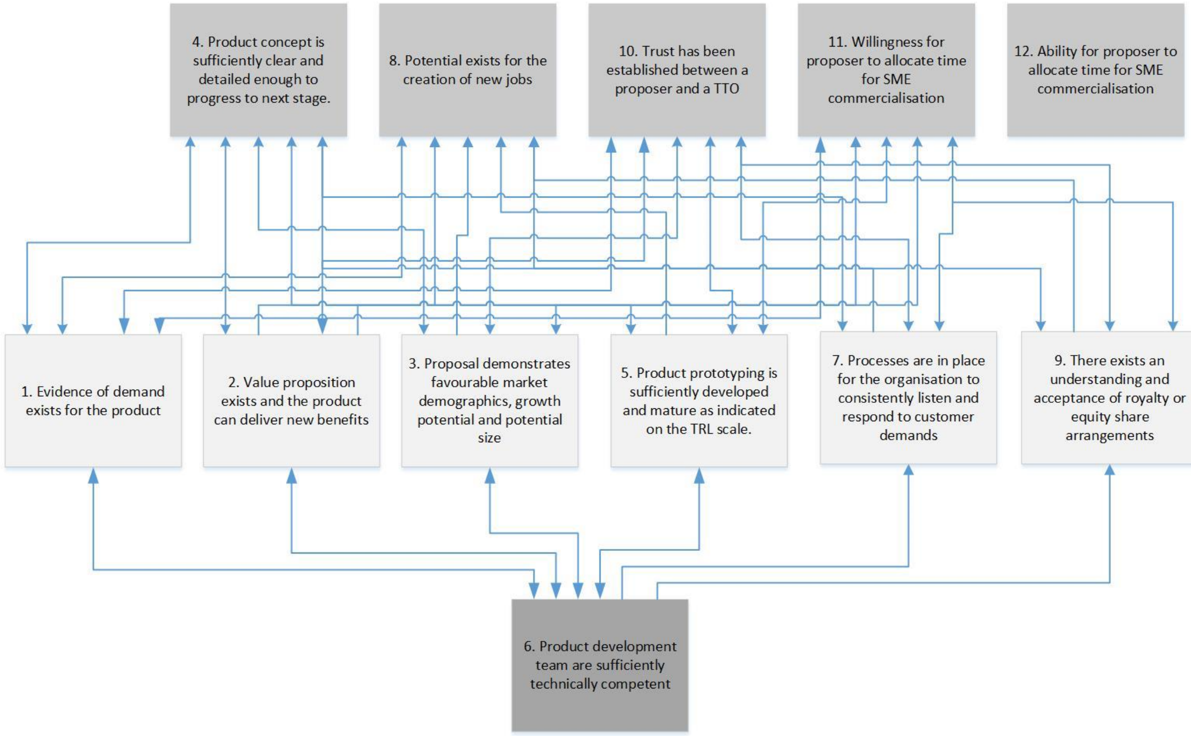

Figure 4 ISM Digraph

The location of the factor S6) *Product development team are sufficiently technically competent* at the base of the digraph indicates the substantial influence of this factor on the remainder of the factors. The positioning of the factors: S4) *Product concept is sufficiently clear and detailed enough to progress to next stage*, S8) *Potential exists for the creation of new jobs*, S10) *Trust has been established between a proposer and TTO*, 11) *Willingness for proposer to allocate time for SME commercialisation* at the top of the digraph indicates the high levels of reliance (dependence power) that these factors have on other interconnected factors within the model. The factor S12) *Ability for proposer to allocate time for SME commercialisation* exhibits no interdependency with any other factors within the model and is therefore, shown with no connections. Lastly, the middle tier within the digraph represents the significant clustering within the linkage quadrant as presented in the MICMAC diagram. This highlights the significant interconnectivity between this cluster of factors and how any impact on any one of these factors is likely to affect them all.

B. AHP - PCM results

Table 10 presents the Pairwise Comparison Matrix {Aij} resulting from the questionnaire presented to the TTO group.

Table 10 Pairwise Comparison Matrix Aij

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
S1.Evidence of demand exists for the product	1.00	2.00	3.00	3.00	8.00	5.00	7.00	5.00	7.00	7.00	3.00	5.00	3.75
S2.A value proposition exists and the product can deliver new benefits	0.50	1.00	0.50	0.50	7.00	3.00	0.50	0.14	7.00	0.50	0.33	5.00	1.5
S3.Proposal demonstrates favourable market demographics, growth potential and potential size	0.33	0.50	1.00	0.33	7.00	3.00	4.00	0.50	5.00	0.50	0.20	2.00	3
S4.Product concept is sufficiently clear and detailed enough to progress to next stage	0.33	0.50	3.00	1.00	7.00	5.00	0.14	0.50	9.00	2.00	2.00	7.00	1.5
S5.Product prototyping is sufficiently developed and mature as indicated on the TRL scale	0.13	0.14	0.14	0.14	1.00	0.14	0.20	0.33	3.00	0.14	0.25	2.00	3
S6.Product development team are sufficiently technically competent	0.20	0.33	0.33	0.20	7.00	1.00	0.50	0.33	7.00	0.20	0.20	0.20	3
S7.Processes are in place for the organisation to consistently listen and respond to customer demands	0.14	3.00	0.25	0.33	5.00	2.00	1.00	0.50	4.00	0.50	0.50	3.00	3
S8.Potential exists for the creation of new jobs	0.20	7.00	0.20	0.25	3.00	3.00	2.00	1.00	5.00	0.33	0.17	0.17	0.6
S9.There exists an understanding and acceptance of royalty or equity share arrangements	0.14	0.14	0.20	0.11	0.33	0.14	0.25	0.20	1.00	0.14	0.25	0.25	1.5
S10. Trust has been established between a proposer and TTO	0.14	2.00	2.00	3.00	7.00	7.00	7.00	3.00	7.00	1.00	3.00	3.00	3
S11. Willingness for proposer to allocate time for SME commercialisation	0.33	3.00	5.00	3.00	4.00	5.00	2.00	6.00	4.00	0.33	1.00	3.00	3
S12. Ability for proposer to allocate time for SME commercialisation	0.20	0.20	0.50	0.14	4.00	5.00	0.33	6.00	4.00	0.33	0.33	1.00	4.2
S13 capability of company to raise finance	0.27	0.67	0.33	0.67	0.33	0.33	0.33	1.67	0.67	0.33	0.33	0.24	1

For example, cell $A_{1,12}$ has a value of 5.0, indicating the TTO consensus view is that Criterion S1) Evidence of demand exists for the product is strongly preferred over Criterion S12) Ability for proposer to allocate time for SME commercialisation. From the reciprocity property, it follows that $A_{12,1}$ will have a value of 1/5.

Solving the Eigenvalue matrix equation (1) and normalizing the eigenvector corresponding to the principal eigenvalue, generates a normalized set of weights. Fig. 5 presents the resulting ranking of the selection criteria incorporating the weighting figures.

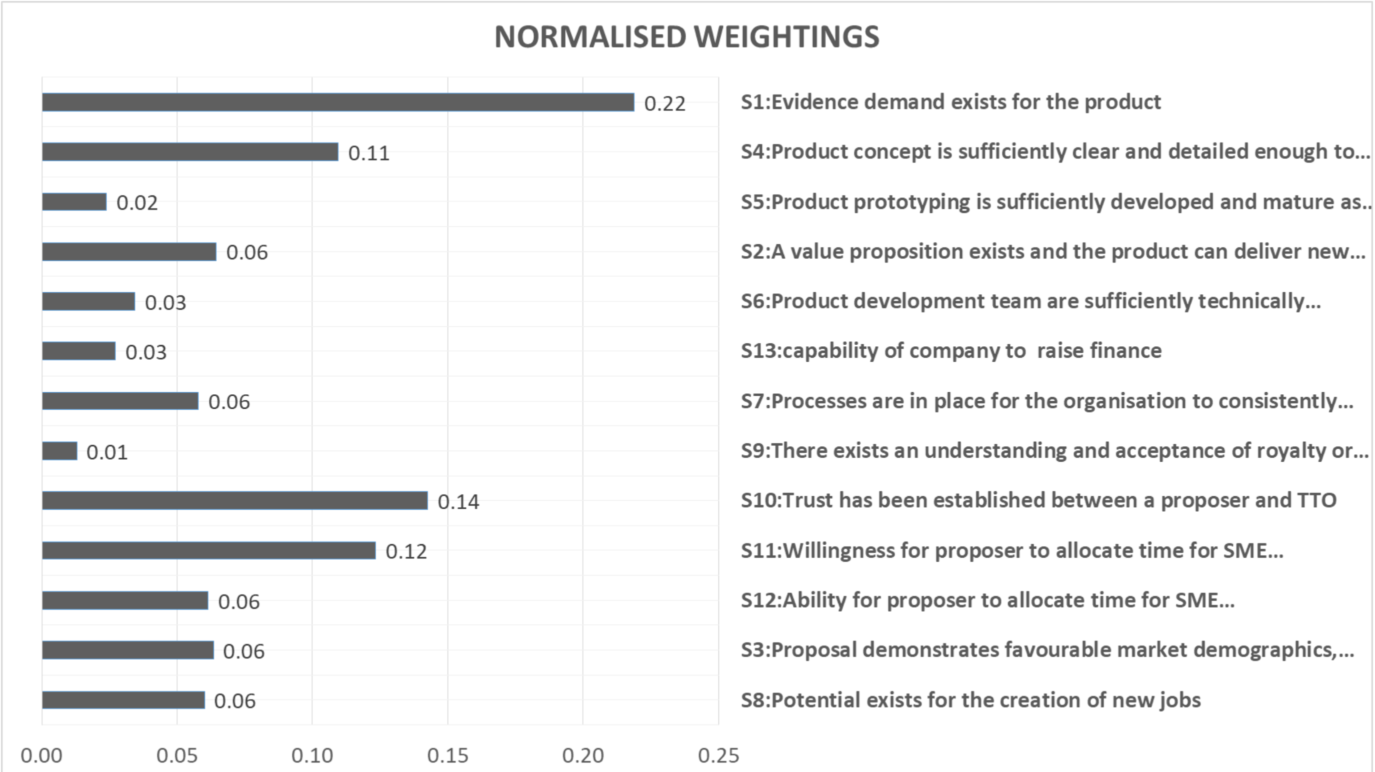

Figure 5: Weightings of Selection Criteria from AHP Pairwise Comparison analysis

The diagram in Fig. 6 illustrates the relative ranking of criteria S1-S12 but now grouped in terms of Day's REAL, WIN, WORTH categories.

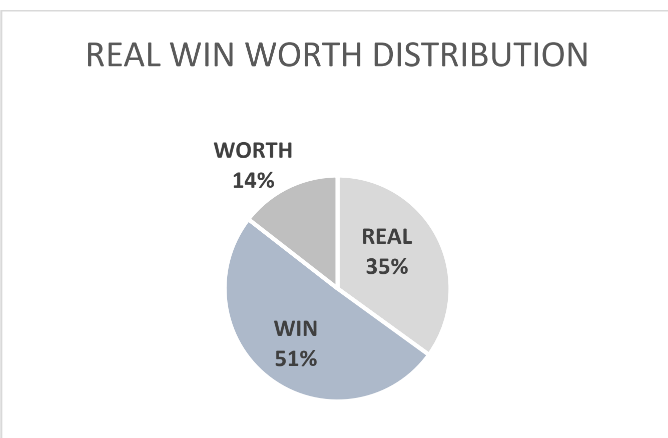

Figure 6: Weightings of Selection Criteria grouped by Day's Real, Win and Worth categories

DISCUSSION

The results of the ISM and PCM processing highlight a number of key insights to the factor relationships. The selection of a dual approach to the application and processing of the interpretive methodologies essentially offers a unique perspective and deeper analysis of accelerator A's factor interdependencies.

The digraph in Fig. 4 highlights the significance and independence of the factor S6) *Product development team are sufficiently technically competent.* This factor's position within the model and MICMAC diagram signifies the high levels of driving power and therefore, influence on other factors in the model and its minimal reliance on any interconnected factors. This finding infers that TTOs view this factor as a key consideration for decision making and that the presence of technical competency within the proposer team is likely to be a fundamental initial gate prerequisite for further decision making. However, surprisingly the PCM analysis figure of 0.03 (a relatively low ranking score) does not seem to support the importance of this factor amongst the TTOs. Subsequent analysis via the inconsistency interviews, identified that in reality, as this decision gate is at TRL3 [69], the TTOs view the proposal from the perspective of inherent prima facie evidence of technical competence via the proof of principle. The net effect of this is that the factor S6) *Product development team are sufficiently technically competent*, although a critical underpinning factor, is a 'given' at this stage in the process. The judgment at this first contact focusses on proposer attributes such as: S11) *willingness for proposer to commit time for commercialisation* and S7) *Processes are in place for the organisation to consistently listen and respond to customer demands,* assuming that the proposer exhibits sufficient technical competence to reach this key stage in the process.

The factor: S8) *Potential exists for the creation of new jobs* is ranked at the mid-range within the PCM analysis and is positioned within the dependent quadrant of the MICMAC diagram as this factor exhibits low levels of driving power and is categorized as a highly dependent factor. This factor tends to be viewed as a core element of any application but is not a key decision-making consideration for TTOs in isolation to other factors.

The top ranking of the factor: S1) *Evidence of demand exists for the product*, reflects the 'opportunity identification' approach that is adopted by the accelerator team. This is supported within the ISM analysis where the factor is rated at 11 out of 12 for driving power, denoting its key influence over other factors in the model. The impact and potential influence of EU structural fund KPIs – particularly KPI7 and KPI8 (new products/process new to company and market) is implied by the high ranking within both methods.

The factors S10) *Trust has been established between a proposer and TTO,* S11) *Willingness for proposer to allocate time for SME commercialisation*, are ranked second and third highest. Both factors appear within the top level of the digraph denoting their high dependence rating within the model and reliance on other interconnected factors. As observed by Marvel et al [24] and Marion et al [70], evidence of willingness to undertake tasks outside of the narrow technical field of expertise (multi-functionality), is a key characteristic of the more successful innovative start-ups. This observation is consistent with Day's [37] analysis of case studies where market success or failure can be attributed to whether a company's activity on 'technology push' is allowed to cloud judgments on market opportunity and customer demographics. The high ranking of S10) *Trust has been established between a proposer and TTO* is supported by Maxwell et al [71], where the study noted that although precise characteristics of the entrepreneur are often difficult to determine objectively or rank in importance, passion, integrity and trustworthiness are key decision criteria for early stage investment.

The factor: S9) *There exists an understanding and acceptance of royalty or equity share arrangements* is located within tier 2 on the digraph exhibiting a relatively high driving power of 10 but the factor is ranked very low within the PCM model, the lowest of all factors. This somewhat surprising finding seems to indicate that although this OpenIP principle is mandatory for state aid compliance, it is of low importance. The subsequent inconsistency interviews highlighted the use of this factor as an initial early gate decision criterion where the application would not progress further if this was not agreed. The net effect of this aspect of the process is that TTOs treat this factor as a "given" if the application progresses beyond the initial gate. Hence, the TTOs implicitly are prioritizing other key WIN attributes as the criticality of this factor is significantly reduced at TRL2 and beyond.

The factor S2) *A value proposition exists and the product can deliver new benefits,* exhibits near maximum driving power within the ISM model yet is ranked at a mid-level position within the PCM results. This factor is associated with KPI1 (Number of Patents Registered for Products). Subsequent discussion via the inconsistency interviews reveals that TTO acceptance at first disclosure stage was not predicated on necessarily identifying a patent opportunity and other forms of IP protection were considered, especially for incremental product development.

The factor S13) *Capability of company to raise finance,* has the third lowest ranking and this observation supports Yin and Luo's assertion (corresponding to their factor Q30) that this criterion is less relevant at the initial screening stage.

The consistency exercise entailed a review with the participant TTO team to evaluate inconsistencies from the initial scoring. Table 10 indicates the final judgment values following this review and generates a Consistency Ratio (CR) of 21% using the fundamental AHP linear scale. This reflects the significant cognitive load imposed on the TTO team when presented with a relatively large number of selection criteria. Both the ISM and PCM analyses are consistent in highlighting the dominance of many of the REAL and WIN criteria over strategic WORTH criteria at the first disclosure stage. This result supports the conclusions set out in Yin & Luo [11]. The inconsistency interviews with the TTOs reveal that proposals rejected at first disclosure were often based on reason to reject in the absence of a set of objective measures. This finding is consistent with Yin and Luo's cautious conclusion for initial phase decision-making. The wide diversity of proposals presented to the accelerator highlight the significant challenges and potential inconsistencies related to subjective decision-making within the process and alignment with an implied rejection approach as referenced within Shafir [72].

The EU funding body has very clear strategic objectives and associated KPIs for stimulating and sustaining regional economic growth articulated in the Economic Prioritization Framework [73]. The clear emphasis on the Real and Win criteria within accelerator A indicate that TTO decision-making at first disclosure reflects the longer timescales associated with proposals accepted for progression from typically TRL3 (experimental proof of concept) to TRL8 (system complete and qualified) . Consequently, the funding body's KPI3: 'jobs created' does not dominate the decision-making process. This is significant and an encouraging observation for an EU program, funded by fixed-term grant support in a region where KT programs are often tempted to allocate funds for proposals that create ostensibly 'new' jobs, which might satisfy the funder's duration criterion of 12 months minimum employment, but do not necessarily form the basis for long term regional economic growth.

The case study of accelerator A provides a framework that seeks to address two factors that researchers might otherwise interpret as inhibiting entrepreneurial action [27]:

- Mitigation and reduction of uncertainty regarding the commercial potential
- Providing a business support environment that motivates and encourages entrepreneurs

The research questions posed at the beginning of this study, namely the identification of the key interdependencies and ranking elements relating to the 12 factors, have been identified and discussed, highlighting the key influence of key elements of the REAL, WIN, WORTH factors within each of the models. Inconsistency interviews with the TTOs has revealed the funder's KPIs, although not an explicit element of many of the decision criteria, were a key integral element of the early stage decision process, particularly the KPIs that were contained in the REAL and WIN categories.

CONCLUSIONS

This study has investigated the decision-making process within in an established Technology Transfer Office for a program funded by EU structural funds with imposed KPIs. This research has considered the interplay between these KPIs and a range of objective selection criteria identified from established TTO decision making criteria and a literature review of best practice. Through the inconsistency interviews used to analyze the many underlying complexities inherent within the decision making underlying process, TTO opinions on the relative importance of the selection criteria based on Day's Real-Win-Worth taxonomy [37], reveal that the TTOs generally exercised judgments at first disclosure stage consistent with Yin and Luo's [11] observations. To the authors' knowledge, this is the first study to apply an interpretive methodological approach to critically analyze and objectively map the decision-making process within an accelerator TTO office, where the subjective process is influenced by the complex interplay between these KPIs and the broader range of criteria identified through international best-practice. The analysis provides confidence that the methodology used can add to the understanding and the developing theory of the cognitive processes involved at early stage evaluation within an Open IP Accelerator programme.

A number of factors were eliminated through initial filtering discussions with the expert panel. For example, the TTOs were clear that, at initial disclosure, they do not take into account prior commercial experience of the proposer or their family. Selection criteria are likely to change as the proposal progresses at each stage of the Accelerator selection process [71][11].

The study is somewhat limited by the use of a pairwise list of 12 factors and that this could be viewed as relatively high for an AHP exercise. The corresponding high cognitive load was mitigated to some extent by re-interviewing the TTO team to review any apparent inconsistencies. Future work could introduce a set of criteria with weightings appropriate to each stage of assessment. This approach could potentially introduce a management framework to assist in more consistent decision-making at each stage and to review the efficacy of any predictive framework within a longitudinal study. Future research is also advocated to apply the analysis and interpretive approach from this study, to varying TTO scenarios with a less structured set of KPIs that form the basis of a "lived-in" set of decision criteria.

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