Vlaams Indicatorenboek 2019

Wetenschap – Technologie – Innovatie

Overzicht van de gemaakte selectie

Het Vlaams Indicatorenboek bevat een portfolio aan beleidsindicatoren die de ontwikkeling van het Vlaams potentieel inzake wetenschap, technologie en innovatie in kaart brengen.

Sinds 1999 wordt het boek om de twee jaar uitgegeven en vanaf 2017 wordt het Indicatorenboek een virtueel boek met een eigen website: http://vlaamsindicatorenboek.be. Het boek dat u nu in handen hebt is een selectie van hoofdstukken uit dit boek. Voor de volledige versie verwijzen we u graag naar de website.

Onderstaande delen werden geselecteerd:

De website van het Indicatorenboek biedt u ook de mogelijkheid om een eigen selectie samen te stellen van hoofdstukken die voor u relevant zijn. Surf hiervoor naar: http://vlaamsindicatorenboek.be/selectie.

Wij wensen u alvast een informatieve zoektocht door het Vlaamse innovatielandschap!

Dankwoord

Wetenschap, technologie en innovatie zijn onmiskenbaar essentiële hefbomen tot welvaart en welzijn in onze maatschappij. De Vlaamse overheid heeft daarom veelvuldig en veelzijdig aandacht besteed aan de ontwikkeling van de kwaliteit en de slagkracht van het Vlaamse Wetenschaps-, Technologie- en Innovatiesysteem. Het brede spectrum van wetenschappelijk en technologisch onderzoek aan de Vlaamse kennisinstellingen is daarbij vervolledigd met maatregelen en instrumenten om het innovatievermogen van de in Vlaanderen opererende ondernemingen te verhogen, en daarbij ook de kleine en middelgrote ondernemingen steeds meer, gerichte innovatiekansen te bieden.

Het is dan ook nuttig en wenselijk om het geheel aan acties, en hun meetbare resultaten, in een coherent, regelmatig te verschijnen Indicatorenboek te bundelen. Het vernieuwde Vlaams Indicatorenboek Wetenschap, Technologie en Innovatie, dat de tijdsreeksen uit de vorige Indicatorenboeken actualiseert en uitbreidt, draagt daartoe bij. Zo is het mogelijk een robuust en internationaal vergelijkbaar overzicht te geven van de situatie in Vlaanderen op het vlak van de bestedingen voor en de resultaten van onderzoek, ontwikkeling en innovatie.

Het Indicatorenboek 2019 houdt ook een belangrijke vernieuwing in ten opzichte van de vorige versies. Vanaf nu wordt het Indicatorenboek immers uitsluitend in een interactieve bevragingsmode elektronisch aangeboden.

Uiteraard bouwt dergelijk Indicatorenboek op de inspanningen van veel enthousiaste medewerkers. De redactie en het schrijven van dit boek kwamen dan ook tot stand onder impuls van een redactiegroep van experts behorend tot de verschillende beleidsactoren uit het Vlaams Innovatiesysteem, die de staf van het Expertisecentrum O&O-monitoring (ECOOM) van de Vlaamse overheid bijstonden in de opdracht dit Indicatorenboek te ontwikkelen. Elk van hen droeg bij tot de conceptie van dit werk. We willen hen dan ook van harte danken voor de constructieve samenwerking om onder de gebruikelijke tijdsdruk dit document af te werken:

- *De Heer Eric Sleeckx van het Kabinet van de Vlaamse Minister voor Economie, Wetenschap en Innovatie en tevens voorzitter van het Beheersorgaan van het Expertisecentrum O&O-Monitoring,*
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- *het ganse ECOOM-Leuven team dat de realisatie van deze digitale versie in goede banen heeft geleid, die samen de nodige expert-inzichten en inbreng geleverd hebben bij het tot stand komen van de Vlaamse O&O gegevens.*

Daarnaast danken we tevens van harte alle auteurs die op basis van de inbreng van de redactiegroep, de verschillende hoofdstukken en dossiers hebben uitgewerkt, geschreven en gedocumenteerd met relevant en betrouwbaar cijfermateriaal.

Zonder hun gezamenlijke inspanning was dit negende Indicatorenboek nooit tot stand kunnen komen!

Van harte dank!

Prof. Koenraad Debackere en Prof. Reinhilde Veugelers
Redacteurs Vlaams Indicatorenboek Wetenschap, Technologie en Innovatie
Leuven, september 2019

Woord van de ministers

Bij het schrijven van dit voorwoord loopt deze legislatuur op haar laatste benen.

Tijdens deze legislatuur hebben we consequent onze inspanningen op het vlak van hoger onderwijs, onderzoek en innovatie verhoogd. De middelen voor het wetenschaps- en innovatiebeleid werden dit jaar nogmaals verhoogd met 280 miljoen en stegen hierdoor in 2019 tot ruim 3,6 miljard euro. Met een verhoging van de middelen met 500 miljoen, mogen we dan ook stellen dat we de ambities van het regeerakkoord "Vertrouwen, verbinden, vooruitgaan" 2014-2019 op het vlak van onderzoek en innovatie hebben gerealiseerd.

Ook het halen van de 3% norm zit in de laatste rechte lijn. Sinds 2006 stegen we van 1.91% naar 2,89% in 2017. De bestedingen van bedrijven en overheid voor O&I gaan standvastig in de goede richting. De bedrijven overschreden zelfs ruim de 2% met hun investeringen in O&O.

Tijdens deze legislatuur vonden er in het O&I-landschap grote veranderingen plaats. Innoveren werd geïnnoveerd. De strategische onderzoekscentra imec en iMinds fuseerden, ook de andere SOCs kregen een nieuwe beheersovereenkomst met meer aandacht voor samenwerking en valorisatie. We versterkten de onderzoekscapaciteit van de hogescholen met meer middelen voor PWO en gaven een extra investeringsimpuls. We erkenden ook het belang van de hogescholen als belangrijke kennismakelaars.

Excellentie werd de norm bij de hervormingen van de FWO-instrumenten. We zorgden ervoor dat onze onderzoekers een beroep konden doen op top onderzoeksinfrastructuur.

Het ééngemaakte agentschap innoveren en ondernemen plaatste de businesscase van de bedrijven centraal, om hen nog beter en efficiënter te ondersteunen. Het clusterprogramma werd uitgerold. We zagen de voorbije jaren dat de speerpuntclusters hun positie in het innovatielandschap innamen.

Naar het einde van deze legislatuur werden nog enkele belangrijke beleidsagenda's gelanceerd t.a.v. kennisinstellingen en bedrijven. Vlaanderen zal zo zijn rol kunnen spelen in domeinen zoals Artificiële Intelligentie, Cybersecurity, Gepersonaliseerde Geneeskunde, …

Vlaanderen heeft meer wetenschappers en technologisch geschoolde mensen nodig om in te kunnen spelen op de noden van onze ondernemingen. Ook hier timmerden we aan de weg verder. Deze legislatuur stond STEM permanent in de aandacht, met verhoging van middelen en structurele ingrepen in het secundair onderwijs. De uitrol van de Vlaamse burgerwetenschapsoproepen was bijzonder succesvol. Ook Technopolis kreeg middelen om zich grondig te innoveren.

Kortom de aangekondigde hervormingen van het O&I-landschap worden stelselmatig uitgevoerd en werpen hun vruchten af.

Ondanks deze positieve evolutie blijft het noodzakelijk om het geheel aan acties en hun meetbare resultaten nauwgezet op te volgen.

Dit negende Vlaams Indicatorenboek Wetenschap, Technologie en Innovatie fungeert als referentie.

Het voorliggende werk geeft een robuust en internationaal vergelijkbaar overzicht van de situatie in Vlaanderen op het vlak van de bestedingen voor en de resultaten van hoger onderwijs, onderzoek, ontwikkeling en innovatie.
Het Vlaams Indicatorenboek is dan ook een belangrijk werkinstrument dat de vinger aan de pols houdt van ons W&I-systeem.

Wij drukken onze waardering uit voor dit indrukkende werkstuk dat onder impuls van ECOOM en met medewerking van vele auteurs tot stand kwam.

Wij wensen u als geïnteresseerde lezer veel leesplezier.

Philippe Muyters
Vlaams minister voor Werk, Economie, Innovatie en Sport

Hilde Crevits
Viceminister-president van de Vlaamse Regering, Vlaams minister van Onderwijs

Volledige inhoudsopgave

7Dossiers

In addition to the recurrent chapters, each edition of the Flemish Indicator Book also offers a number of specific dossiers that provide a summary of relevant figures and recent research into relevant themes. In this edition there are six different files that deal with very different topics.

7.1Scientometrics 2.0 – and beyond? Background, promises, challenges, limitations and recent developments

By Wolfgang Glänzel and Pei-Shan Chi (KU Leuven)

Open science, open access as one of its important platform and instrument and altmetrics (i.e., alternative metrics), as its possible assessment tool, have gained huge importance since their emergence during the last decade. Priem and Hemminger (2010) have outlined this new concept, compiled a comprehensive list of relevant services and provided a critical look at uses, limitations and future challenges. In their article they also heralded the emergence of a new paradigmatic "Scientometrics 2.0" model. The expectations of the new metrics are enormous and so is the enthusiasm for their use. Unfortunately, their use is, at present, even less critical (and sometimes careless) than it was about three decades before in the case of the emergence of their predecessor metrics. Bibliometricians have already raised their voice (e.g., Wouters and Costas, 2012; Gumpenberger et al., 2016) to admonish of latent and real challenges and dangers in the use of the new metrics. Before we give a short summary of the recent discussion, we briefly review the development from scientometrics till its recent opening towards a possible broader discipline called 'scientometrics 2.0'.

7.1.1Scientometrics 1.x – A historical sketch

From the historical viewpoint, scientometrics expresses the development of methods, indicators (metrics) for monitoring and measuring quantitative aspects of *scholarly communication*. It was originally developed for application to the basic sciences, first within the framework of scientific information. With time elapsing, the increasing demand for indicators in research evaluation resulted in a '*perspective shift*' (Glänzel, 2006). The main field of application of the metrics was now laid in evaluation and assessment of scientific research. As the first consequence of this shift, both scientometricians and users were faced with a change in application contexts and interpretation of indicators. Indicators became gradually used in contexts for which they never were designed (cf. Journal Impact Factors) and measures of scholars' communication patterns (cf. author self-citations) were, in the light of the new focus, re-interpreted. Inevitably, first limitations became apparent, uninformed use occurred and earned the attention of both researchers and users. – This was the era of scientometrics 1.0.

Following the pioneering days of the field and its coming of age, a new challenge was issued to the meanwhile established discipline: the necessary extension towards applied sciences, and later on also to the social sciences and humanities (SSH) and technology. The extension of data sources and partially broadening the scope of scientometrics resulted in what can be considered Scientometrics 1.x versions. It has two main characteristics: on one hand the already mentioned "perspective shift" and the trend to the applications to lower levels of aggregation, away from the macro level down to the meso level and increasingly to the evaluation of individual scientists (challenges of individual-level bibliometrics – cf. Wouters et al., 2013). In short, the changes are not only shown in the shift of different targeted samples but also in the scale of scientometric analyses.

The advanced features of Scientometrics 1.x and the challenges from them involve in several issues. The opening and inclusion of new data sources has become an essential prerequisite to meet these challenges. New data sources including proceedings, books, national sources and the web became integrated in the traditional foundation of bibliometrics. Hence also data-related issues arose, including big-data related issues, such as data cleaning, name disambiguation and coping with redundancies. Other issues arising from this broadening the scope of scientometrics were of more conceptual and methodological nature as being closely related to specific cultures in scholarly communication of various fields, notably in the applied, social sciences and the humanities, but also meso- and micro-level specific issues like individual co-authorship, gender, publication in an Open Access (OA) require new qualities of data processing and a higher granularity of information.

Beyond doubt, the traditional scientometric 1.x model had undeniable *strengths*. First, as to data sources it was based on a dynamic but closed universe: unique, mostly multidisciplinary bibliographic databases such as The ISI Science Citation Index, later on, its successor, Thomson Reuters Web of Science, or Elsevier's Scopus. This offered a great potential for standardisation and integration of indicators, which, in turn, facilitates comparability of scientometric result. Since it was restricted to the measurement of *scholarly communication*, it furthermore provides clear definitions of actors, impact and the users of information within this framework (i.e., scholars themselves) and this facilitates the interpretation of scientometric results. Third, because of the general availability of the mostly proprietary data products it shows high level of reproducibility and documentability. Fourth, it proved to work at any level of aggregation and useful in combination with peer review system also at lower levels of aggregation. Finally, mathematical-statistical models for a variety of processes (publication activity, citation impact, co-authorship, citation-based networks, literature growth and evolution, etc.) could successfully be applied to the empirical results.

The other side of the coin are the *limitations* of the scientometrics 1.x model that should not be ignored. Various opportunities and limitations have been discussed among others by Glänzel and Debackere (2003). Most of those are of methodological or technical nature and concern the use and application of results and indicators. Apart from these, perhaps the most general and conceptual limitation is due to the focus on scholarly communication. However, web-based data sources go, at least in part, already beyond this framework (cf. Google Scholar, web[o]metrics). As an example, shown in a small-scale study, Hoffmann et al. (2014) observed no correlation of online communication activity with any of the more established impact measures.

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7.1.2Scientometrics 2.0 – Promises, challenges and limitations

Recently, the conception of Scientometrics 2.0 was proposed to embrace a big step towards the measurement of societal impact and "broader impacts" of research and to cover "open science" – 'social media metrics' or 'alternative metrics' as groundwork and components for a "Scientometrics 2.0" (Priem and Hemminger, 2010). As possible sources Priem and Hemminger recommended to include bookmarking, reference managers, recommendation systems, comments on articles, microblogging, Wikipedia, blogging, and other sources such as social networks, video, and open data repositories. In the recently launched Handbook of Science and Technology Indicators (Glänzel et al., 2019) we see social media metrics, book reviews, scholarly twitter metrics, readership, web citation indicators and online indicators were all considered and introduced as new indicators for reseach assessment in the context of Scientometrics 2.0.

Promises

One of the most important promises is, of course, to overcome a number of limitations of the scientometrics 1.x model, above all, the restriction to the measurement of scholarly communication and impact. Within this broader scope of new version of Scientometrics 2.0, in general, and altmetrics, in particular, a number of important features and promises have been addressed. Thus Sugimoto (2016) pointed to the increasing demand for showing impact of research beyond academia, and democratising the impact by giving greater voice and vote, e.g., to underrepresented groups (gender, ethnicity, disability, geographic etc.) in determining impact. The other main promise of Scientometrics 2.0 is from social networks. Network-based approaches based on social media data may also contribute to a more diversified system of scientific impact assessment by adding a relational and social capital-based perspective (Hoffman et al., 2014). In particular, Wouters et al. (2019) provided three basic examples of this kind of network-based application analyzing the relationships and interactions among different actors: communities of attention, hashtag coupling analysis, and reader pattern analysis.

Challenges and limitations

The promises are contrasted by a number of challenges and limitations have been summarised by Wouters and Costas (2012), Sugimoto (2016), Gumpenberger et al. (2016) and Kousha (2019), including:

- Analyses are usually conducted at the individual (micro) level and most benefits of Scientometrics 2.0 are at the micro level. However, the aggregation at higher levels is questionable, so that the validity, reliability and feasibility of the large scale studies are one of the main challenges.
- A number of assumptions are not yet validated and tested but the high dynamics and rapid development of online and electronic communications (Web 2.0 – and beyond?) would increase the difficulties for altmetrics to keep pace with this development once validated and implemented.
- More transparency and clarity in the data covered is needed. There is not yet any clear definition of actors on both sides. Thus, if we talk about impact – impact upon whom is meant? And what are the potential biases in terms of actor and user profiles? Without clarification the standardization and normalization of measures is hardly conceivable.
- Data quality: Automated processes produce errors and influence social media metrics. Web search also needs to tackle false matches and duplicate results for a better data quality.
- In contrast to the previous scientometrics model, altmetrics still lacks mathematical background and proper models, which impedes the clear interpretation of indicators. Issues caused by composite indicators and the arbitrariness of their construction make their interpretation and comparability even more difficult. One of the goals of the altmetrics movement was to overcome the flaws of the traditional citation-based indicators but instead new 'all-in-one' indicators are created ("old habits die hard").

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7.1.3Altmetrics in practice

Abraham Bookstein (1997) characterised the three most essential demons to informetrics distribution measurement in social sciences as *randomness*, *fuzziness* and *ambiguity* already in the context of scientometrics and more generally of information science. All the three demons may serve even more crucial roles in altmetrics model than in traditional informetrics. Reflecting to the above-mentioned limitations, the downloads, mentions, likes, tweeds counting and other social-media related measures without knowing the real purpose behind these actions certainly cannot provide unequivocally interpretable (quantitative) evidence. Even though most of the previous studies have found some degree of correlation between altmetrics and traditional citations indicators and considered the new metrics as complementary sources providing different points of view (Costas, Zahedi & Wouters, 2014; Gorraiz et al., 2018), the altmetric indicators in their present design and availability so far do not provide comprehensive solution nor alternative to the consistent scientometric systems. In our previous papers (e.g., Chi et al., 2018; Chi & Glänzel, 2019; Glänzel & Chi, 2019) we have found some lack of consistency of the currently used altmetric metrics to measure the broader impact of research. The use of the new metrics still falls short of the enormous expectations. Given the enormous sensitivity to (the coverage of) data sources, the possible manipulability and the lacking interpretability of metrics, the applicability of altmetrics in an evaluative context and most notably to benchmarking exercises remains still questionable. For example, removing from or including the SciELO database to the data sources resulted in dramatic changes and showed that this effect may turn local or regional effects into global phenomena (cf. Glänzel & Chi 2019).

Despite these observed effects, we agree that some of these new metrics may already provide useful information based on the feedback of broader groups of users that could supplement the traditional bibliometric indicators. Several alternative metrics have shown their potential for measuring important aspects beyond scholarly communication, Thelwall (2018) has shown the usefulness of Mendeley readership as early impact indicator, but he also pointed to limitations for their use in research evaluation (Thelwall, 2017a,b). The goal set for the enthusiastic purposes to extend the broader impact of research will lead Scientometrics 2.0 to better standardised, normalised and interpretable metrics. To conclude, we refer to van Noorden's (2014, p. 129) statement: "Some analysts argue that despite their millions of users, massive social academic networking sites have not yet proven their essential worth." What the future will bring for scientometrics 2.0 thus remains to be seen.

Acknowledgement

This dossier is an extended and updated version of a note published in the ISSI Newsletter (Glänzel and Chi, 2016).

- Chapter 7.1.2
- 7.1.4 References

7.1.4References

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7.2High-growth innovative firms with impact

By Elie Ratinckx and Danielle Raspoet (Flemish Advisory Council for Innovation & Enterprise, VARIO[1])

High-growth innovative enterprises play an important role in the economic cycle of value creation and the upscaling of innovations. High-growth firms are also an important policy issue. Most jobs are created by a limited number of fast-growing firms, while employment remains stable for most companies. High-growth firms are usually (but not always) young, not necessarily small, not more common in hi-tech industries... In its advisory report[2] '*High-growth innovative firms with impact*', VARIO (2018) proposed an *integral strategy to increase the number of successful high-growth innovative firms in Flanders, focusing on four closely interwoven policy goals*:

1. *Increasing the number of ambitious entrepreneurs*
2. *Developing effective high-growth entrepreneurial ecosystems*
3. *Creating favorable framework conditions*
4. *Strengthening evaluation and monitoring instruments*

The roll-out of this strategy requires an innovative, holistic policy approach, away from silos and based on an intricate insight into the internal functioning of high-growth entrepreneurial ecosystems, in close cooperation with a variety of stakeholders.

[1] The Flemish Advisory Council for Innovation and Enterprise (Vlaamse Adviesraad voor Innoveren en Ondernemen or VARIO) advises the Flemish Government and the Flemish Parliament on its science, technology, innovation, industry and entrepreneurship policy. VARIO works independently from the Flemish Government and the Flemish stakeholders in the field of science, innovation, industry and enterprise. https://www.vario.be/en

[2] VARIO (2018). High-growth innovative firms with impact. Advisory report 4. https://www.vario.be/nl/node/1302

7.2.1Stimulating high-growth innovative firms

Towards 2050, Flanders[1] aims to excel as an innovative knowledge society. In 2017, 2,89% of its GDP was invested in Research & Development. With this percentage Flanders far exceeds 1,96%, the average of the 28 European member states (*3% nota*[2], 2019). However, the available knowledge and expertise should also lead to innovative output and the upscaling of innovations (Vision 2050[3]). High-growth innovative firms play an important role in this.

Stimulating high-growth innovative firms is a point of concern, according to the RIO Country Report Belgium 2016. High-growth firms are also an important policy issue. Most jobs are created by a limited number of high-growth firms, while employment remains stable for the majority of the firms.[4] High-growth innovative firms are also crucial for vibrant and dynamic economies; they are usually (but not always) young (Figure 1), not necessarily small, not more common in hi-tech industries...[5]

The ambition for the Flemish region must be to generate as much added value as possible, through innovation across all economic and societal domains. High-growth innovative firms and the entrepreneurial ecosystems in which they thrive, play a crucial role. In an entrepreneurial ecosystem, the complex ensemble and the strengths of the interconnections are important, rather than the individual components as such. A global, healthy high-growth entrepreneurial ecosystem with strong links leads to a higher number of fast-growing companies (as the output of the ecosystem). The focus of the advice is both on young (+/- <10 years) and more mature (> 10 years) high-growth innovative firms.

[1] Dutch speaking northern region in Belgium
[2] https://www.ecoom.be/assets/194
[3] This is the long-term strategy or vision of the Flemish government towards 2050. https://www.vlaanderen.be/vlaamse-regering/visie-2050
[4] Autio, E. (2016). Entrepreneurship Support in Europe: Trends and Challenges for EU Policy. 10.13140/RG.2.1.1857.1762
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[5] See also Autio, 2016, page 6

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7.2.2VARIO proposed an integral strategy

A small, centrally located region as Flanders with innovative companies and top knowledge institutions in near proximity, is unique in any case, and an important asset for further developing entrepreneurial ecosystems. High performance cross-border ecosystems are the breeding ground par excellence, in which young and more mature high-growth innovative firms can (continue to) grow, turning themselves into international, world-class players.

VARIO proposes an integral strategy (Figure 2) to increase the number of successful high-growth innovative enterprises in Flanders. The strategy focuses on four closely interwoven policy goals:

1. *Increasing the number of ambitious entrepreneurs*
2. *Developing effective entrepreneurial ecosystems*
3. *Creating favorable framework conditions*
4. *Strengthening evaluation and monitoring tools*

VARIO emphasizes that the elements in the strategy are strongly interwoven and influence each other. When some elements in the system do not function properly, this can hamper appropriate functioning of the entire system. Due to the complexity this requires an innovative, holistic policy approach, away from silos, and based on a detailed understanding of the internal dynamics of entrepreneurial ecosystems, in close collaboration with a variety of stakeholders.

Figure 2: Integral strategy to optimize the number of successful high-growth innovative firms

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7.2.3Four broad recommendations with ten more tangible policy actions

The advice of VARIO consists of four broad recommendations with ten more tangible policy actions. The advice was supported by a thorough quantitative and qualitative analysis and realized after extensive consultation of high-growth innovative entrepreneurs and the professional field in Flanders.

RECOMMENDATION 1: Develop an integral, long- and short-term strategy to increase the number of ambitious (serial) entrepreneurs in Flanders

- *Action 1:* Implement a long-term strategy to get more Flemish people attracted by ambitious entrepreneurship. An integral policy framework is needed based on a chain approach, from primary education to higher education towards the labor market. Universities and their Technology Transfer Offices, university colleges… have yet to experiment with hands-on entrepreneurship education. This must be done in an evidence-based way and based on (international) good practices that have proven their impact.
- *Action 2:* For the short-term, implement a targeted, strategic immigration policy to attract ambitious entrepreneurs from abroad, for instance based on startup or scale-up visa. VARIO refers to its first advice '*Attracting and retaining top international talent*' (2017)[1].

RECOMMENDATION 2: Focus on strong high-growth entrepreneurial ecosystems based on a patient, long-term horizon. Committing to entrepreneurial ecosystems offers the advantage that they are more difficult to disrupt than a single company: moving or transferring (professional) networks is extremely difficult to achieve

- *Action 3:* Develop a coherent and coordinated strategy for each of five growth accelerators within the ecosystem, for a diversity of young and more mature high-growth innovative firms:
    1. The availability of (international) talent (in STEM, business development, in regulatory affairs…) should be a top priority for boosting high-growth innovative firms. VARIO refers to his advice '*Attracting and retaining top international talent*'.
    2. Improve leadership capacity by introducing excellent, science-based MBA programs for growth managers. These programs should consider the different growth phases of enterprises and the growing pains linked to them. Additionally, encourage self-learning peer-to-peer networks.
    3. Flanders Investment & Trade (FIT[2]) has an important, proactive role to play in guiding high-growth innovative companies to conquer international markets. FIT could be more actively involved in setting up foreign branch offices (administration, hiring staff, forming communities among clusters of Flemish companies abroad…).
    4. A more active involvement of PMV[3] is important for financing high-growth. PMV needs to detect and remedy existing thresholds in the (interactions between) demand (from companies) and supply factors (from capital providers). As a matchmaker in the ecosystem, PMV should continue to focus on stimulating high-quality networks between investors, researchers, ambitious entrepreneurs…
    5. Build flexible (digital) infrastructures and an environment that facilitates collaboration between stakeholders in the ecosystem. VARIO refers to two acknowledged good practices from the United Kingdom: Engine Shed[4] (Bristol) and Canary Wharf[5] (Level39, London).
- *Action 4:* Provide specific professional coaching of a select group of young high-growth innovative firms towards a more efficient scale. Business accelerator programs should be structurally embedded in entrepreneurial ecosystems. Additionally, VARIO advocates the further development of high-performing and professional Technology Transfer Offices with necessary management autonomy, operational strength and critical mass. Ideally, Technology Transfer Offices consist of large teams with complementary skills that bridge the gap between science, technology and industry. Here, flipped TTOs[6] are worth mentioning: ambitious entrepreneurs are playing a more central role here, cooperating with academic researchers from a demand-driven perspective, originating from the market and from societal needs.
- *Action 5:* An entrepreneurial ecosystem stands or falls with the strength of its internal connections. In an ecosystem, all partners are equal, and coordination must come from bottom up. A neutral, independent organization should facilitate, together with private, structural partners and stakeholders. This facilitator is well acquainted with, and has knowledge of, the internal functioning of the entire ecosystem. VLAIO's Team Bedrijfstrajecten[7] can take on this role, with PMV's active involvement in growth financing and FIT in international markets. Essential tasks are:
    1. Detecting and remedying bottlenecks
    2. Actively engaging and identifying stakeholders with the entire ecosystem aiming for internal cohesion (i.e. matchmaking)
    3. Improving international visibility and the image of Flemish entrepreneurial ecosystems. Quality labels such as French Tech[8] can play a role in both internal cohesion and international visibility.

RECOMMENDATION 3: Develop general stimulating framework conditions for ambitious entrepreneurs

- *Action 6:* Increase the quality of a broad spectrum of institutional factors - regulations, the tax system, government effectiveness - for high-growth innovative firms. VARIO asks the Flemish government to make this a priority in the domains for which it is competent (e.g. an efficient licensing policy, stable regulation, administrative simplification, digitization…) and to start the dialogue with the federal, Belgian government for the other policy areas (labor market regulation, bankruptcy legislation…).
- *Action 7:* Further develop a creative economy based on an open and tolerant climate, increasing people's mobility and creating a smooth interplay of ideas. Focus on legislation, taxation and/or KPIs that stimulate intersectoral mobility and connectivity between companies and knowledge institutes. Additionally, priority should be given to (tax) incentives for stimulating serial entrepreneurship (together with its financial dynamics).

RECOMMENDATION 4: Strengthen monitoring tools and introduce policy interventions based on careful evaluation procedures

- *Action 8:* To monitor the strategy's ambition, the impact of high-growth innovative firms on GDP should be determined, also in function of economic sectors and/or entrepreneurial ecosystems. Secondly, the evolution of bottlenecks, such as access to talent, problems with regulations… should be monitored. To this end, the monitoring and/or statistical mechanisms in Flanders should be strengthened, for instance by analyzing existing data such as from the R&D[9]- and CIS[10]-surveys.
- *Action 9:* Make use of policy experiments when introducing new policy interventions such as business accelerator programs. Carry out

careful assessments of their impact and make adaptations if necessary.

- *Action 10:* VARIO points out that not only young but also older companies are represented in the population of high-growth firms (Figure 1, see above). VARIO calls attention to this diversity and asks for more research into the drivers of high-growth among the more mature firms.

[1] VARIO (2017). Attracting and retaining top international talent. Advisory report 1. https://www.vario.be/en/publications/advisory-report-1-attracting-and-retaining-top-international-talent

[2] FIT facilitates investment projects in Flanders and gives support to Flemish export companies: https://www.flandersinvestmentandtrade.com/en

[3] PMV is a Flemish investment company located in Brussels, providing risk capital for promising businesses, from their very start, through their various growth stages and even on to operating internationally: https://www.pmv.eu/en

[4] https://engine-shed.co.uk/

[5] https://www.level39.co/

[6] De Cleyn, S. & Festel, G. (2016). Academic spin-offs and technology transfer in Europe: best practices and breakthrough models. UK: Elgar publishing.

[7] '*Team Bedrijfstrajecten*' can be translated as '*Team Business Processes*'. VLAIO (Agentschap Innoveren en Ondernemen) stands for Flanders Innovation & Entrepreneurship: https://www.vlaio.be/nl/andere-doelgroepen/flanders-innovation-entrepreneurship

[8] https://www.lafrenchtech.com/en/

[9] R&D Survey: http://iri.jrc.ec.europa.eu/survey.html

[10] Community Innovation Survey: https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

- CHAPTER 7.2.2
- 7.2 SUMMARY

7.3KPIs in function of policy objectives in Flanders: short history and new conceptual framework by VARIO

By Annelies Wastyn, Veerle Linseele and Danielle Raspoet (Flemish Advisory Council for Innovation and Enterprise, VARIO)

In its memorandum 2019-2024 'Forging ahead. Aim: top 5 knowledge regions' (December 2018) VARIO asks the Flemish Government to speed up the development of an overarching long-term vision on innovation and to translate this vision into a strategy with specific objectives. The vision and strategy must be future-proof and therefore go beyond one legislature (time span of at least 10 years). Output parameters and KPIs (Key Performance Indicators) are powerful tools to achieve objectives because they are often linked to financing. VARIO therefore recommends setting up output parameters and KPIs in a smart way, in function of policy objectives.

On the 1st of March 2019, VARIO received a request from Philippe Muyters, Flemish Minister for Innovation and Economy at that time, to "*set up a qualitative and measurable set of output parameters and KPIs for the next Flemish Government, which express the Flemish ambition to be one of the European leaders in innovation*".

In response to this request for advice, VARIO proceeded in two steps. The first step was the Advisory Report 7 'Conceptual framework for setting up KPIs in function of policy objectives' published in May 2019 together with an accompanying analysis report. The report provides a conceptual framework as well as a number of specific points of attention and recommendations. In addition, the importance of monitoring, systemic evaluations and impact analyses to follow up on whether the intended objectives are being achieved is also discussed.

This dossier summarizes the VARIO Advisory Report 7 and the analysis report. In addition, VARIO is working on a qualitative set of indicators for the policy domain EWI (Economie, Wetenschap en Innovatie; Economy, Science and Innovation), which will enable the Flemish Government to monitor and evaluate its performance. The VARIO memorandum 2019-2024 will serve as a basis for this. The outcome of this second step, in the form of a new Advisory Report, is foreseen for October 2019.

Lees verder

7.3.1(Key Performance) Indicators in Flanders

Drawing up KPIs and output parameters should be done at three levels:

1. The level of overall policy objectives of the Flemish government,
2. The level of individual policy domains and
3. The level of instruments/structures/actors/programmes within the individual policy domains.

A short history of the indicators of Flanders, allows to better understand the current 'state-of-play'.

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7.3.1.1Long-term strategy and goals of the Flemish Government

The Flemish Government is responsible for drawing up a long-term strategy with associated policy objectives, resources, a time line and monitoring tools. In the past, the Flemish Government has already set up several strategic plans, such as for example Flanders in Action (ViA) and Pact 2020, drawn up in 2009.

At the end of 2015, the UN resolution 'Transforming our world: the 2030 agenda for sustainable development' was adopted. This resolution contains 17 Sustainable Development Goals (SDGs), which together form an integrated, indivisible and universal action plan for peace, people, planet, prosperity and partnership. The UN 2030 Agenda for Sustainable Development calls on Member States to take forward the implementation of the SDGs. A number of steps have been taken in Flanders:

- In 2016, Vision 2050 - a long-term strategy for Flanders - was developed. This vision is aligned with the SDGs of the UN. For the objectives of Vision 2050 to succeed, the Flemish Government must work on seven transition priorities: circular economy, smart living, industry 4.0, lifelong learning, caring and living together, mobility and energy transition.
- More recently, Flanders drew up 'Vizier 2030 - a 2030 objectives framework for Flanders' based on the UN resolution and Vision 2050. Vizier 2030 translates the UN SDGs into a Flemish framework and Flemish objectives for 2030. More specifically, 48 Flemish 2030 objectives were drawn up, with a label according to the 17 SDGs and grouped in a number of larger dimensions. Vizier 2030 also includes a dedicated monitoring and reporting system, with a set of 84 unique indicators, nine of which are known as 'dashboard' indicators that provide a global picture per dimension (Table 1). The choice of indicators is based on quality, measurability, relevance and international comparability, with a strong preference for existing indicators.

Performance budgeting

The implementation of a performance budget is currently being prepared for the entire Flemish Government. Therein, a clear link will be made between policy and policy objectives on the one hand and the budget on the other. Within the current policy domains, budget programmes have therefore been further divided into underlying themes to which both objectives and budget appropriations can be allocated. This allocation is done based on 'substantive structural elements'. These are groupings of appropriations or partial powers within a programme or policy domain that make sense in terms of content.[1]

Six policy domains, including the EWI policy domain, already implemented the new structure in 2018. The other policy domains followed in 2019. It is being investigated how indicators can be used to achieve high-quality monitoring of the objectives.

[1] Prestatiebegroting; Wat, waarom en wanneer? Departement Financiën en Begroting – 25/09/2018.

- 7.3.1 Summary
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7.3.1.2Indicators for science and innovation

In the past, the VRWB [1] and the VRWI [2] worked out a framework and instruments for monitoring S&I (Science and Innovation) policy. The VRWB as well as the VRWI started from existing policy objectives, respectively the Innovation Pact and relevant policy documents, both at the level of the Flemish Government and of the EWI policy domain. In addition to the frameworks of the VRWB and the VRWI, the Flemish Indicator Book also includes a collection of policy indicators on science, technology and innovation.

[1] *VRWB - Flemish Science Policy Council – a predecessor of VARIO.* [2] *VRWI - Flemish Science and Innovation Policy Council – a predecessor of VARIO.*

VRWB core indicators

In 2003, the VRWB was asked by the minister of Innovation in office to develop a set of indicators for the quantitative evaluation and follow-up of the Innovation Pact. The aim of the exercise was "to select those indicators that are useful for monitoring the strengths and weaknesses of innovation policy in Flanders, taking into account the different phases in the innovation trajectory". The set was developed in two steps:

Step 1: Measures or indicators were linked to a systemic analysis of the text of the Innovation Pact. In addition, input-activity-output effects were identified throughout the innovation process, in the context of objectives and environmental factors. The result was a very extensive list of indicators.

Step 2: To arrive at a reference toolkit immediately usable by Flanders, a selection of 11 priority core indicators was made (Table 2) from the extensive list of indicators based on (1) measurability for Flanders; (2) international comparability and (3) being in line with existing statistics as much as possible. Above all, the aim was to achieve a balance between: types of indicators and indicator categories (Table 2).

In 2005, at the request of the then vice-minister-president Fientje Moerman, this list of 11 priority core indicators was supplemented with an indicator that monitors the fiscal favourable measures for research and development (R&D).

VRWI/VARIO-indicators

Due to major changes in the innovation landscape and in the area of indicators themselves, an update of the set of indicators was carried out in 2014 by the successor to the VRWB, the VRWI. A new concept was developed based on the following principles:

Principle 1: Implementation of a systematic link with the Flemish policy objectives regarding science and innovation. All relevant policy documents and actions were consulted. Four objectives were identified to become a top region: (1) sufficient financial resources for S&I; (2) availability of highly qualified human capital; (3) excellent knowledge creation as a basis for innovation; (4) an efficient and knowledge-intensive economic fabric.

Principle 2: The set of indicators was limited to the rather traditional, well-defined S&I indicators. A deliberate choice was made not to include broad outcome indicators, such as growth of GDP.

Principle 3: For the first time, a meta-quality analysis was linked to the proposed set of indicators. The extent to which the selected indicators met the criteria of international comparability, frequency, reliability and validity was examined.

Principle 4: The set of indicators made it possible to zoom in on specific themes and aspects of science and innovation policy.

The result was a set of 50 indicators classified according to four objectives (principle 1). 15 core indicators were highlighted, which together are as representative as possible for the four main objectives and allow them to be closely monitored (Table 3). The 15 core indicators are reported every two years in the Flemish Indicator Book, since the transformation of the VRWI into VARIO under the heading of VARIO core indicators.

- Chapter 7.3.1.1
- Chapter 7.3.1.3

7.3.1.3KPIs and output parameters Flemish instruments/structures/actors/ programmes

Approximately 30 years ago, the Flemish Government pioneered with the set-up of a system of output-driven financing. The public funding of R&D-actors in Flanders depends on the output they generate. This is measured by KPIs and output parameters.

- Output parameters in Flanders are used for the distribution of the resources of the BOF (Bijzonder Onderzoeksfondsen; Special Research Funds) between universities and the resources of the IOF (Industrieel Onderzoeksfonds, Industrial Research Fund) between University Associations. The output parameters merely serve to distribute a closed envelope of resources; no target is attached to them in advance. The output parameters themselves consist of a number of fixed variables whose value is calculated on a regular basis, linked to past performance.
- For other knowledge actors and instruments (e.g. Strategic Research Centres, clusters, programmes such as the Artificial Intelligence and Cybersecurity Policy Plan) KPIs are set. A KPI is an indicator to which also a target/objective is linked. A KPI is used for monitoring, evaluation and allocation of funding. It is a measure agreed upon in advance that represents the performance level of a critical activity.

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- 7.3.1 Summary

7.3.2Conceptual framework for setting up KPIs and output parameters in function of policy goals

The overview in 7.3.1. shows that a number of frameworks and indicator sets exist in Flanders. However, the KPIs and output parameters appear to be insufficiently linked to the policy objectives. Also, the feedback between objectives and KPIs at different levels is not present or not transparent. To remedy this, VARIO proposes a new conceptual framework consisting of the different steps that VARIO believes need to be taken systematically to arrive at a high-quality set of KPIs and output parameters.

Figure 1: Conceptual framework for KPIs and output parameters (OP)

Step 1: The starting point should be a long-term strategy with the policy objectives of the Flemish Government. These objectives typically go beyond consecutive legislatures, are transversal and serve as an anchor point for a coalition agreement. (A limited number of) KPIs should be linked to these objectives, ideally with specific milestones/targets per legislature.

Step 2: The strategic policy objectives of the Flemish Government must be translated (not just adopted) into objectives per policy domain with associated KPIs.

Step 3: The objectives per policy domain should be translated into instruments/structures/actors/programmes. KPIs and output parameters should then be linked to these at a disaggregated level. Several instruments/structures/actors/programmes contribute to the same objective.

Step 4: Evaluations should be carried out at appropriate times (ex-ante and ex-post) as to whether/what the different instruments/structures/actors/programmes together contribute to the achievement of the objectives at the policy domain level. KPIs and output parameters are not objectives but a means to meet a higher goal.

Step 5: At appropriate times, it should be evaluated whether/how the different objectives per policy domain together contribute to the long-term strategy and objectives of the Flemish Government.

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7.3.3Recommendations for the Flemish Government

KPIs and output parameters must be set in a smart way. The government must formulate clear objectives and KPIs need to be linked to these objectives. VARIO formulates recommendations on how to achieve this.

Recommendation 1: Apply the proposed conceptual framework for setting up KPIs

A conceptual framework for setting up KPIs has already partly been drawn up in Flanders, but there are important gaps and coherence is lacking. The first important recommendation, as part of the measures to remedy this, is to apply the conceptual framework for setting up KPIs in function of policy objectives proposed by VARIO (Chapter 2).

Recommendation 2: Translate the long-term strategic objectives in clear objectives for the EWI policy domain

VARIO notes that the feedback between the strategic long-term objectives and objectives per policy domain is insufficient (steps 2 and 5 in the conceptual framework).

The policy objectives for economy, science and innovation are not always clearly defined and the link with the overarching long-term objectives is not clearly articulated. However, VARIO considers it important that the overarching long-term strategic objectives are translated into clear and concrete objectives for the EWI policy domain. The following principles should be applied:

- Transversal and crossdomain thinking. The translation of long-term strategic objectives into objectives per policy domain must not and cannot be a linear one-to-one relationship. Several policy domains contribute - in different ways - to certain long-term objectives. Science and innovation can contribute pre-eminently to objectives in many other policy domains.
- Tuning and synchronizing. The objectives formulated at the level of the various policy domains must not contain any contradictions.
- The whole must form a dynamic process in which there is interaction between the policy objectives of the Flemish Government on the one hand and those of the different policy domains on the other.

Recommendation 3: Make an extensive exercise for the EWI policy domain – how do instruments/ structures/actors/programs fit in with the objectives set?

It is important to clearly identify the individual objectives of the different instruments/structures/ actors/programmes within the policy domain EWI and how they contribute together, at systemic level, to the objectives of the entire policy domain (steps 3 and 4 in the conceptual framework). When designing new initiatives, it is important to consider how they will contribute to the objectives of the policy domain and how they will interact with existing initiatives.

VARIO notes that such exercises have not yet been carried out in a structured manner in Flanders. Therefore, VARIO advises to conduct a thorough analysis of the existing initiatives and actors, including the following:

- The (priority) objectives of each individual instrument/structure/actor/programme.
- The objectives of the policy domain to which they must contribute (as a matter of priority)
- An assessment of how they reinforce or counteract each other's objectives.

Based on the results of this analysis, the existing system can then be streamlined.

Recommendation 4: Link KPIs to the objectives at the different levels

It is important that the right KPIs are linked to the objectives, at the long-term strategic level (step 1), at the level of the policy domain (step 2) and at the level of the individual structures/actors/ instruments/programmes (step 3). Objectives and KPIs should be attached to new initiatives when they are launched. Transparency on the KPIs is needed at all levels. KPIs should be complementary and create synergies.

Recommendation 4.1: Draw up high-quality KPIs for the policy domain EWI

VARIO notes that although there is frequent monitoring of activities in the EWI policy domain (see VRWI indicator set and Flemish Indicatorbook), no clear KPIs, including targets, are linked to the policy objectives for science and innovation (step 2). VARIO therefore recommends that, in addition to clear objectives, the corresponding KPIs for the EWI policy domain should also be formulated clearly. These should have a longer-term perspective and be more impact-oriented than the KPIs at a lower level (the individual instruments/structures/actors/programmes). For this purpose, one can look for example at the EU's 'Research and Innovation Observatory' (RIO) includes (macro) impact indicators such as added value for services broken down by knowledge intensity, employment in knowledge-intensive activities as a percentage of total employment...

Recommendation 4.2: Establish high-quality KPIs for the EWI instruments/structures/actors/ programmes

At the level of individual instruments/structures/actors/programmes, KPIs and output indicators are common and are mostly directly linked to funding (step 3). At this level, it is normal to focus on short term (output) and medium term (outcome). It is more difficult to link KPIs to impact, as there are many factors that are beyond the control of the initiatives themselves, and isolating their specific impact from that of other sources of funding and initiatives is often difficult. VARIO believes that impact is very important (cf. recommendation 5.2), but asks to be cautious about impact indicators at this level. They are not very common at the moment, but for example the cluster pacts do include impact indicators. Especially for such indicators it is essential to remain alert for as to whether the correct measurement is being made and to adjust them if necessary.

Recommendation 4.3: Look beyond indicators, output parameters and other quantitative data

Quality aspects are already (partly) included in the KPIs and output parameters. In addition, VARIO believes that we should not restrict ourselves to quantifiable information, and that more qualitative data should be included, certainly for impact analyses (see also recommendation 5.2), e.g. on the basis of surveys and (in-depth) interviews. Wide surveys, outside of the initiatives to which the KPIs and output parameters apply, can also help to detect the undesirable side effects of KPIs and output parameters.

Recommendation 5: Assess at appropriate times whether objectives have been achieved

At appropriate times one needs to monitor to what extent objectives have been achieved. It should be checked whether and to what extent the existing KPIs contribute to (not) achieving the objectives (steps 4 and 5). It is important to remember that KPIs are not a goal in themselves but a tool for realizing higher goals. This evaluation, both ex-post and ex-ante, should be carried out at different levels:

1. To what extent are the long-term objectives of the Flemish Government achieved?
    - How do the various policy domains jointly contribute to this?
2. To what extent are the objectives of the EWI policy domain achieved?

    - How do the various instruments/structures/actors/programmes jointly contribute to this?

The focus of recommendations 5.1 and 5.2 below is at the level of the EWI policy domain. The KPIs need to be adapted if the objectives set are not achieved, or if the KPIs of one objective counteracts the achievement of another. For this purpose, the government must make use of data analysis and monitoring systems, which are becoming increasingly effective (see recommendation 6).

Recommendation 5.1: Need for more systemic evaluations

VARIO is in favour of adjusting the current, strongly programme- and structure-driven evaluation culture towards more and broader system evaluations. VARIO strongly recommends including how the initiatives jointly contribute to the achievement of objectives. An evaluation of portfolios of instruments/structures/actors/programmes within the EWI policy domain and their interrelationships should be carried out on a more regular basis. These can provide insights that are relevant for future policy decisions regarding the EWI policy mix.

Recommendation 5.2: Need for more standardised and systemic impact analyses

In order to gain a better understanding of how the tools/structures/actors/programmes contribute to the stated objectives of the EWI policy domain, it is necessary to look beyond their individual outputs (short term) and results (medium term), and to carry out impact analyses. VARIO recommends that more emphasis be placed on impact analyses and on standardising their methodology, so that they can be better compared and interpreted. In addition, VARIO advocates that impact analyses should be more systematic. What is the combined impact of the various initiatives and to what extent do they allow to achieve the objectives formulated at policy domain level?

Recommendation 6: Develop monitoring tools further

In order to carry out evaluations and impact analyses, the necessary data must be available. That is why monitoring, and therefore the creation and measurement of good indicators, is extremely important.

At present, monitoring is still often carried out at output level. In order to monitor the long-term strategies of policy, a longer-term perspective must also be included in the monitoring. Thus, it is necessary to monitor not only outputs but also results and impacts.

There is currently a problem in the accessibility of existing data. VARIO considers it important to improve and to simplify access to (administrative) data for the evaluation of EWI policy. In its memorandum 2019-2024, VARIO already called for an open data platform where the necessary data for monitoring and evaluation should be made available to policy makers.

- Although data are regularly collected, they are often not used on an aggregated level for analysis, the reason being a problem of linking different information sources. This can be overcome by a better (IT) data infrastructure. VARIO recommends to work on this and sees a role for artificial intelligence in making maximum use of the available data.
- The extent to which and how FRIS (Flanders Research Information Space) can contribute to the evaluation of the objectives of the EWI policy domain and its instruments/structures/ actors/programmes must be examined. The use of the FRIS portal for this purpose is in any case in line with the objectives of this initiative. The possibility of linking additional data sources to the FRIS portal should also be examined.
- It should be examined how anonymised data can be made available for analysis and evaluation without compromising the confidentiality of (sensitive) data.

Recommendation 7: Make more in-house capacity for policy preparation and evaluation available

As in its memorandum 2019-2024, VARIO advocates that the public administration itself should have enough substantive expertise. In-house knowledge and capacity building are crucial to correctly interpret (monitoring) data and evaluation reports provided by external parties and to translate them into policy. Knowledge, and especially continuity in knowledge, is often at the level of administration, and this needs to be called upon more frequently by policy makers.

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7.4Infrastructure and financing channels within the Research Foundation – Flanders (FWO)

By Caroline Volckaert (Research Foundation-Flanders (FWO)

In the international competition for knowledge and talent, the building blocks of the knowledge economy, the availability of high-performance research infrastructure is increasingly becoming a critical success factor. Excellent research is only possible with excellent research infrastructure.

Research infrastructure is therefore broadly defined as comprising '*all facilities and sources that promote the performance of frontier and strategic basic research across all scientific disciplines*'. Besides scientific infrastructure, this includes collections, natural habitats, corpora and databases (including digital opening up). They may be single-sited, distributed, or virtual.

The financing of research infrastructure is aimed at strengthening research and innovation in Flanders by improving cooperation between the various players. For Flanders, it is crucial that its knowledge institutions have access to infrastructure with an international reference. This is a prerequisite to get (or remain) at the top and it attracts researchers and companies.

The Research Foundation-Flanders (FWO) provides two financing channels for research infrastructure: the funding of medium and large-scale infrastructure that is located in Flanders and the selection and funding of the Flemish participation in international infrastructures (such as *European Strategy Forum on Research Infrastructures* (ESFRI)).

7.4.1Medium and Large-Scale Research Infrastructure

Medium-scale research infrastructure is defined as research infrastructure with a total financing cost from €150,000 to €1,000,000 VAT included. Large-scale research infrastructure covers investment initiatives in excess of €1 million. Applications for the acquisition of several instruments may be submitted, provided that these instruments constitute a coherent whole and it is demonstrated that the proposed research programme(s) cannot be carried out if one of them is not available.

The selection of applications for medium-scale research infrastructure is organised at university level, whereas for large-scale research infrastructure it is organised through competition at Flemish level. Calls for both medium and large-scale research infrastructure are organised every two years. The organisation and selection of applications for these financing channels is organised via separate calls but within the same timeline.

7.4.1.1Medium-scale research infrastructure

The call is addressed to the research groups of the universities. Each university incorporates a regulation on medium-scale research infrastructure into the University's Regulations and establishes an internal advisory committee "Infrastructure". The composition and the name of this committee are left to the discretion of the university. The university's administration assesses and ranks the applications on the basis of the selection criteria, on an indicative list which is then submitted to the FWO for subsequent funding. Universities formally act as applicants in calls for medium-scale research infrastructure. Supervisors can therefore not directly submit applications to the FWO.

Application dossiers submitted by the universities must clearly indicate whether there is already cooperation with (an)other university(ies) or with third parties, or whether such cooperation will be developed further. In the context of the call and selection procedure for medium-scale research infrastructure, third parties are defined as bodies other than a Flemish university. After submission of the applications, the FWO organises consultation between the universities to detect potential synergies between applications in order to arrive at a maximum cooperation and an optimal use of the requested infrastructures.

The application must include a proposal for the overall financing of the infrastructure (incl. co-financing and the financially assessable contribution by third parties), as well as a usage plan showing the use of the available capacity.

Selected initiatives for medium-scale research infrastructure receive a subsidy in the amount of 100% of the costs eligible for subsidy. Third parties can make use of infrastructure provided they make a financially assessable contribution. They cannot, however, receive subsidies.

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7.4.1.2Large-scale research infrastructure

At the Flemish level, applications for large-scale research infrastructure are submitted directly to FWO. The target group is defined broader than for medium-scale research infrastructure. Applicants can, in fact, belong to a research group or research groups at a Flemish university, at higher education institutions in charge of scientific research pursuant to the Higher Education Code of 11 October 2013, or at strategic research centres. A partnership between the above bodies or a partnership between at least one of the above bodies and one or more third parties is also possible.

The acquisition and operation of large-scale research infrastructure often transcends the capabilities of an individual institution. Strategic cooperation is therefore appropriate. A grant application for large-scale research infrastructure can therefore be submitted by different parties: an institution application (from one and the same institution) or a consortium application, or either one of these types involving the participation of one or more third parties in the project. As with medium-scale research infrastructure, third parties can make use of infrastructure in return for a financially assessable contribution. They cannot, however, receive subsidies.

To promote cooperation among Flemish public knowledge institutions and with third parties, a progressive subsidy percentage has been introduced for large-scale research infrastructure:

- for applications submitted by a single institution eligible for subsidies, 70% of the eligible costs are financed;
- for applications submitted by a consortium comprising two or more institutions eligible for subsidies, the percentage is increased to 90%;
- finally, for applications submitted in collaboration with third parties that co-finance a substantial portion of the costs, the eligible costs are fully financed.

In deciding whether or not to finance investment initiatives for large-scale research infrastructure, the FWO relies on the advice of (international) experts who evaluate the scientific quality of the applications and subsequently verify, for applications ranked as excellent, whether the proposed investment plans are sufficiently realistic and objective.

- Chapter 7.4.1.1
- Chapter 7.4.1.3

7.4.1.3Cost categories eligible for subsidies

In the call for medium and large-scale research infrastructure, the FWO finances not only the costs for purchasing or building the infrastructure, but also a portion of possible maintenance costs and upgrades, and specialised technical personnel for its operation and maintenance;

- equipment: costs for research investments, i.e. the costs for purchasing and connecting the actual research infrastructure or purchasing the components for the construction of the planned research infrastructure, including the non-refundable portion of VAT. This also includes the upgrading, i.e. the substantial improvement of existing research infrastructure;
- personnel costs for the development and construction of the research infrastructure. This also includes the personnel costs for upgrading existing research infrastructure and the costs for the operational or maintenance personnel once the infrastructure is up and running;
- operational costs consisting of maintenance costs over the entire depreciation period, i.e. the costs arising from maintenance agreements or research infrastructure upgrades and equipment repairs.

Operational costs relating to the use of the research infrastructure are not eligible for subsidy. These costs will normally be charged to the research projects using the infrastructure.

- Chapter 7.4.1.2
- Chapter 7.4.1.4

7.4.1.4Results of past calls

With no change in policy, the available funds per call amount to €28,000,000. Of this amount, 60 to 70 percent is earmarked to fund medium-scale research infrastructure and 30 to 40 percent to fund large-scale research infrastructure. Within these limits, the FWO Board of Trustees determines the distribution of the resources available for a call.

For the funding of medium-scale research infrastructure, *pursuant to Article 11 of the amendment to the Decree amending various decrees relating to the economic, science and innovation policy, approved on 1 March 2019,* the five Flemish universities, previously referred to as associations, have annual drawing rights representing a portion of the total available amount determined on the basis of the Hercules allocation key. This key is the weighted average of the BOF (Special Research Funds) and the IOF key (Industrial Research Funds). Resources for medium-scale research infrastructure attributable to a university that have not been allocated at the end of the relevant calendar year can be transferred to the following year with retention of their original allocation.

When looking at submitted vs. approved applications for medium and large-scale infrastructure projects, both in terms of numbers and amounts allocated, we see that this financing channel is severely oversubscribed.

Since 2015, the maximum amount for large-scale research infrastructure has been reduced from €1.5 million to €1 million. The number of applications submitted in the 2015-2016 call immediately increased by a factor of 1.8. This number returned to normal in the next call where an increase in the number of applications for medium-scale infrastructure was noticeable.

The average success rate (22%) for the sixth call for medium-scale research infrastructure is the lowest of all calls thus far. Excellent applications cannot be accepted due to lack of funds. Since 2013, the target of 1 in 3 approved applications has not been achieved, so that the need for resources for research infrastructure remains high.

The exceptionally high success rate for large-scale infrastructure in 2014 is attributable to the one-off addition of resources from the “Competitiveness Pact” to this call. For the other calls, the modest success rate illustrates the considerable need from Flemish researchers in all disciplines for high-performing research infrastructure, which is indispensable for high quality research in an increasingly internationalised environment.

- Chapter 7.4.1.3
- Chapter 7.4.2

7.4.2International Research Infrastructure

High-performance research infrastructure is necessary to remain internationally competitive and to retain excellent researchers and companies, in Flanders and abroad. The modernisation of existing, and the construction of new research facilities is not only a priority in neighbouring countries, but is also highlighted in Horizon 2020 (the EU Research & Innovation programme) and the follow-up programme Horizon Europe of the European Commission.

7.4.2.1Flanders creates a new framework: towards a new IRI programme

In January 2018, the Flemish Government approved the Decision regulating the Flemish participation in and/or funding of international research infrastructures. This integrated regulatory framework makes it possible to support the Flemish participation in and/or funding of international investment initiatives that are carried out at large-scale international or supranational facilities to which the Flemish Government contributes and/or whose strategic importance for Flanders can be demonstrated. The Decision for the first time establishes a structural basis for infrastructure funding in an international context based on calls, on the one hand, for the selection for participation of Flemish researchers in European and pan-European research infrastructures and, on the other hand, for the funding of both one-off and structural costs associated with such participation.

The Decision allowed the development of a call-based method for the participation of Flemish researchers in European and pan-European research infrastructure projects. In 2018, the IRI (International Research Infrastructure) call was launched, a new FWO programme that replaces the previous ESFRI and Big Science funding. Until then, resources for these international infrastructure participations were limited or the necessary funding was addressed on an ad hoc basis.

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- Chapter 7.4.2.2

7.4.2.2The IRI programme of the FWO

For participation in international infrastructure investment initiatives, a number of scenarios are possible. These do not apply simultaneously to all projects and can therefore vary from infrastructure to infrastructure:

- the decision for Flanders to participate in the international research infrastructure
- the payment of membership fees (in many cases, these fees are paid by the Federal Government)
- the funding of activities or investments associated with the participation.

The subsidies under the IRI programme are used for the participation in and funding of research infrastructure and for the institutional, operational and logistic costs of participating Flemish research groups. Expenditure for performance of the actual research cannot be budgeted under the international research infrastructure programme, but funding can be applied for through other financing channels.

Applications can be submitted by a research group or research groups of a Flemish scientific institution, a Flemish university, a strategic research centre, an institution for post-initial education, the Flanders Marine Institute, the RZSA-CRC, the Botanic Garden Meise, or a Flemish museum with a research mission, a partnership between the above-mentioned bodies, or a partnership between at least one of the above-mentioned bodies and one or more third parties. "Third parties" is defined broadly and not limited to Flanders-based companies or research centres. They are not entitled to subsidies, but can make a real, financially assessable contribution to the project in exchange for a (limited) right of use or access.

As a rule, calls for international research infrastructure are organised every two years. If an applicant has already received funding under a call, that same applicant or the consortium to which the applicant belongs, cannot submit a new application for the same infrastructure (investments and recurrent costs) under the next new call, unless, due to exceptional circumstances, the investment initiative or the consortium composition has changed substantially during the term of the funding.

In its decisions, the FWO relies on the advice of experts who evaluate the scientific merit of the applications and, for applications that are rated 'excellent' or 'very good', examine whether the investment plans presented are realistic, feasible and of strategic importance for the Flemish Region or the Flemish Community.

7.4.2.2.1 The funding rates

Cooperation is encouraged by applying a variable funding rate:

- The subsidy for selected proposals for international research infrastructure amounts to 80% of the eligible costs.
- The subsidy is raised to 90% if the investment initiative originates from one or more research groups with more than one applicant, and if the application file proves that all applicants bear at least half of the amount that they would have to pay if the remaining 10% of the eligible costs were divided proportionally, so as to demonstrate the effective contribution and commitment.

The operational plan shows which costs will be covered in-kind as a financially assessable contribution, via co-funding or via income. The operational plan provides clarity about the annually expected costs and how they will be financed, via one-off or recurrent costs, throughout the term of the project.

- If the consortium is able to prove in the operational plan that, due to the nature of the infrastructure, no co-funding is possible, the subsidy percentage may be raised to 100% provided the participation, support and commitment of the relevant bodies is demonstrated. Infrastructures are very diverse in nature and co-funding options vary widely.

The application must include a usage plan including information and access provisions for researchers from other institutions to the installations financed by the FWO.

7.4.2.2.2 Cost categories eligible for subsidies

Eligible costs include both one-off and recurrent costs associated with the participation in and/or funding of international research infrastructures.

The subsidy is used for the financing of equipment, staff, institutional, operational and logistic costs. This includes the following cost categories, not all of which need to be present simultaneously in each project application:

- equipment: costs for research investments, notably costs for the acquisition or building and connection of (components) of the international research infrastructure, and for substantial upgrades, including the non-recoverable portion of VAT;
- personnel costs for the development, construction or building of the international research infrastructure. This also includes personnel costs for upgrading the international research infrastructure and costs for operating or maintenance personnel once the infrastructure is up and running;
- operational costs such as maintenance costs over the entire depreciation period, i.e. costs arising from maintenance contracts or upgrades of the international research infrastructure and equipment repair costs, coordination costs arising from the multilateral nature including coordination costs to establish partnerships between international projects, institutional costs such as contributions and commitments entered into under international cooperation agreements and being a condition precedent for participation, and logistic costs that are necessary to conduct research at international research facilities, such as the accommodation of researchers.

Additional funding of operational costs can be applied for if the Flemish consortium, or its members, assume a visible and demonstrable additional role within the international consortium in support of the international infrastructure.

Operational costs for research carried out with the international research infrastructure, expenditure for performance of the actual research and costs for infrastructural provisions such as costs for buildings, provisions that are considered being part of the standard accommodation, with the exception of costs for modifications to buildings and connection costs for the international research infrastructure, are not eligible costs. These costs will normally be charged to the research projects using the infrastructure.

- Chapter 7.4.2.1
- Chapter 7.4.2.3

7.4.2.3The first IRI call (2018)

The first call for the Flemish participation in and/or subsidisation of international research infrastructures was opened on 1 March 2018. By the deadline of 4 June 2018, the FWO had received 25 applications under the IRI call, 5 of which were applications for participation only without funding and 20 were funding applications for a total subsidy amount of €79.85 million for 4 years. This number includes 16 applications of already ongoing participations in international infrastructures, representing a total amount of €71.54 million. The current authorisation, based on the ongoing ESFRI and Big Science projects, amounts to just over €32 million for the next 4 years (2019 through 2022). The available resources for international infrastructure are in any case inadequate to meet current needs.

To allow a new call to be organised within two years, the FWO Board of Trustees decided to reserve €10 million of the available budget of €32.29 million for the next call. Furthermore, an additional €15 million was added on a one off basis to this call, bringing the total subsidies for this call to €37.29 million. This amount was used for the partial or limited funding of 16 applications to enable the continuation or limited development of ongoing commitments, and to support 3 of the 5 submitted applications for participation in international research infrastructures without funding request.

- Chapter 7.4.2.2
- 7.4.3 Conclusion

7.4.3Conclusion

Anyone who wants to engage in high-quality research requires access to high-performance, state-of-the-art research infrastructure. With research infrastructure gaining in importance in virtually all scientific disciplines, investments therein are indispensable if Flanders wants to remain at the forefront and strengthen its position in future-oriented fields. Moreover, the FWO's financing channels for infrastructure provide the much needed and urgently required impetus to give high-performing Flemish research groups the opportunity to compete successfully at the international level. Without this funding, these researchers would certainly and inevitably lose connection with leading groups at the international level.

Furthermore, the majority of the infrastructures are not focused on a specific research group or discipline, but are used by a broad research community in Flanders (universities, colleges, strategic research institutes, etc.) with an interdisciplinary range of research topics. The multiplicator effect therefore extends simultaneously across many future research groups, labs and talented researchers.

The successful but oversubscribed infrastructure initiatives highlight the specific current demand among Flemish researchers for additional support.

- 7.4 Summary

7.5The professorial career at Flemish universities

By Noëmi Debacker (UGent)

From 1999-2000 till 2016-2017, almost 3,400 persons began their assistant professorships at one of the Flemish universities. In addition, another 1,300 persons started as associate or (senior) full professor without a previous position as assistant professor within Flanders.

To date, little is known about the career trajectory of assistant professors at one of the Flemish universities: how long do they stay employed as an assistant professor, do they leave the Flemish universities or do they move on to become an associate professor and/or eventually a (senior) full professor? The current chapter focuses on those starting out as assistant professors: what are their characteristics, what does their further academic career in Flanders look like and are there differences with regard to nationality, gender and scientific cluster?

This was investigated using the database Human Resources in Research Flanders (HRRF update 2016-2017) that contains the appointment data of all researchers who have been affiliated with one of the Flemish universities since 1990 and the data of all registered and defended doctoral dissertations. The database was commissioned by the Flemish Government within the remit of the Expertise Centre for Research and Development Monitoring (ECOOM). For the current analysis data from the academic years 1999-2000 onwards were used.

7.5.1Characteristics of starting assistant professors

The number of assistant professors starting out each academic year has remained fairly unchanged between 1999 and 2006, apart from one exception in 2000. On average, 153 assistant professors have started each academic year. From 2007 until 2010 there has been a gradual increase of starting assistant professors. On average, 193 assistant professors started each academic year during this period. In the following period (from 2011 to 2016) there was no further increase; the two outliers in 2013 and 2014 (268 and 265 assistant professors respectively) are mostly related to the integration process of the university colleges, leading to a part of the college lecturers being transferred to the universities. The average number of new assistant professors from 2011 to 2016 was 229 (Figure 1).

In 1999-2000, less than one in four of the starting assistant professors were women. Their share has gradually increased to a maximum of 41% in 2016-2017. The starting assistant professors initially were mainly Belgians (96%). Over time, their share has gradually decreased to 77% in 2016-2017 (Figure 1).

The median age of starting assistant professors was slightly higher in the earlier cohorts (38 and 39 years in 1999-2000 and 2000-2001). From 2001-2002 till 2010-2011 the age at the start of the assistant professorship was lower (35 to 36 years). From 2011 there was again a slight increase to 36 to 37 years. Overall, there was no significant difference in starting age between men and women in the 1999-2016 period (Mann-Whithey U for independent groups, p = 0.9) (Figure 2).

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7.5.2Global career trajectory of assistant professors starting at one of the Flemish universities

For the cohort having started their assistant professorship in the academic year 1999-2000 (N = 141) we find that 17 years after starting, more than one in three (37%) was no longer employed at one of the Flemish universities as a paid professor (Figure 3). Only 31% of this group had reached retirement age at that time and 15% were 60-65 years old. This means that for at least one in five of the starting assistant professors from the 1999-2000 cohort, their academic career in Flanders had been terminated prematurely (54% of 37%). In Figure 4 we compare different cohorts of starting assistant professors with regard to the share no longer employed at one of the Flemish universities five to seven years after starting. Those who had reached retirement age at the time of evaluation (an absolute minority: 0 to 2.4%) were not taken into account. Five years after starting, on average 13% of the starting assistant professors were no longer employed in Flanders as a professor; after seven years it was 15%. There are some cohorts where the proportion of "leavers" is lower or higher, but there is no trend over time.

For the analysis of the further career trajectory, we exclude those who were no longer employed as a professor in Flanders.

Seven years after starting, about half of the assistant professors who had started in 1999-2000 (and who were still employed by the university) had moved on to associate professor or further; eight years after starting, this was already 73%. A small proportion (10%, N = 9) was still employed as an assistant professor 17 years after starting (Figure 3).

In the 2004-2005 cohort we see that seven years after starting as an assistant professor, 79% had already moved on to associate professor or further (Figure 5). This was 77% in the 2009-2010 cohort (Figure 6). Although the promotion to associate professor in these two more recent cohorts happened faster than in the 1999-2000 cohort, a larger share in this latter cohort had already moved on to (senior) full professor seven years after starting (17% from the 1999-2000 cohort versus 7% and 3% from the 2004-2005 and 2009-2010 cohorts respectively).

Figure 7 shows the promotion to (senior) full professor for a few cohorts. We do indeed observe that seven years after starting the share having moved on to (senior) full professor was higher in the older cohorts. In the 1999-2000 to 2004-2005 cohorts, an average of 18.3% had moved on to (senior) full professor. In the 2005-2006 to 2009-2010 cohorts this was 8.6% ($p < 0.001$). Nine years after starting however, there was no difference between the cohorts: in the cohorts 1999-2000 to 2004-2005 an average of 33.5% had moved on to (senior) full professor and in the cohorts 2005-2006 to 2007-2009 that was 29.3% ($p = 0.13$).

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- Chapter 7.5.3

7.5.3Career trajectory by gender, nationality and scientific cluster

- Chapter 7.5.2
- Chapter 7.5.4

7.5.3.1The career trajectory of male and female assistant professors

First, we look at the group that was no longer employed as a professor at one of the Flemish universities n years after starting as an assistant professor ("leavers") (Figure 8 and Figure 9). In both cohorts, the proportion of leavers was not significantly different between male and female assistant professors (24% versus 25%, 14 years after starting as an assistant professor (p = 0.7, oldest cohort) and 16% versus 20%, eight years after starting as an assistant professor (p = 0.2, most recent cohort)). If we limit the group of leavers to those who have not yet reached retirement age, there is still no significant difference between men and women: in the oldest cohort 19% men versus 21% women had left (p = 0.5, situation 14 years after starting); in the 2008-2009 cohort, the proportion that had left eight years after starting was 14% men versus 20% women (p = 0.06).

For the analysis of the further career trajectory we exclude the leavers. In both cohorts, the proportion having moved on to a next career step was lower among female assistant professors than among male assistant professors (Figure 8 and Figure 9). In the oldest cohort, 63% of the male assistant professors had moved on to (senior) full professor 14 years after starting versus 51% of the female assistant professors (p = 0.02). For both men and women, 11% were still employed as an assistant professor. So 14 years after starting an equal share of male and female assistant professors had already moved on to a higher position, but subsequently the women advanced less quickly to the next phase of the professorial career. In the second cohort (2005-2006 till 2008-2009) we note that eight years after starting as an assistant professor, 24% of men versus 13% of women (p = 0.004) had advanced to (senior) full professorship. The proportion that was employed as an associate professor was the same for men as for women (57%), but the proportion of women who were still employed as an assistant professor was higher than for men (30% women versus 19% men, p = 0.003).

For both cohorts, the career situation of men and women eight years after starting as an assistant professor is shown in Table 1. Over time there has been no improvement for women compared to men. On the contrary, the gap between men and women in terms of promotion from assistant professor to a next career step was bigger in the more recent cohort.

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7.5.3.2The career trajectory of Belgian and non-Belgian assistant professors

In this section we look into the career trajectory of Belgian versus non-Belgian assistant professors. However, as mentioned at the beginning of this document, the latter group is very small (N = 39 in the cohort 1999-2002 and N = 58 in the cohort 2005-2008).

Of the small group of starting non-Belgian assistant professors a larger share left the Flemish universities earlier compared to their Belgian peers. The first cohort in particular contained a large group of leavers: more than half (54%) of the non-Belgian assistant professors were no longer employed as a professor at one of the Flemish universities 14 years after starting. For their Belgian peers this was only 22% ($p < 0.001$) (Figure 10). When excluding those who had already reached retirement age, this was 46% versus 18% ($p < 0.001$) respectively. Also in the more recent cohort we observe a significantly larger group of leavers among non-Belgians than among Belgians: eight years after the start, respectively 35% versus 14% were no longer employed as a professor at one of the Flemish universities ($p < 0.001$, figures excluding those who had already reached retirement age) (Figure 11).

It is striking that in the oldest cohort the non-Belgian assistant professors left the Flemish universities rather quickly and abruptly, namely between two and five years after starting as an assistant professor. Leaving happened much more gradually among their Belgian peers. In the more recent cohort there was no difference in speed of leaving between Belgians and non-Belgians.

For the analysis of the further career trajectory we exclude the leavers.

In the oldest cohort, of the (few still present) non-Belgians (N = 18), a larger share was employed as associate professor 14 years after starting compared to their Belgian peers (44% versus 28% respectively) and a smaller share was employed as (senior) full professor (44% versus 61% respectively), but that difference was not statistically significant ($p = 0.32$).

In the more recent cohort, there was a larger share of non-Belgians (N = 38) that had already advanced to associate professor or higher eight years after starting, but again this difference was not statistically significant (90% versus 77% among Belgians, $p = 0.08$).

- Chapter 7.5.3.1
- Chapter 7.5.3.3

7.5.3.3The career trajectory in the five scientific clusters

Next we look into the career trajectory of the assistant professors broken down by scientific cluster of employment.

In the 1999-2002 cohort the highest share of assistant professors no longer employed as a professor at one of the Flemish universities 14 years after starting, was observed in the social sciences (39%). The lowest shares were observed in the medical and natural sciences (19% and 17% respectively) (Figure 12). Even after exclusion of those who had already reached retirement age, the social sciences remained the cluster with the highest share of leavers (30%). In the medical and natural sciences, this was 14% and 15% respectively ($p = 0.004$).

In the 2005-2008 cohort, the social sciences do no longer lead with respect to the share of leavers (Figure 13). The applied sciences come out on top with 21% of assistant professors no longer employed as a professor at one of the Flemish universities eight years after starting. This scientific cluster was followed by the human sciences with 20% and the social sciences with 18% (figures excluding people who had reached retirement age). Hence the medical and natural sciences still show the smallest group of leavers (11% and 10% respectively had left eight years after starting) ($p < 0.001$).

For the analysis of the further career trajectory we exclude the leavers.

In the cohort of assistant professors having started in 1999-2002 the medical sciences showed the largest share of assistant professors who had not moved on to associate professor or further 14 years after starting (15%). This cluster was followed by the human and social sciences with 12% and the applied sciences with 9%. In the natural sciences, on the other hand, almost everyone had already advanced to a further career step (only 1% was still active as assistant professor) ($p = 0.04$). The natural sciences also contained the largest group being employed as a (senior) full professor 14 years after starting (72% versus a maximum of 59% in the other clusters); however this difference was not statistically significant ($p = 0.3$).

Similar observations were made in the more recent cohort: eight years after starting as an assistant professor the share of those still employed as an assistant professor was lowest in the natural sciences (7%), followed by the applied (15%), social (21%), medical (26%) and human sciences (30%) ($p = 0.001$). In the natural sciences we also observed the largest share of (senior) full professors eight years after starting (27%), followed by the medical sciences with 23%, the applied sciences with 21%, the social sciences with 19% and the human sciences with 15% ($p = 0.36$).

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7.5.4Summary and discussion

In this chapter we zoom in on the details of the professorial career trajectory in Flanders. More specifically we examine how the careers of starting assistant professors within the Flemish university system evolve. For this research we looked at those who began their assistant professorship at one of the Flemish universities between 1999-2000 and 2016-2017 (N=+/-3,400).

On average, the number of starting assistant professors in the period between 2007 and 2016 was higher than in the preceding period of 1999-2006 (respectively 214/year versus 153/year). In 1999-2000 the share of women and non-Belgians among these starting assistant professors was low (24% and 8% respectively); a steady rise over time finally led to 41% women and 23% non-Belgians among the starters in 2016-2017.

Not all starting assistant professors continued their academic career in Flanders: seven years after starting, an average of 15% were no longer employed as professors in Flanders. The proportion of assistant professors who stopped their professor's career in Flanders was higher among non-Belgian assistant professors compared to their Belgian peers and lower in the medical and natural sciences compared to the other scientific clusters. The database contains no information on what has happened to the leavers; a part of them will have continued their academic careers outside Flanders, a part will have quit the academic career track, and of course some will no longer be part of the database because they are deceased.

The largest part of assistant professors who advanced to a next career step did so within seven to eight years after starting. The promotion to (senior) full professor occurred faster in the older cohorts, but in the end all cohorts presented a more or less equal share of assistant professors who had been promoted to (senior) full professor: somewhat less than one in three of the assistant professors still present had moved on to (senior) full professor nine years after starting. At that moment, an average of 18% was still employed as an assistant professor and 50% as an associate professor.

As known, there was an increase in the share of women among starting assistant professors[1]. Among the assistant professors who began in 2016-2017, 41% were women. There was no difference between men and women in terms of the age at which they were appointed as assistant professors. The analysis shows, however, that both in the 1999-2002 and the 2005-2008 cohort, women advanced less rapidly to a next career step. ECOOM-brief no 15 has already shown that the proportion of women has gradually been increasing at all levels of the professorial trajectory[1], but the current results based on the cohort starters from 1999-2002 and 2005-2008 do not show that this is related to an increasing speed of promotion among women compared to men.

The share of non-Belgians among starting assistant professors has steadily increased from almost non-existent to 23% in 2016-2017. Due to the low influx of non-Belgians at this level and the high share of leavers among non-Belgian assistant professors only a small number is eventually appointed as professor within Flanders. Their share in the total population of professors in Flanders may be compensated by non-Belgian professors who start as associate professors or higher, but this number falls outside the scope of the current analysis. The career progression of the remaining non-Belgian assistant professors does not differ from that of their Belgian peers.

The professorial career trajectory differed by the scientific clusters. In the medical sciences we observe the largest share of assistant professors who have not advanced to a further career step. This is partly due to the combination with clinical practice. Also striking are the findings in the applied and in particular in the natural sciences; in addition to a low share of leavers, we observe a faster promotion to a next step in the professorial career. Although previous results have shown that in the natural and the applied sciences it is more difficult to promote to professor at one of the Flemish universities after doctoral and/or postdoctoral research, and that on average it takes longer to do so compared to the other scientific clusters[2], the professorial trajectory in these clusters seems more stable and faster once it has started.

This is the first time a mapping of the career trajectory of assistant professors in Flanders is made. The figures allow to gain insight into this trajectory and to identify and monitor trends. These 3,400 incoming assistant professors are, of course, only a part of the entire pool of professors. For example, the approximately 1,300 persons who were employed as associate professors or (senior) full professors during the same period are not taken into account. However, the current chapter aims to report on the rather traditional academic career trajectory. In the future, the other group will also be subject to analysis, as this can provide important information about the influx from outside Flanders.

In the current chapter no distinction is made based on the appointment percentage of starting assistant professors. The main reason being that the intention was to capture all starting assistant professors. Moreover, given the discipline-dependent characteristics - for example, more part-time appointments in medical sciences - it is not easy to use a clear cut-off point that ensures that all disciplines are treated equally. This chapter serves rather as a basis and a starting point for further more detailed analysis whereby, if necessary, the appointment percentage of the starting assistant professors can be taken into account. Finally, it is worth mentioning that the policy on professorial careers may differ from university to university and that changes have taken place over time. Although interuniversity differences in Flanders in this respect are expected to be small, it might be worthwhile to explore this further on.

1. Debacker, N., Vandevelde, K. (2018) The share of women among professorial staff in Flanders (Belgium). ECOOM Brief 15: https://biblio.ugent.be/publication/8613159/file/8613163.pdf.
2. HRRF Basisindicatoren senior researchers update 2016-2017 (2019). ECOOM: https://www.ecoom.be/nodes/hrrfbasisindicatorenenkerncijfers/nl.

- Chapter 7.5.3
- 7.5 Summary

7.6Publications in questionable journals

By Raf Guns, Joshua Eykens and Tim Engels (University Antwerp)

In the summer of 2018, *De Morgen* and other Flemish newspapers published a series of articles in which they investigate to what extent Belgian researchers have published in so-called 'fake' or 'predatory' journals. The investigation was based on similar articles that appeared in the German press. While the debate in the popular press has settled down since then, in this dossier we aim to provide some factual information on 'predatory' publishing, in general and in Flanders.

7.6.1‘Predatory’, ‘fake’ and questionable journals

Open access (OA) publications are publications that are distributed online and are free to consult and reuse. This stands in contrast to traditional scholarly publishing, where the reader or their organization pays for access to the literature. Among several other OA business models, there is the ‘author pays’ model, in which the author pays a certain sum to the publisher, who in exchange makes the publication openly available.

Unscrupulous publishers can abuse the ‘author pays’ model by deliberately not carrying out all the tasks that are expected of them, while maximizing profit. Typically, predatory publishers and journals exhibit problems relating to one or more of the following areas:

- Integrity: does the journal or publisher pretend to be something they are not? This includes issues like fake ISSNs, pretending to be non-profit when that’s not the case, and causing confusion with a legitimate (high-profile) journal.
- Peer review: does the journal or publisher have an adequate peer review system and editorial board?
- Fees: does the journal or publisher communicate clearly and correctly about any fees?
- Access and copyright: does the journal or publisher have adequate (open) access and copyright policies and are these enacted in practice?
- Business practices: does the journal or publisher conduct its business appropriately and honestly?

The above list is based on Cabell’s blacklist criteria, which in addition also distinguish criteria relating to publication practices, and indexing and metrics. Taken together, these problems may lead to waste of funds and resources, poor quality research being given a false aura of reliability, and/or good quality research being available for a limited time or not at all. Since at least some items on the list relate more to low quality than deception (Eriksson & Helgesson, 2018), we opt to refer to these journals as ‘questionable journals’ instead.

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7.6.2Data sources

Generally speaking, there are two main types of data sources – lists of quality journals ('whitelists') and lists of questionable journals ('blacklists'). While there are many indexes of respectful journals, we especially want to mention the Directory of Open Access Journals (DOAJ) as an important resource of peer-reviewed OA journals that adhere to a set of well-defined quality criteria.

The most well-known data source on questionable journals is Beall's list of "potential, possible, or probable predatory scholarly open-access publishers" (and an associated list of standalone journals). The list was maintained by scholarly librarian Jeffrey Beall from 2008 until early 2017, when Beall took his entire website, including the lists, offline. During this period, Beall's list and blog were highly influential in raising awareness about questionable journals, but also quite controversial, in part because it was often unclear exactly why a certain journal or publisher appeared on the list. The investigation of Flemish researchers was based on Beall's list, specifically focusing on two major questionable publishers.

After the sudden disappearance of Beall's list, several potential successors emerged. These include:

- Cabells Journal Blacklist: an extensive list, including detailed reports per journal, maintained by analytics company Cabells and only accessible after purchasing a subscription;
- Beall's list of journals and publishers: an archived copy of Beall's original lists, to which the anonymous maintainer has added newer journals and publishers;
- Journal Black List: a list maintained by the Iranian Ministry of Health and Medical Education;
- List of journals removed from the DOAJ: while not directly intended to be used as such, this list can function as a blacklist, especially when focusing on those journals that are removed for "[s]uspected editorial misconduct by publisher".

It needs to be mentioned that, with the possible exception of Cabells Journal Blacklist, these resources are largely unstudied and not much is known about their characteristics and use.

The Antwerp group of ECOOM has been conducting yearly screenings of publications submitted to the VABB-SHW since 2014. Data sources have included Beall's list, DOAJ, Web of Science, and Cabells Journal Blacklist. The combination of several data sources avoids the situation where idiosyncrasies in one data source affect the treatment of some publications or journals. A recent analysis (Eykens, Guns, Rahman, & Engels, 2019) shows that the number of questionable journals in VABB-SHW (and publications therein) has increased until 2012 and decreased afterwards. This stands in contrast to the number of peer-reviewed journals and DOAJ-indexed journals in VABB-SHW, which are increasing without an inflection point in 2012. This finding also illustrates that questionable journals are not representative of open access journals in general.

- Chapter 7.6.1
- Chapter 7.6.3

7.6.3Authors of publications in questionable journals

Studies have shown that the majority of authors who publish in questionable journals are mainly inexperienced researchers coming from the Global South, although more experienced researchers and researchers from Western countries are also represented (Shen & Björk, 2015; Xia et al., 2015). One of the most controversial questions is to what extent these authors are themselves aware that they have submitted to a questionable journal: are they victims who have been misled about the true nature of the journal or have they deliberately submitted to an 'easy target', hoping to boost their publication counts? Kurt (2018) presents the results of a survey, showing that some authors are aware of the questionable nature of the journal in question, whereas others are not. In the latter group, there are different factors at play, with pressure to publish being identified as the main factor for researchers from Western countries.

Eykens et al. (2019) have investigated some aspects in greater detail for the set of publications found in the yearly ECOOM screenings. First, the findings show that publications in questionable journals are not just the result of lack of experience on the part of the authors: between 2004 and 2016, the proportion of senior authors in questionable publications was greater than 50% each year, and in 8 publication years greater than the proportion across all peer-reviewed publications. For publications with three or more authors, a junior author occupied the first position in the author list in 75% of the cases; this might be an indication that, at least in some cases, the leading author did not have sufficient research experience to distinguish genuine journals from questionable ones. On the other hand, in some fields in our data, alphabetical co-authorship is the norm and no hierarchy can be deduced from the order of authors in that case. In some cases, authors published in journals that were cognitively quite distant from their own field of research; this, too, may be a factor that contributes to getting 'tricked' into publishing in a questionable journal.

- Chapter 7.6.2
- Chapter 7.6.4

7.6.4Measures

The results of Eykens et al. (2019) give reason for some optimism: at least as far as VABB-SHW is concerned, publications in questionable journals appear to be on the decline in Flanders. It would be naïve, however, to assume that the problem will disappear by itself. Indeed, it seems likely that the decline is largely due to active countermeasures that have been taken in Flanders and internationally. Sustained efforts are needed to make sure that the positive trend continues in the future.

What measures can be taken? As mentioned before, regular screening is useful to assess the scope of questionable publishing and to make sure that researchers are not somehow 'rewarded' for such publications. In the case of VABB-SHW, the latter is obtained through the VABB-SHW's goal in the regional performance-based research funding system (Engels & Guns, 2019).

It is an important question whether researchers have sufficient information to decide which journals to choose or avoid. Nowadays, there are several excellent resources that help researchers to recognize questionable outlets, such as ThinkCheckSubmit and ThinkCheckAttend (for conferences). While for most practical purposes checklists like ThinkCheckSubmit are sufficient to recognize bad-faith outlets, researchers can also consult 'positive' lists like DOAJ or the VABB-SHW journal list as well as 'negative' lists like Cabells Journal Blacklist to obtain more information on a specific source.

Given the existence of various information sources, it seems that the problem is often not so much a lack of available information, as much as a lack of awareness. Hence, we believe that raising awareness with researchers is crucial. Many actors in Higher Education can play a role here. Universities can raise awareness with their researchers through various means, including the doctoral schools' training on scientific integrity. Learned societies can play an important role as well, by making their members aware of the dangers of questionable journals. Funding agencies can advertise more clearly their own policy regarding publications in questionable journals.

- Chapter 7.6.3
- Chapter 7.6.5

7.6.5References

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- Chapter 7.6.4
- 7.6 Summary