Samuel Neaman Institute
for National Policy Research

Science & Technology

Environment & Energy
Long-term Planning
Industry & Innovation
Physical Infrastructure
Health
Human Capital
Higher Education
Society
Education
Economy

# Evaluation of R&D Instruments for Fostering Academia-Industry Collaboration: The Case of the MAGNET Consortia


Dr. Eran Leck
Vered Gilad
Dr. Daphne Getz
Sima Tziperfal
Rinat Klein




March
2022

Samuel Neaman Institute
for National Policy Research

# Evaluation of R&D Instruments for Fostering Academia-Industry Collaboration: The Case of the MAGNET Consortia

Researchers:
Dr. Eran Leck
Vered Gilad
Dr. Daphne Getz
Sima Tziperfal
Rinat Klein

Haifa, March 2022

Technion, Haifa 3200003    Tel. 04-8292329
www.neaman.org.il    info@neaman.org.il

# ABOUT THE SAMUEL NEAMAN INSTITUTE

The Samuel Neaman Institute was established in 1978 in the Technion at Mr. Samuel Neaman's initiative. It is an independent multi-disciplinary national policy research institute. The activity of the institute is focused on issues in science and technology, education, economy and industry, physical infrastructure and social development which determine Israel's national resilience.

National policy research and surveys are executed at the Samuel Neaman Institute and their conclusions and recommendations serve the decision makers at various levels. The policy research is conducted by the faculty and staff of the Technion and scientists from other institutions in Israel and abroad and specialist from the industry.

The research team is chosen according to their professional qualifications and life achievements. In many cases the research is conducted by cooperation with governmental offices and in some cases at the initiative of the Samuel Neaman institute and without direct participation of governmental offices.

So far, the Samuel Neaman Institute has performed hundreds of exploratory national policy research projects and surveys that serve decision makers and professionals in economy and government. In particular the institute plays an important leading role in outlining Israel's national policies in science, technology and higher education.
The Samuel Neaman Institute's various projects and activities can be viewed at the Institute website.

The chairman of Samuel Neaman Institute is Professor **Zehev Tadmor** and the director is Professor **Irad Yavneh**.  The institute operates within the framework of a budget funded by Mr. Samuel Neaman in order to incorporate Israel's scientific technological economic and social advancement.

# TABLE OF CONTENTS

# LIST OF ILLUSTRATIONS

# LIST OF TABLES

# Acknowledgments

This research was supported by the Ministry of Innovation, Science and Technology (MOST). We thank MOST for their generous financial support which made this research possible.

We thank our research partners, Professor Natalja Apanasovich, Dr. Radzivon Marozau and Nikolai Zianchuk from the School of Business Management and Technology at the Belarusian State University (BSU) for their insights and knowledge sharing.

We thank Dr. Aviv Zeevi, Dr. Assaf Kovo, Moshe Avrahami, Yael Hay Knobel and Elior Bliah from the Israel Innovation Authority for their support, collaboration and data sharing.

Finally, we thank Mr. Golan Tamir, Information Systems Manager at the Samuel Neaman Institute for his important technical support.

# תקציר מנהלים

בעשורים האחרונים, מדינות רבות מעורבות באופן נרחב בפיתוח כלי מדיניות, תוכניות ומכשירי מו"פ שמטרתם לחזק חדשנות. חלק גדול ממאמץ זה מופנה לקידום שיתוף הפעולה בין האקדמיה לבין התעשייה ולשיפור מנגנוני העברת הידע בין שני שחקנים אלו. בישראל, מכשירי המו"פ החשובים ביותר לשותפויות אקדמיה-תעשייה מקודמים ונתמכים על ידי רשות החדשנות. הרשות אחראית על חיזוק התשתית התומכת באקו-סיסטם החדשנות הישראלי ומסייעת בפיתוח טכנולוגיות חדשות ובקידום שיתופי פעולה בארץ ובעולם.

למרות שהמסגרת האופרטיבית לשיתוף פעולה בין האקדמיה לבין התעשייה מוגדרת יחסית היטב בישראל באמצעות מגוון מכשירי מו"פ, מחקרים עדכניים מצביעים על קשיים ומכשולים בשותפויות אלו המעכבים את העברת הידע ומונעים משני המגזרים הללו לנצל את הפוטנציאל שלהם באופן אופטימלי. חלק ממכשולים אלו נובעים מהיעדר תקשורת, מפערי תרבות בין המגזרים, מאי הסכמה על זכויות קניין רוחני ומהצבת חסמים מצד החברות להעברת ידע באוניברסיטאות. בעוד זיהוי המכשולים והקשיים חשוב והכרחי, הם טרם נבחנו בהקשר הרחב יותר של הדרך בו הם מושפעים או ממותנים ע"י מכשירי המו"פ הקיימים. אתגר זה מספק הן את הטריגר המדעי והן את הזרז האמפירי למחקר זה.

במחקר זה אנו מיישמים גישה מקיפה ושיטתית למיפוי וההערכה של מכשירים וכלי מו"פ ממשלתיים קיימים לשיתוף פעולה בין האקדמיה לבין התעשייה בישראל ובמדינות נבחרות. דגש מיוחד מושם על הערכת תוכנית מאגדי מגנ"ט, המהווה את ספינת הדגל של תוכניות המו"פ של רשות החדשנות.

מטרת המחקר היא לבצע ההערכה של תוכנית מאגדי מגנ"ט מבחינת האפקטיביות, ההשפעה והתוצרים. יעדי המחקר הם ללמוד מהניסיון של מודלים ותוכניות דומות בקבוצת המדינות המפותחות, לבחון את טיב מנגנון העברת הידע בין האקדמיה לבין התעשייה, לבחון ולנתח את הזרזים ואת החסמים לשיתוף פעולה ולנסות לאמוד את התועלת של שיתופי הפעולה הסינרגטיים לחברות, לאקדמיה ולמשק.

אוכלוסיית המחקר כוללת חוקרים מקבוצות מחקר מהאקדמיה ומהתעשייה שהשתתפו במסלול מאגדי מגנ"ט בפרויקטים שהסתיימו לפני כשנתיים. אוכלוסייה זאת כוללת כ-20 מאגדים שפעלו בין השנים 2020-2006 ומורכבת מ-130 חברות מהתעשייה ומ-17 מוסדות אקדמיים שונים.

המתודולוגיה משלבת ניתוח של מקורות ראשוניים (ניתוח איכותני של דוחות מאגדים) עם שיטות המבוססות על דיווח עצמי (שאלונים מקוונים, ראיונות מובנים) וכוללת ניתוח כמותי ואיכותני. נערך סקר ספרות בנושא שת"פ אקדמיה-תעשייה וסקירה של מכשירי מו"פ לקידום שת"פ אקדמיה-תעשייה במדינות שונות. מדוחות המאגדים המסכמים, המוגשים לרשות החדשנות בסיום פעילות המאגד נאספו ומוצו תובנות רבות הקשורות לתפוקות והישגי המאגדים, ביניהן: מימוש תוכניות העבודה ועמידה ביעדים שהוגדרו; אופי העבודה מול האקדמיה וטיב שיתופי הפעולה בין המשתתפים השונים; התייחסות ללקחים והמלצות לשיפור מאגדי מגנ"ט; ביקורת על ניהול המאגד וניתוח של הממשקים בין החברות והמוסדות האקדמיים לבין רשות החדשנות.

כלי המחקר המרכזי בו נערך שימוש לשם ההערכת תוכנית מאגדי מגנ"ט היה סקר עמדות מקוון. במסגרת המחקר נבנו שני שאלונים גנריים שונים, האחד לחוקרים מקבוצות מחקר מהאקדמיה והשני לשותפים מהתעשייה. השאלונים הורכבו משאלות סגורות ומשאלות פתוחות. בעת מילוי השאלון, התבקשו הנשאלים לבחור את החלופה המתאימה ביותר מבחינתם מתוך מספר תשובות אלטרנטיביות, או לדרג את העוצמה (בסקלת ליקרט אורדינאלית) של גורמים או מאפיינים שהוצגו בפניהם. השאלונים כללו שאלות בתחומים הבאים: פרטים על ממלא השאלון, פרטים על מאפייני המאגד, השיקולים והמוטיבציה להשתתפות במאגד, הגורמים המשפיעים על יצירת שת"פ בין האקדמיה לבין התעשייה, החסמים והזרזים לשת"פ, תועלות ותוצרים ישירים ובלתי ישירים כתוצאה מהשתתפות במאגד, קריטריונים להצלחת המאגד ופטנטים וקניין רוחני. בשל הצורך לערוך הכללה ולהסיק מסקנות לגבי התופעות הנחקרות, בניתוח השאלות הפתוחות בשאלון נערך שימוש

בטקסונומיה איכותנית אשר סיווגה את התגובות הטקסטואליות לקטגוריות או קבוצות של תגובות בהתאם לדמיון התוכני שלהן. שכיחויות הקטגוריות ששויכו לכל נושא סוכמו ובוצעה טרנספורמציה מתמטית אשר אילצה כל קטגוריה לקבל ערך הנע בין 1 ("רמת עוצמה נמוכה") ל-5 ("רמת עוצמה גבוהה"). הסקרים נשלחו למשתתפי תוכנית המאגדים באמצעות פלטפורמת שאלונים מקוונת (דואר אלקטרוני) המאפשרת ליזום את הפנייה, לבצע מעקב אחר המשיבים בזמן אמת, לאסוף את הנתונים באופן אגרגטיבי ולייצא אותם לתוכנה סטטיסטית לצורך ביצוע ניתוחים מפורטים. מתוך כ-900 שאלונים שנשלחו, התקבלו 174 שאלונים מלאים (100 מהתעשייה ו-74 מהאקדמיה).

נערכו מספר ראיונות אישיים עם חברי מאגדי מגנ"ט מהאקדמיה ומהתעשייה. הראיונות התמקדו בבחינת טיב שיתוף הפעולה בין האקדמיה לבין התעשייה, בבחינת האפקטיביות, התוצרים והתועלות של המאגד לחברות ולשותפים מהאקדמיה ובבחינת הממשקים של השחקנים השונים עם רשות החדשנות ובהצעות לשיפור התוכנית.

לאחר תהליך איגום וניתוח הנתונים נערכה טריאנגולציה של מקורות המידע שכללה השוואה והצלבה בין הנתונים על מנת לזהות דפוסים חוזרים ולהגיע לתובנות על מאפייני שיתוף הפעולה, הזרזים והחסמים לשת"פ והדרכים לשיפור התוכנית. להלן עיקרי המימצאים:

- תובנות שנאספו מסקירת הספרות ומההערכה של כלי מו"פ שונים בארץ ובעולם שמטרתם לקדם שיתופי פעולה והעברת ידע בין האקדמיה לבין התעשייה מדגישות את השונות בהיקף, במאפיינים, במטרות ובתוכניות המימון של המכשירים השונים. רובם המכריע של כלי המו"פ שנבדקו כוונו לתמיכה בפרויקטים לטווח הקצר או הבינוני. נמצא כי שותפויות מסוג מאגדים שמות דגש רב יותר על שיתופי פעולה בנושאיים רב-תחומיים, בעוד שותפויות אינטימיות או פרויקטים (שותפות למשל בין קבוצת חוקרים ממוסד אקדמי לבין חברה אחת) קידמו בדרך כלל נושאים או יעדים ספציפיים.
- קיום דו-שיח וערוצי תקשורת יעילים, תיאום ציפיות ומטרות ויצירת אמון ומחויבות הנם הגורמים החשובים ביותר לקיום השת"פ בין האקדמיה לבין התעשייה. לא נמצאו הבדלים מובהקים בין האקדמיה לתעשייה בהיבטים אלו.
- הנושאים של הסכמה על סוגיות קניין רוחני ומסחור ידע מהווים גורמים בעלי חשיבות פחותה לשת"פ בין האקדמיה לבין התעשייה (אם כי הן נושאים קריטיים לשת"פ בין חברות), בשונה מההיבט של העברת ידע הנתפס כנושא חשוב לקיום השת"פ הן בקרב השותפים מהאקדמיה והן בקרב השותפים מהתעשייה.
- כ- 83% מהמשתתפים מהתעשייה סבורים כי איכות השת"פ בתוכנית המאגדים הייתה גבוהה או גבוהה מאוד לעומת 69% מהחוקרים באקדמיה.
- הזרזים העיקריים שזוהו לקיום שת"פ יעיל הם: מיתון פערי ידע בין האקדמיה לבין התעשייה וקידום יכולות משלימות; היכרות מוקדמת בין השותפים ויחסים אישיים טובים (רמת עוצמה גבוהה); הגדרת מטרות ברורות ותואמות, העברת ידע ומסחור ידע (רמת עוצמה בינונית); קידום סטודנטים, הסיוע הפיננסי של רשות החדשנות, מצוינות של השותף האקדמי, רמת הניהול המקצועי של המאגד ונהלים בירוקרטים כמו קיום פגישות מסודרות (רמת עוצמה נמוכה).
- החסמים העיקריים שזוהו לקיום שת"פ יעיל הם: מטרות ויעדים שונים, אי הבנה והתחשבות בצרכים המשותפים, אי רצון להעברת ידע, קצב עבודה לא תואם, אמון ומחויבות נמוכים למאגד, פערי תרבות בין האקדמיה לבין התעשייה (רמת עוצמה גבוהה); אי הסכמה על סוגיות קניין רוחני, חוסר סנכרון בין השותפים, פער בין ידע תיאורטי ואפשרות יישום (רמת עוצמה בינונית); שינוי מטרות "תוך כדי תנועה", בעיות תקשורת, בירוקרטיה ותקצוב נמוך של הפרויקט במאגד (רמת עוצמה נמוכה).
- התוצרים הבולטים של תוכנית מאגדי מגנ"ט הם: כתיבת מאמרים מדעיים (בעיקר אקדמיה), המשך המחקר המשותף במסגרת אחרת , קיום סמינרים וימי עיון והמשך מחקר עצמאי באקדמיה.
- כ-30% מהחוקרים באקדמיה הגישו לפחות בקשה אחת לפטנט שנבעה באופן ישיר או עקיף מתוצרי המו"פ של המאגד, לעומת 24% מהמשתתפים מהתעשייה.
- כ-42% מהמשתתפים מהתעשייה סברו כי השת"פ תרם במידה רבה או רבה מאוד לביסוס הקניין

הרוחני של החברה, לעומת 26% מהחוקרים באקדמיה שסברו כי שת"פ זה תרם לביסוס הקניין הרוחני של האוניברסיטה. נמצא כי השונות בהתפלגות בין שתי האוכלוסיות מובהקת סטטיסטית.

- התועלות הבלתי ישירות (spillovers) שזוהו כתוצאה מהשתתפות במאגד: יישום הידע שפותח במאגד לתחומים ומוצרים אחרים (רמת עוצמה גבוהה); התועלת הכלכלית לחברה, קידום שת"פ במסגרות אחרות (רמת עוצמה בינונית); חשיפה והכשרת סטודנטים לתעשייה, קידום ההון האנושי בחברות, קידום מחקרי המשך, יצירת תשתיות מחקר וחיזוק האקוסיסטם (רמת עוצמה נמוכה).

להלן ההצעות וההמלצות העיקריות לשיפור התוכנית:

- לתת קדימות לפרויקטים הרחוקים מבשלות ליישום תעשייתי ובעלי סיכון גבוה ושהתעשיות לא מעוניינות לקחת על עצמן.
- לתת יותר מעמד לאקדמיה – בהקמה, בהכוונה ובהובלה של המאגד.
- להקטין את המאגדים (יותר מידי שותפים).
- לצמצם היבטי בירוקרטיה ו"מיקרו-ניהול".
- לתקן את ההטיה של התוכנית כלפי החברות הגדולות. רוב המו"פ מתבצע ע"י החברות הקטנות והאקדמיה ונתון לשימוש החברות הגדולות, אך לא להפך.
- לשפר את שיעור המימון של החברות הקטנות.
- לשתף יותר חברות הזנק בתוכנית.
- לשקול אפשרות לצרף שותפים חיצוניים במהלך פעילות המאגד, במעמד דומה לחברות או מעמד מיוחד אחר.
- לחזור לתקופת מאגד של חמש שנים במקום שלוש כדי לאפשר הבשלה מקסימלית של המחקר.
- לפתח מערכת לניהול הנתונים והמידע שנצבר לאורך השנים מהמאגדים.
- לקדם את הפיתוח של מסד נתונים מובנה על פרויקטים של מאגדי מגנ"ט אשר יצייד את משתתפי התוכנית ואת רשות החדשנות הישראלית עם נתונים טכניים ופרוצדורליים על תוכנית המאגדים ויסייע בקבלת החלטות.

# Executive Summary

In the past few decades, many nations have been increasingly involved in the development of tailored policy instruments and tools aimed at strengthening R&D and innovation. Much of this effort has been directed towards promoting collaboration between the academia and the industry and in facilitating knowledge transfer between these two actors. In Israel, the most important STI instruments for academia-industry partnerships are promoted and supported by the Israel Innovation Authority (IIA). The IIA is responsible for strengthening the infrastructure which supports the Israeli innovation ecosystem, assisting in the development of new technologies and promoting cooperation in R&D both nationally and internationally.

Although the operational framework for cooperation between the academia and the industry is relatively well defined in Israel, recent research points out to substantial difficulties and obstacles in these partnerships which hinder knowledge transfer and prevent these two sectors from utilizing their full potential. These obstacles include lack of communication and continuous dialogue, cultural differences, conflict over IP rights, lack of IPR management capabilities, absence of mechanism for sharing IP and poor performance of university TTOs. While the obstacles and difficulties identified in the literature are very important and useful, they have yet to be addressed within the larger context of revisiting existing mechanisms and policy instruments. This challenge provides both the scientific and empirical trigger for this research.

In this project, we implement a comprehensive and systematic approach for mapping and evaluating existing government tools and instruments for academia-industry collaboration in Israel and in selected countries. A special emphasis is placed on the evaluation of the IIA MAGNET Consortia Program, which constitutes the flagship of the IIA R&D instruments. The main goals of the research are to evaluate the effectiveness of the MAGNET Consortia Program in terms of the cooperation between the partners, as well as the main achievements, contributions and outputs of the program from the viewpoint of both sectors. In order to identify the key catalysts and obstacles for joint partnerships between the academia and the industry, we employ several qualitative and quantitative tools to facilitate an integrated examination and analysis of the investigated phenomena. This examination involves the implementation of self-report methods (semi-structured interviews with researchers from the academia and the industry; surveys aimed at evaluating the MAGNET instrument) with an analysis of primary sources (textual analysis of MAGNET final reports and open-end questions from the surveys). This synthesis examination will be targeted at identifying and addressing existing gaps and providing recommendations for stakeholders.

The research population includes researchers from the academia and R&D personnel and executives from industrial companies who participated in 20 IIA MAGNET consortia projects between the years 2006 and 2020. These researchers and R&D personnel come from 130 companies and 17 different academic institutions (research universities, academic colleges, public research institutions and hospitals).

Insights gathered from the review of the literature involving a cross-national evaluation of R&D policy instruments, tools and programs for promoting collaboration between the academia and the industry accentuate the differences in the scope, characteristics, goals and funding schemes of the different instruments. The overwhelmingly majority of the reviewed tools and instruments were directed towards supporting either short-term or medium-term projects. Consortia type partnerships were found to place much more emphasis on multi-disciplinary thematic collaborations, whereas project-oriented projects were more limited to specific themes or objectives.

The findings of the research reveal a high degree of compatibility between the results of the R&D instrument evaluation (MAGNET Consortia case study) and the findings reported in the literature with regards to the factors which hinder and facilitate academia-industry cooperation. The main obstacles that were reported, both in the literature and in the framework of this research include: lack of compatibility of goals and objectives; cultural differences between the academia and industry; misunderstanding of mutual needs; a gap between theoretical knowledge and its implementation and disagreement between the partners on IP rights and commercialization aspects. The main catalysts for successful academia-industry partnerships that were identified both in the literature and in the framework of this study include: reduction of knowledge gaps and the promotion of complementary goals; understanding and accepting cultural differences; setting clear goals and objectives; having high degree of mutual commitment; previous experience and familiarity with the partners; good personal relationship; agreement on IP rights in the beginning of the project and utilizing government support, mechanisms and policy tools.

Findings obtained from the analysis of the research surveys and the personal interviews reveal that the main considerations for joining the MAGNET Consortia program were the development of breakthrough technology, the financial support of the Israel Innovation Authority and the collaboration between the consortium's members. Other motivations include the support of research students, exposure to problems and challenges in the industry, access to data originating from the industry (academia only); the ability for mutual "brainstorming" and the possibility of continuing the research with the academic or industrial partner at the end of the MAGNET project. The data also shows that consortia members from the academia attributed higher importance level (as compared to industry members) to the IIA financial support for being a major driver for joining the MAGNET Consortia Program. Statistical difference between the academia and the industry was also found in the perceived ability of the program to promote knowledge commercialization, whereas industry consortia members attributed higher importance to this factor, as compared to academia consortia members.

According to the self-reported survey data, the main outputs of the MAGNET Consortia Program were scientific papers (noted by 88% of academia participants and 50% of the industry participants), continuing research (61% academia and 58% Industry), the support of graduate students (noted by 57% of Academia participants) and attending and presenting in conferences (51% academia and 37% industry). Surprisingly, patent applications were stated as an output only among one third of the MAGNET Consortia participants. About 42% of industry participants believe that their collaboration with the academia has contributed to a large or very large extent to the establishment of the company's intellectual property. In comparison, only 26% of the participants from the academia believed that their collaboration with the industry has contributed to the establishment of the university's IP.

The research also identified indirect benefits resulting from the participation in the MAGNET program. These spillovers include the application of the technology developed in the framework of a specific consortium to other technological fields, strengthening and expanding the cooperation to other research ventures; the exposure of university students to work in the industry, strengthening the human capital in the industry and boosting the local innovation ecosystem.

The findings of this research can supply various government actors in Israel (e.g. Israel Innovation Authority) key insights for the formulation of public policy in the field of R&D instruments. Our recommendations for the improvement of the MAGNET Consortia Program are as follows:

- Eliminate excessive bureaucracy (e.g. reduce paper work and the number of mid-term reports).
- Address the bias of the program towards big companies and include more startup companies in MAGNET projects.
- Improve the IIA financial subsidy given to smaller companies.
- Consider the possibility of joining external partners to MAGNET Consortia projects (e.g. special status partners).
- Consider reinstating the “five-year project period” (instead of a three-year period today), especially in selected high-risk projects, in order to allow MAGNET projects to reach maximal maturity level.
- Continue and intensify the support for high stake projects that are not ripe for industrial application and that industrial partners are hesitant to take upon themselves due to the high risk, even at the expense of less tangible outputs or products.
- Provide a more prominent role and status to the academia in the establishment, guidance and leadership of the MAGNET Consortia.
- Promote the development of a structured database on MAGNET Consortia projects, which will equip both Consortia partners and decision makers at the IIA with valuable technical and procedural data on MAGNET projects.

The research is a part of the Israel-Belarus bilateral call “Methodologies and models for shaping national scientific policy". The research was jointly funded by the State Committee on Science and Technology of the Republic of Belarus (SCST) and the Israel Ministry of Innovation, Science and Technology (MOST). The project took place from November 1, 2019 to November 30, 2021, with the participation of the Samuel Neaman Institute for National Policy Research (SNI) and the Belarusian State University (BSU).

# Introduction

In the past few decades, many nations have been increasingly involved in the development of tailored policy instruments and tools aimed at strengthening R&D and innovation. Much of this effort has been directed towards promoting collaboration between the academia and the industry and in facilitating knowledge transfer between these two actors. In Israel, the operational framework for cooperation between the academia and the industry is relatively well defined due to the existence of sophisticated government instruments and tools for fostering and supporting innovation. Yet, recent research points out to substantial difficulties and obstacles in these partnerships which hinder knowledge transfer and prevent these two sectors from maximizing their full potential. Some of these obstacles include lack of communication and continuous dialogue, cultural differences, conflict over IP rights, lack of IPR management capabilities, absence of mechanism for sharing IP and poor performance of university TTOs.

In this project, we implement a comprehensive and systematic approach for mapping and evaluating existing government tools and instruments for Academia-Industry collaboration in Israel and in selected countries. A special emphasis is placed the evaluation of the IIA (Israel Innovation Authority) MAGNET Consortia Program, which constitutes the flagship of the IIA R&D instruments. In order to identify the key catalysts and obstacles for joint partnerships between the academia and the industry, as well as identifying and addressing the existing gaps, we employ several qualitative and quantitative tools to facilitate an integrated examination and analysis of the investigated phenomena.

The report is organized as follows: Chapter 1 provides the literature overview for this work, focusing on the specific elements and factors which hinder and promote academia-industry cooperation and technology transfer.  Chapter 2 provides a cross-national comparative analysis of selected R&D instruments in Israel and abroad designed to facilitate academia-industry collaboration. Chapter 3 reviews the methodological framework of the research, including the research goals, the research questions, research population and research data. Chapter 4 reports the findings of the research based on a triangulated methodological approach (fusing primary-source data analysis and self-report data analysis), which identifies and maps the key catalysts and obstacles for academia-industry collaborations in Israel and analyzes the effectiveness and impact of a specific R&D tool (IIA MAGNET program) in contributing to this end. Chapter 5 concludes and summarizes the research findings and provides recommendations for policy makers.

# Chapter 1: Literature Review

Science, technology and innovation (STI) policies are part of more inclusive and comprehensive policies for the promotion of R&D growth, ensuring that firms, consumers and the government have access to appropriate and up-to-date technology at the lowest possible cost (Ergas, 1987; Freeman, 2015). Here, it is important to distinguish between science policy and innovation policy. Science policy mostly relates to policies needed to promote scientific research, determine and select scientific objectives and goals consistent with national plans or strategies, and exercise judgment in fixing norms to govern the ways and means by which science is developed, transferred and applied (Freeman, 2015; Huggel et al., 2015; Schot and Steinmueller, 2016; UNESCO, 2016). Innovation policy on the other hand relates to important questions dealt by policy-makers in the field of science policy. These include establishing and strengthening government structures and mechanisms for planning, budgeting and coordination, managing and promoting scientific research, monitoring national scientific development and maintaining a proper balance between basic and applied research (Etzkowitz and Ranga, 2015; McKelvey and Saemundsson, 2018; Schot and Steinmueller, 2018; UNESCO, 2016).

In the past two decades, the scope of cooperation between the business sector and the academic sector in mutual R&D oriented projects and partnerships has sharply risen. This trend had a significant impact on the path and the design of national R&D policies, as research was not only associated with universities but also with industrial actors and government agencies who often budget mutual academia-industry partnerships through specific tools and instruments (Freeman 1995; Godin and Schauz, 2016; Geiger, 2017).

Historically, university faculty and their departments regarded their mission as twofold – conducting research and teaching students. However, over the last few decades this perception has changed (Rubens et al., 2017) and involves an additional role. The "third mission" entails a variety of activities, including not only research, development and innovation but also social engagement with the surrounding society (Laredo, 2007; Molas-Gallart and Castro-Martínez, 2007). There are three interpretations of the concept of universities' third mission. One is associated with a 'third source of income' or a third stream of revenue related to knowledge transfer and licensing intellectual property rights (IPR) in collaboration with the private sector. Another interpretation associates the third mission with direct activity for the commercial exploitation of universities' resources and research through licensing, consulting and advisory services, and spin-out firms - e.g. technology transfer. A third interpretation is associated with *societal outreach* (Piirainen et al., 2016).

Knowledge transfer refers to the multiple ways in which knowledge from universities and public research institutions can be exploited by firms to generate economic and social value and industry development (OECD, 2013). It encompasses a broad range of activities to support the collaborations between universities, industry and the public.

Knowledge transfer from the academia to the industry flows through both formal (direct) and informal (indirect) channels. While formal technology transfer is seen as a mechanism to allocate property rights, informal technology transfer is much more about informal communication processes (Grimpe and Hussinger, 2013). Examples for formal channels for technology include: creation of joint-ventures, patents and granting licenses, creation of spin-out companies by university personnel and commercial partners, contract research and consultancy, problem solving, sharing research facilities and equipment. Indirect modes of knowledge transfer include: networking, participation in joint conferences, joint journal publications, student placements and graduate employment and collaborative research (Miller et al., 2018; Schaeffer et al., 2018). Formal and informal technology transfer cannot always be easily isolated from each other. There are many forms of academia-industry collaboration which are acceptable in universities, for example, receiving research funds from companies or a day per week consultancy work done by researchers for companies. Temporary leave of absence which researchers take in order to work in industry for a given period can also be beneficial for universities because they often result in upgraded teaching skills (Bentur et al., 2021).

The literature suggests that formal and informal technology transfer may go well together. Informal contacts improve the quality of a formal relationship and formal contracts are accompanied by an informal relation of mutual exchange on technology-related aspects (Grimpe and Hussinger, 2013).

Societal outreach and engagement entail a dialogue with the society through a number of mechanisms such as consultancy services, expert advice, public access to teaching, etc. Spiel (2017) highlights four key criteria for third mission social engagement: expand teaching to the relevance of society/economy, expand research to the relevance of society/economy, networking with society/economy, future orientation and sustainability. She considers social engagement, knowledge transfer and technology and innovation transfer as three key dimensions of the third mission of the university.

## Barriers and Obstacles for Academia-Industry Collaboration

Contemporary studies on academia-industry collaborations points out to several factors that hinder knowledge transfer and prevent the academia and the industry to utilize their full potential:

- Lack of compatibility of goals - universities and companies are looking for different outcomes. Universities wish to publish findings whereas companies seek to withhold them from competitors (Newberg and Dunn, 2002).
- “Cultural differences” between the two actors – while the academia is driven by curiosity, academic freedom, publishing research findings in peer-reviewed journals and “long run” vision, the industry is motivated by economic interests, confidentiality, hierarchical management structure and “short term” goals (Trigger-Foresight, 2011).
- The complex structure and inflexibility of universities is opposed to the flat hierarchy of company management. Also, bureaucracy on behalf of the Government often constitutes a barrier both for the academia and for the industry.

- Lack of communication between the academia and the industry – industrial needs do not come to the attention of the academia and basic research that has industrial potential does not receive enough exposure in the business sector (Trigger-Foresight, 2011).
- Conflict over IP rights – there is a clash of interests around IP ownership between the universities (through their TTOs) and the industry.
- There is too much emphasis on behalf of universities and TTOs on the maximization of revenues from IP instead of focusing on the maximization of research funds (Bentur et al., 2021).
- Lack of national guidance or tailored policy tools in some countries.

## Factors Facilitating Fruitful Academia-Industry Collaboration

Several studies conducted in recent years have identified best practices for facilitating fruitful academia-industry collaboration (e.g. Rybnicek and Königsgruber, 2019; De Wit-de Vries et al., 2019). The main agents identified as catalysts for successful partnerships involve institutional factors, relationship factors, output factors, framework factors and other factors relating to mutual objectives, goals, strategy, visions, plans or shared outcomes. These include:

- Having clear aims, planning as realistically as possible, agreeing on responsibilities, specifying the extent of the contribution of each partner and defining roles right at the beginning (Rybnicek and Königsgruber, 2019).
- Commitment - the degree of identification with the collaboration and its goals.
- Trust is another important factor in fostering academia-industry partnerships. In successful collaborations, partners experience trust as a supportive factor, while in modest collaborations the lack of trust is often mentioned by partners as negatively affecting the collaboration project (Rajalo and Vadi 2017).
- Ability of partners to learn about and understand one another. Both companies and universities benefit when they closely work together and use each other's experience and feedback for further improvements (Ryan, 2009; Rybnicek and Königsgruber, 2019).
- Understanding and accepting cultural differences. Partners have to handle the cultural gap between industry and universities carefully and must achieve a balance between each partner's requirements and priorities. Successful partnerships identify and deal with cultural gaps and discrepancies in the early stages of the project (Schein, 2004; Rybnicek and Königsgruber, 2019).
- Good personal relationships are the basis to enabling vital linkages between companies and universities. This includes regular interaction, continuous feedback, mutual exchange of information and updating partners about incidents or new activities (Guan et al. 2005; Rybnicek and Königsgruber, 2019).
- Absorptive capacity refers to the capability of firms to absorb new knowledge depends on the shared knowledge base of the academics and the firm employees. Technological relatedness and technological capability (which increases absorptive capacity) were found as the most important facilitators of knowledge transfer in university–industry collaborations (De Wit-de Vries et al., 2019)
- Geographical distance- A suitable geographical distance enhances the access to highly qualified facilities and human resources and makes the collaboration between industry and university partners more likely (D'Este et al. 2012).

- Utilizing government support, mechanisms and policy tools:
    - Tax incentives, public funding (through tailored policy tools) or the governmental network can greatly contribute to successful partnerships.
    - Confidentiality and non-disclosure agreements play an important role in joint projects and the setting up of proper agreements is an important task for the participating partners. Being clear about expectations regarding market potential, IPR policies, ownership and patent earnings or about the exploitation of project results. Government can play a role in mitigating differences between the parties (Rybnicek and Königsgruber, 2019).

# Chapter 2: Policy instruments for Academia-Industry Cooperation: A Cross-national Comparative Analysis

## Policy Instruments in the Israeli Innovation Ecosystem

The government sector is responsible for creating a system that defines and regulates the innovation process. In the contemporary knowledge-based economy, STI policies are promoted by tailored STI instruments and policy tools. These are the levers by which governments and organizations ultimately implement the decisions on a day-to-day basis and attempt to produce the desired effect on the variables the policy has set out to influence. Policy instruments include financial instruments (e.g. R&D tax credits, export incentives, soft loans, etc.) and regulatory instruments such as laws and binding regulations (UNESCO, 2016).

In Israel, the most important STI instruments for academia-industry partnerships are promoted and supported by the Israel Innovation Authority (IIA), formerly the Office of the Chief Scientist at the Ministry of Economy. IIA is responsible for creating and strengthening the infrastructure and framework required to support the Israeli innovation ecosystem, assisting in the development of new technologies and promoting cooperation in R&D both nationally and internationally (UNESCO, 2016).

Several IIA operational policy instruments were designed and formulated to encourage collaboration between industrial companies (including start-ups) and academic institutions. The following includes a short review of selected IIA programs and instruments[1]:

- **MAGNET Program** - a program for encouraging collaboration among industrial companies and between companies and researchers from academic institutions, through several instruments that deal with innovative technologies. This incentive program includes three consortia types:
    - **Industrial consortium** – includes technology leaders from the Israeli industry that have a significant presence in the global market and researchers from the academia with broad knowledge in the fields relevant to the consortium. The consortium's members usually come from numerous technology fields. The consortium's products must produce a potentially large impact on the Israeli economy.
    - **Knowledge-Building Consortium** – this consortium focuses on applied academic studies in fields in which the industry is not yet ready to play a significant part in the R&D process. The industrial companies in this consortium serve as mentors and consultants.
    - **Ma'agadon** – this consortium is relevant for a limited number of companies that receive assistance from a small number of academic researchers for focused technological development that may have a significant influence on the companies' business activity.

[1] https://innovationisrael.org.il/en/page/programs

- **MAGNETON** – encouraging the transfer and commercialization of technologies from a research institute to an industrial corporation. These partnerships are based on collaboration between one or more research institutes and a single industrial corporation. They are focused on repeating and validating study results as submitted by the research institute and on adapting the knowledge to the needs of the industrial corporation.

- **Knowledge Import** – encouraging collaboration that repeats and validates the research findings transferred from a foreign research institute. The instrument is designed to prove the feasibility and adapt the knowledge to the applicant's needs. Development of the technology is based on collaboration between the applicant and one or more foreign research institute.

- **Applied Research in the Academia** - this program incentivizes applied research with innovative technological feasibility originating in the academia that is advanced to the stage at which an Israeli industrial company will adopt it to develop a commercial product. The program's goal is to bridge the knowledge gap between the academia and the industry, with the option of leading a project to significant milestones, thereby attracting the interest of business entities and ultimately achieving a commercialization agreement between the two parties.

- **TELEM Forum –** The program aims at promoting consultation and coordination between the forum's member entities on issues relating to R&D; initiation, coordination, assessment, pooling of resources (from the budgets of the forum's member entities and other relevant bodies) and assignment of responsibility for implementation and supervision of the establishment and operation of national R&D infrastructures (IIA website[2]).

## Comparative Analysis of Policy Instruments for Fostering Academia-Industry Collaboration

In the framework of this section, we present a comparative, cross-national review of various policy instruments, tools and programs aimed at promoting collaboration between the academia and the industry. This comparative analysis places an emphasis on the specific dimensions and characteristics of these instruments and their role in facilitating cooperation and technology transfer between the two parties. Table 1 presents a comparison between the IIA R&D instruments described in the previous section and other similar foreign tools and programs. An in-depth description of each instrument is detailed in Annex 1. The analysis covers both international and national R&D instruments in the following countries and territories: The European Union, Switzerland, Denmark, the United Kingdom, Norway, Sweden, Austria, Belgium, the United States, Israel and Belarus.

As can be clearly seen from the table, there is a large variance between the instruments with regards to their main characteristics and dimensions, as demonstrated by their stated goals, the type of partnership in which they are set to

[2] https://innovationisrael.org.il/en/page/programs

promote, the technological fields in which they support or cover and the extent and duration of the financial subsidy in which they offer for their beneficiaries.

The main goals and the objectives of the various R&D instruments vary widely and include themes such as bridging intra-sectoral and inter-sectoral knowledge gaps and promoting knowledge transfer from the academia to the industry (e.g. Applied Research in the Academia; MAGNETON, BRIDGE, COIN, COMET, Beyond Europe); Providing early proof of concept (Applied Research in the Academia, ISCF Hub pre-announcement); Promoting knowledge commercialization (Applied Research in the Academia, MAGNETON, MAGNET, MEIMAD, BRIDGE, COIN, PFI, GOALI); creating integration between different knowledge fields and supporting generic or innovative technologies (e.g. MAGNET, Eureka Eurostars, Eureka Globalstars) and addressing societal challenges (Belarus Innovative infrastructure, SCCER, Norway's Knowledge Building Project and Collaborative Project to Meet Societal Needs).

The instruments also differ in the scope of partnerships or collaborations: from single and targeted projects which are designed to promote cooperation between individual researchers from the academia and a single company (MAGNETON, Applied Research in the Academia, Knowledge Import, SSTP, Network Plus, Knowledge Building Project and Collaborative project to meet Societal needs, ICON artificial intelligence, PFI, GOALI) to large consortia structures which involve large research groups and labs from the academia, multiple industrial partners such as multinational companies, start-ups, incubators and SME's (MAGNET, Eureka Eurostars, Eureka Clusters, Eureka Globalstars, Eureka Network projects, BRIDGE, COIN, COMET, Beyond Europe, Manufacturing USA).

In terms of the thematic focus of the R&D instruments, generally two types of approaches can be identified – sectoral and horizontal. In the sectoral approach benefits go to specific knowledge discipline or technological areas whereas in the horizontal approach the benefits go to all disciplines (UNESCO, 2016). Examples for tools using the sectoral approach include TELEM (Biotechnology and Nanotechnology), SCCER (environment) ISCF Hub (materials) and ISCF Network Plus and Knowledge Building Project (raw materials and energy). Examples for instruments which apply a more horizontal approach include MAGNET, the Eureka instruments, SSTP, PFI, GOALI BRIDGE, COIN and COMET. Generally, it seems that project type instruments tend to be more sectoral in their nature, whereas consortia instruments tend to cover wider and more multi-disciplinary fields (horizontal).

Almost all of the R&D instruments for supporting academia-industry collaborations are directed towards supporting either short-term (1-3 years) partnerships (e.g. Knowledge Import, Applied Research in the Academia, Eureka Network, Eureka Globalstars, SSTP, BRIDGE, COIN, Beyond Europe, ICON artificial intelligence, PFI, IUCRC) or medium-term duration (4-5 years) partnerships (MAGNET, SSCER, NTN, Knowledge Building Project and Collaborative project to meet Societal needs, COMET). An exception is the Manufacturing USA and Eureka Clusters consortia which advocates long-term partnerships which are unlimited in their temporal dimension.

The R&D instruments are funded entirely by dedicated government or public agencies (e.g. Israel Innovation Authority, the Industrial Strategy Challenge Fund of UK

Research and Innovation), federal government (e.g. US instruments) or by the state budget/government ministries. The scope of government subsidy may differ substantially from tool to tool and across beneficiaries (academia or industry). For example in the MAGNET Consortia program Israeli companies receive up to 66% of the approved budget, whereas research institutions receive 100% of the approved budget (80% as a grant, 20% from the consortium companies)

Table 1: Academia-Industry collaboration Programs

| Country/Program name | Technological fields | | Financial subsidy | Subsidy duration | Type of partnership | Funding agency/source | Purpose |
|---|---|---|---|---|---|---|---|
| **Israel - MAGNET** | Generic technologies | | Yes | Usually 3 years, could be extended to 5 years | Consortium | Innovation Authority Israel | Generic technology for industry |
| **Israel - MAGNETON** | Innovative technologies | | Yes | 2 years | R&D project | Israel Innovation Authority | To encourage the transfer and commercialization of technologies from a research institute to an industrial corporation. |
| **Israel - Knowledge Import** | Innovative technologies | | Yes | 2 years | R&D project | Israel Innovation Authority | Encouraging collaboration that repeats the research findings as transferred from a foreign research institute and validating them; proving feasibility and adapting the knowledge to the applicant's needs in order to advance it technologically. |
| **Israel - Applied Research in the Academia (previously NOFAR and KAMIN)** | Innovative technologies | | | Usually 2 years. In some cases 3 years | R&D project | Israel Innovation Authority | To bridge the knowledge gap between academia and the industry's needs, with the option of leading a project to significant milestones, thereby attracting the interest of business entities and, ultimately, achieve a commercialization agreement between the two parties. |
| **Israel - MEIMAD** | Innovative technologies | | Yes | n/a | R&D project | Israel Innovation Authority, Ministry of Finance, Ministry of Defense, Maf'at | Innovative solutions for the defense and commercial markets |
| **Israel - TELEM** | Biotechnology and Nanotechnology | | n/a | n/a | Infrastructure | Government through TELEM | R&D infrastructure |

| Country/Program name | Technological fields | | Financial subsidy | Subsidy duration | Type of partnership | Funding agency/source | Purpose |
|---|---|---|---|---|---|---|---|
| **Israel - Entrepreneurial incubators in the periphery** | Research, development and commercialization, technological initiative | | Yes | 1 year | Incubator | Israel innovation authority | Promoting local entrepreneurship |
| **European Union – Eureka Eurostars** | All disciplines | | Yes, country specific | 3 years | Consortium | Member countries | Supports innovative SMEs and R&D-performing SMEs with international projects. Eurostars is open for any technological innovation and supports early stage projects (preliminary data) towards prototype development. |
| **European Union – Eureka Clusters** | Generic technologies | | Yes, country specific | Long-term | Consortium | Member countries | Eureka Clusters are thematic funding programs driven by communities of large companies, SMEs, universities, research institutes and end users. |
| **European Union – Eureka Globalstars** | Generic technologies | | Yes, country specific | 3 years | Consortium | Member countries | A funding program with calls for projects (sometimes thematic) with countries outside The Eureka. |
| **European Union – Eureka Network Projects** | Various theme areas, sometimes country specific calls | | Yes | 1-3 years | Consortium | Member countries | Provides flexible funding program for international R&D projects. |
| **Belarus - Innovative infrastructure** | Innovative activity in accordance with the priority areas of scientific, technical and innovative activity | | Yes | 1 year | A system of business entities | State budget | Implementation of innovative activities in the interests of the whole society |
| **Belarus - SSTP** | Scientific, technical and innovative activities in the field of information, medical, biological, machine-building, agro-industrial technologies, energy, construction, rational use of natural resources | | Yes | 1 year | R&D project | State budget | Development of technologies and creation of innovative industries |
| **Switzerland- SCCER** | Industrial efficiency, energy-saving, renewable energy, waste heat recovery | | Yes | 4 years | Competence Centers | Innosuisse, SNSF, Government | Solutions for the 2050 Energy Strategy |
| **Switzerland- NTN** | Manufacturing, economy, energy, decarbonization, Food, photonics, technology, Medtech. | | Yes | 4 years | Projects | Innosuisse | Develop product and service concepts |

| Country/Program name | Technological fields | | Financial subsidy | Subsidy duration | Type of partnership | Funding agency/source | Purpose |
|---|---|---|---|---|---|---|---|
| **Denmark- Technological services and knowledge-based networks** | Lifestyle & Design, Healthtech, Materials, Security, Environmental Technology, Energy, knowledge-intensive technologies, Bio- and Life Science, Food, Transport, ICT, Biomass, economy, Digitalization | | Yes | 2 years | Networks and clusters | Government | Collaboration and knowledge transfer between universities and companies on |
| **Denmark- Commercialization and entrepreneurship** | All disciplines | | Yes | n/a | Incubators | Government | Entrepreneurs and new innovative enterprises |
| **Denmark- Research infrastructures** | Biotech, Health and Life Sciences; Energy, Climate and Environmental Sciences; Physical Sciences; Humanities and Social Sciences; Materials Technology and Nanotechnology | | Yes | 5 years | Infrastructure | Government | |
| **UK- ISCF- Hub pre-announcement** | Metal, glass, ceramics, paper, cement, and chemicals | | Yes | 3 years | Hub | UKRI - ISCF | Early stage 'proof-of-concept' |
| **UK- ISCF- Network Plus** | Raw materials, energy | | Yes | n/a | Project | UKRI - ISCF | Adoption of new technologies and business models |
| **Norway- Knowledge-building Project - for Industry** | Energy, transport and low emissions, Oceans, Petroleum | | Yes | 2-5 years | Project | Research Council | Address important societal challenges |
| **Norway- Collaborative Project to meet Societal and Industry-related Challenges** | Antimicrobial resistance, land under pressure, renewable, energy, transport and low emissions, global development, oceans, health, climate and polar, land-based food, environment and bioresources, education and competence welfare, culture and society | | Yes | 2-4 years | Project | Research Council | Address important societal challenges |
| **Sweden- SIO Grafen** | biotechnology, electronics, energy, composite, manufacturing, and coating | | Yes | n/a | Project | Vinnova | A need that could be met with material development of graphene |
| **Austria- BRIDGE** | Space, Environment and energy, Human Resources, Information technology, Life Sciences, Material and manufacturing, Mobility and Transport, Security and Defense, Society | | Yes | 1-3 years | Consortium | Government, FTE | Development and transfer of basic research findings to industrial application |
| **Austria- COIN** | Space, Environment and energy, Human Resources, Information technology, Life Sciences, Material and manufacturing, | | Yes | 1-2 years | Consortium | Government | Encourages technology transfer within entrepreneurial cooperation schemes |

| Country/Program name | Technological fields | | Financial subsidy | Subsidy duration | Type of partnership | Funding agency/source | Purpose |
|---|---|---|---|---|---|---|---|
| | Mobility and Transport, Security and Defense, Society | | | | | | |
| **Austria- Beyond Europe** | Space, Environment and energy, Human Resources, Information technology, Life Sciences, Material and manufacturing, Mobility and Transport, Security and Defense, Society | | Yes | 3 years | Consortium | Government | Development of R&D competence deepening the cooperation between science and business |
| **Austria- COMET** | Service innovations, society, information technology, life sciences, materials and production, mobility, security and defense, environment and energy, space | | Yes | 3-4 years | Consortium | Government | Carry out high-quality research in cooperation between science and industry |
| **Belgium- Thematic ICON project artificial intelligence** | | | Yes | 1 year | Project | VLAIO | Strengthening top AI strategic basic research |
| **USA- PFI** | All disciplines | | Yes | 1.5-3 years | Project | Government- NSF | Potential for commercialization |
| **USA- GOALI** | All disciplines | | n/a | n/a | Project | Government- NSF | Future breakthrough technologies to address critical industry needs |
| **USA- IUCRC** | Advanced electronics, advanced manufacturing, and advanced materials, biotechnology, civil infrastructure systems, energy and environment, health and safety, Information, communication and computing, sensing and information systems, system design and simulation | | Yes | 1 year | Research centers | Government- NSF-IUCRC | breakthrough research |
| **USA -Manufacturing USA** | Advanced Manufacturing | | Yes | Unlimited, long-term | Consortium | Federal Government | Promoting advanced manufacturing |

# Chapter 3: Methodology

This study implements a comprehensive and systematic approach for evaluating an existing government instrument for academia-industry collaboration – the IIA MAGNET Consortia Program. The research aims at facilitating an understanding of the factors contributing and hindering academia-industry collaboration in Israel. It also sets out to evaluate the effectiveness of the MAGNET instrument in terms of promoting cooperation between the partners, as well as investigating its main achievements, contributions and outputs from the viewpoint of the academia and the industry.

## Research Goals and Objectives

The main goals of the evaluation exercise are as follows:

- To identify and evaluate the key barriers and obstacles (both from the viewpoint of the industry and the academia) that hinder successful academia-industry partnerships within the MAGNET Consortia Program.
- To evaluate the effectiveness of the MAGNET Consortia Program (e.g. technological cooperation between the various actors; main achievements, contributions, utility and outputs of the program from the viewpoint of the academia and the industry).
- To provide recommendations for stakeholders for improving the MAGNET Consortia R&D policy instrument.

## Research Population

The research population includes researchers from the academia and R&D personnel and executives from industrial companies who participated in 20 IIA MAGNET consortia projects between the years 2006 and 2020. These researchers and R&D personnel come from 130 companies and 17 different academic institutions (Research universities, academic colleges, public research institutions and hospitals).

Table 2 presents the distribution of the research population, parsed by consortium name. As can be seen from the table, the total research population of the 20 MAGNET consortia which were active between the years 2005-2020 includes 1118 individuals, of which 675 are from the industry and 443 are from the academia. About 49% of the research population worked on ICT related projects, 27% on Electro-Optics projects, 9% on Cleantech projects and 5% (each) on Materials, Life-Science and other projects.

## Research Method

The research employs a wide range of qualitative and quantitative research methods including descriptive statistics and inferential statistics. We use a triangulation methodology which fuses together primary sources with self-report methods in order to identify repeating patterns and shared insights relating to the characteristics of academia-industry collaboration, the catalysts and barriers for cooperation, success indicators and suggestions for improving the MAGNET Consortia Program.

Table 2: Research population parsed by Consortium

| Consortium | Technology Field | Years active | N ACADEMIA | N INDUSTRY |
|---|---|---|---|---|
| **ISRC** | ICT | 2005-2010 | 6 | 34 |
| **REMON** | ICT | 2006-2010 | 27 | 56 |
| **RESCUE** | ICT | 2008-2013 | 17 | 43 |
| **NET-HD** | ICT | 2009-2014 | 19 | 14 |
| **NES** | Materials | 2009-2014 | 10 | 39 |
| **BSMT** | LIFE SCIENCE | 2009-2014 | 33 | 17 |
| **CORNET** | ICT | 2010-2014 | 29 | 38 |
| **HYSP** | Electro-Optics | 2010-2015 | 8 | 40 |
| **TERASANTA** | ICT | 2010-2015 | 9 | 28 |
| **ISG** | Cleantech | 2012-2016 | 28 | 46 |
| **Metro450** | Electro-Optics | 2013-2017 | 33 | 52 |
| **TEPS** | Cleantech | 2013-2018 | 8 | 17 |
| **PRINTEL** | Electro-Optics | 2014-2017 | 26 | 43 |
| **NEPTUNE** | ICT | 2014-2019 | 36 | 34 |
| **INFOMEDIA** | ICT | 2015-2018 | 41 | 42 |
| **HERON** | ICT | 2016- | 20 | 24 |
| **ALTIA** | Electro-Optics | 2016-2019 | 18 | 17 |
| **PETACLOUD** | ICT | 2016-2020 | 22 | 13 |
| **MDM** | Electro-Optics | 2017- | 24 | 42 |
| **SHPS** | | 2017-2019 | 29 | 36 |

Source: Israel Innovation Authority and SNI Informatics Data Center

## Analysis of Primary and Self Report Sources

## Summary of MAGNET Consortia Reports

The final consortia reports, submitted to the Innovation Authority by an individual consortium at the end of its activities (after three or five years), include valuable information from which many important insights can be derived. This rich textual data source includes information on the consortium's outputs and achievements, implementation of work plans, defined goals and objectives, the nature of work with academia and the quality of cooperation between the various participants. Reports from recent years also include reference to lessons learnt and recommendations for improving the MAGNET Consortia Program (e.g. proposed changes and improvements, difficulties and obstacles encountered, suggestions for improving the interface with the Innovation Authority, evaluation of academia-industry collaboration etc.). In the framework of the qualitative textual analysis, data from several consortia were collected, compiled and analyzed. Textual data was aggregated and summarized into key insights according to predefined parameters, while omitting personal data and other sensitive details which can identify the academic and industrial partners.

## Analysis of Self Report Data

The analysis of self-report data included the evaluation of three different data sources: the evaluation of the MAGNET Consortia Survey, an analysis and aggregation of open-end questions from questionnaires and interviews with stakeholders from the academia and the industry.

## MAGNET Consortia Survey

In order to tackle the research questions at hand, two comprehensive online questionnaires aimed at evaluating the MAGNET Consortia Program were drafted. The first questionnaire was addressed to participants of the program from the academia and the second questionnaire targeted R&D professionals from the business the industry. Both questionnaires included identical questions, allowing comparison between the two population groups. The surveys encompassed consortia members who participated in 20 different MAGNET consortia between 2006 and 2020. The surveys focused on inquiring the status of the cooperation between the academia and the industry, on the factors that facilitated successful partnerships, on the problems that were encountered in the duration of the project and on possible solutions for improving the instruments and the cooperation mechanisms of the IIA. The survey response scales that were used in both surveys are the five category Likert type scale (either agreement level or rating) and the dichotomous scale (e.g. “yes” and “no” type questions). The following themes were covered in the framework of the two questionnaires:

- Personal details and professional background
- The technological field of the consortium
- The company’s and the academic institution’s considerations for participating in the consortium
- Information on the scope and quality of joint academia-industry work meetings
- The factors impacting the collaboration between the academia and the industry
- Criteria for the success of the consortium
- Interfaces with the Israel Innovation Authority

The data was collected using an online digital survey platform (LimeSurvey) between the 20/4/2021 and 15/6/2021 time period. The LimeSurvey platform is an online questionnaire system that allows to initiate the contact with the surveys’ subjects (respondents), track respondents in real time (e.g. response status, completion/incompletion of survey, e-mail validation etc.), collect the data in an aggregate manner and export it to statistical software for detailed analyses. The questionnaires are distributed by sending an Internet link to the respondents via e-mail. The link is distributed with an explanation of the research objectives, the name of the PI and researchers responsible for the research and a confidentiality and privacy statement ensuring the proper use of the data collected.

Out of the 900 questionnaires that were distributed, 174 full responses were received and recorded on the online system (100 responses from the industry and 74 responses from the academia).

## Interviews

During the June-July 2021 time period, seven personal interviews were held with researchers from the academia and with senior R&D professionals from the industry who participated in five different MAGNET consortia projects. The objectives of the interviews were to expand our understanding on the nature of relationship between the academia and industry within the consortium, to further investigate and evaluate the cooperation mechanisms between the two parties and to better explain the drivers that facilitate collaboration and the constraints that hinder it. The interviews also examined the effectiveness, outputs and benefits of the consortium (for the companies and the research groups from the academia) and the interfaces of the partners from the academia and the industry with the Israel Innovation Authority (e.g. suggestions for improving the program).

## Analysis of Open-end Questions

The MAGNET consortia surveys included five open-end questions that supplied a wealth of detailed textual data on the nature of inter and intra cooperation between the partners as well as on the outputs of the program and suggestions for further enhancing and improving it. The open-end questions investigated the following themes:

- Barriers and catalysts for cooperation between the academia and the industry
- Barriers for cooperation between industrial partners (e.g. IP rights)
- Barriers for cooperation between academia/industry MAGNET consortia members and the Israel Innovation Authority
- Expected spillovers or indirect benefits to the company due to the participation in the MAGNET Consortia Program
- Suggestions for improving the MAGNET Consortia Program

Due to the need to make a generalization and inference on the investigated phenomena, for each theme (open-end question), we used a taxonomy process which classified each individual textual response into categories or groups of responses according to their content similarity. The frequencies of the categories within each theme were summed up and a mathematical transformation which constrained each category to receive a value between 1 ("low intensity level") and 5 ("high intensity level") was performed.

## Data Augmentation

All inputs and data originating from the primary and self-report sources were augmented and summarized in order to allow a systematic evaluation and understanding of the phenomena. The final output of the research was targeted at providing recommendations for stakeholders from the Government for improving existing policy and policy instruments.

# Chapter 4: Research Findings

The objective of this chapter is to deepen our understanding on the factors which facilitate and hinder academia-industry cooperation and to make inference on the effectiveness of a specific R&D instrument (MAGNET Consortium Program) in contributing to this end. This examination is carried out by triangulating various types of data sources which allow to examine this phenomenon from different angles and resolution levels. Triangulation is a commonly used approach in which findings from one method are cross validated by those in another method with the aim of achieving greater validity in the research.

Figure 1 and Figure 2 present descriptive statistics on the distribution of the research sample, parsed by the consortium's name and the consortium's main technological field. As can be seen from Figure 1, about 27% of the research sample (consortia members) come from relatively recent projects which started after 2015 (e.g. MDM). The distribution of the research sample by the consortium’s main field shows that 21% of the MAGNET Consortia members have participated in Communications projects, 11% in Physics projects, 9% in Electronics projects, 6%, each, in Robotics, Chemistry and transportation projects and 41% in projects which belong to other fields.

Figure 1: Distribution of research sample by consortium name

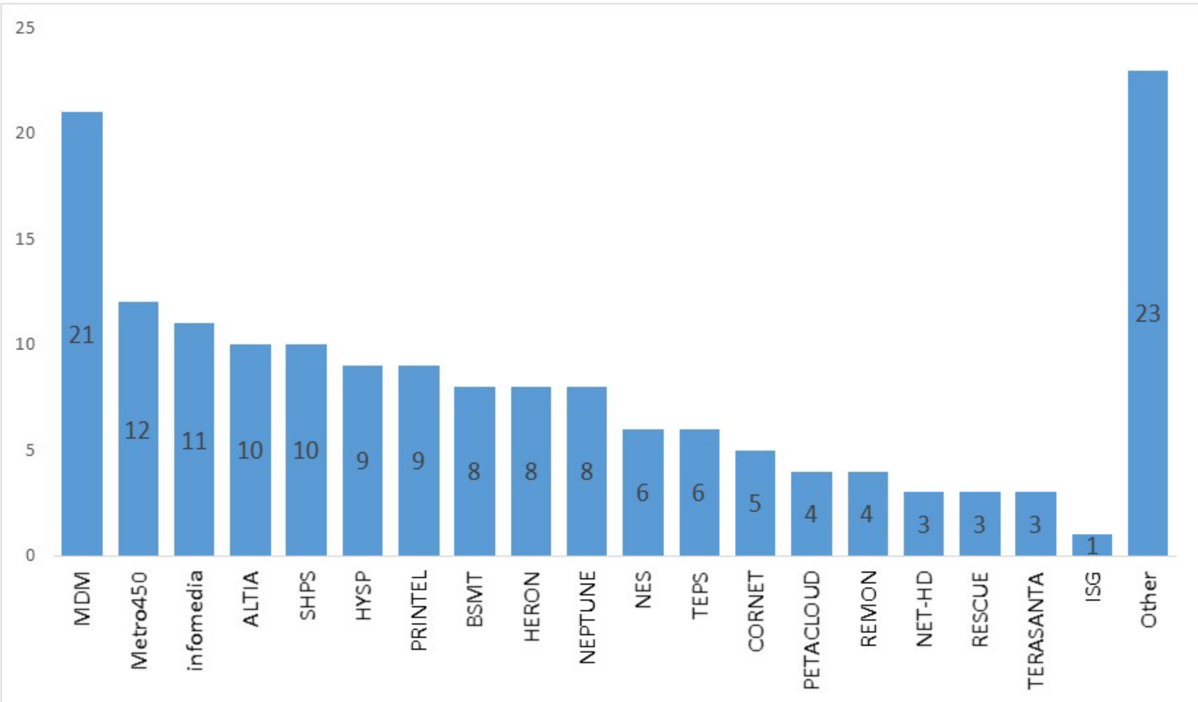
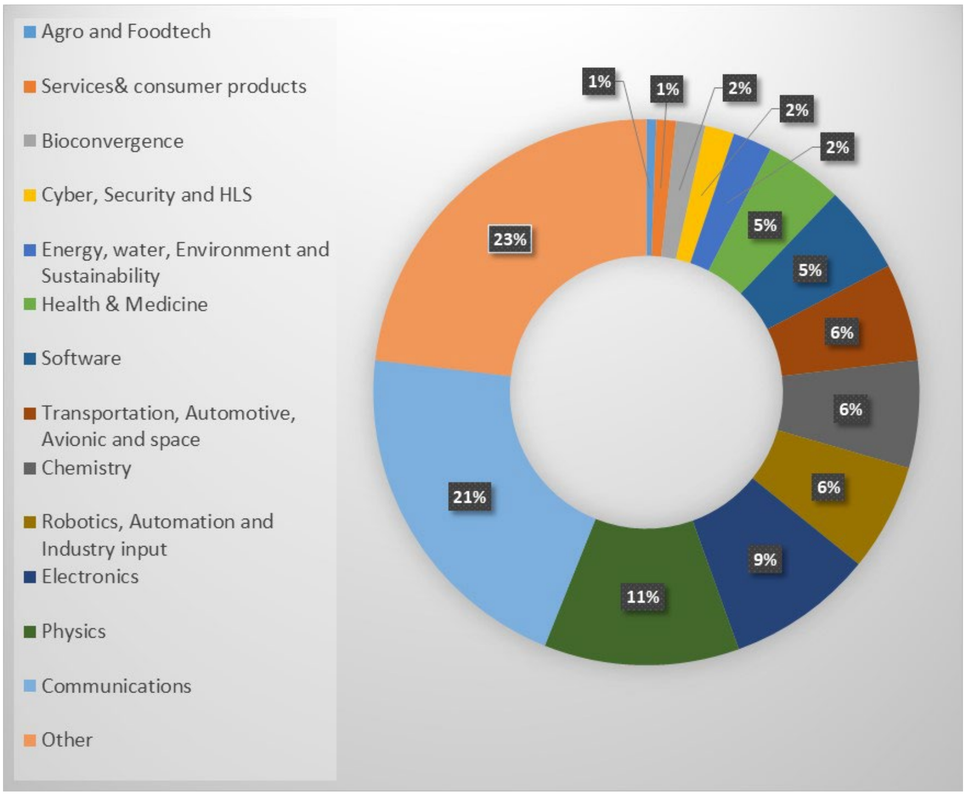


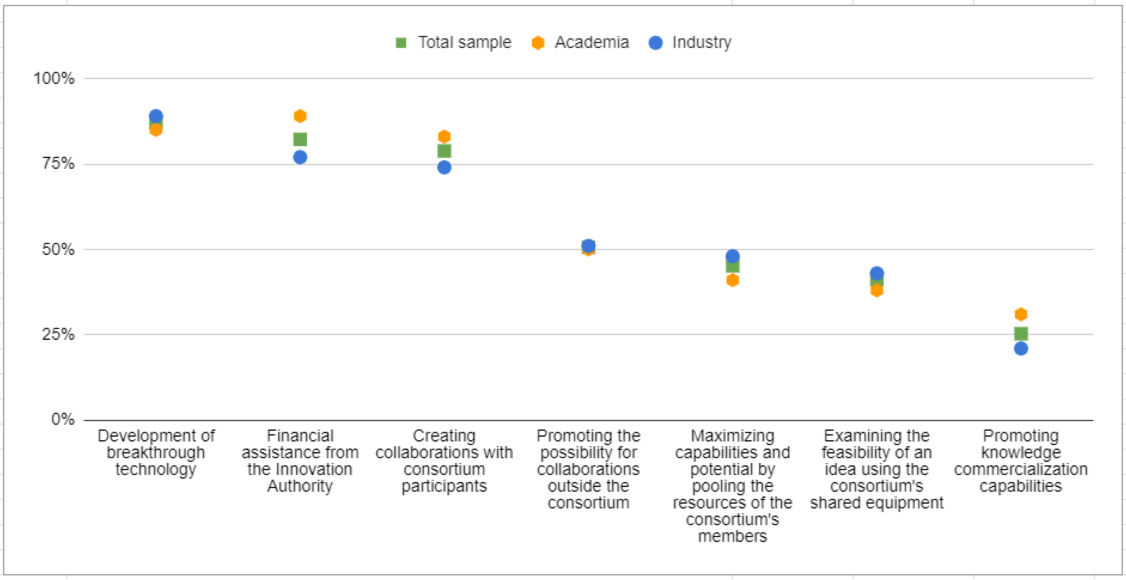
Figure 2: Distribution of research sample by the consortium's main technological field




## The Motivations and Considerations for Joining the MAGNET Consortia Program

This section evaluates and discusses the research findings arising from the analysis of the primary sources and the self-report data (surveys and interviews). Figure 3 presents the MAGNET consortia members' main motivations for joining the program. The figure displays the share of participants (parsed by academia and industry) who attributed high or very high importance to each of the motivation/consideration statements. As can be seen from the illustration, the consortia members’ main considerations for joining the program were the development of breakthrough technology (89%), the financial support of the Israel Innovation Authority (77%) and the collaboration between the consortium’s members (74%). Mann–Whitney U tests were performed for each of the motivation statements in order to test for differences between the academia and the industry in the distribution of the dependent variable. Statistical differences between these two populations were found to be significant in two of the motivation/consideration statements. Consortia members from the academia attributed higher importance level (compared to industry members) to the IIA financial support for being a major driver for joining the MAGNET Consortia Program. Statistical difference between the academia and the industry was also found in the perceived ability of the program to promote knowledge commercialization, whereas industry consortia members attributed higher importance to this factor, as compared to academia consortia members. Inferences made from the analysis of selected MAGNET Consortia final reports and the personal interviews held with consortia members support and elaborate the findings of the surveys. In concordance with the survey results, the IIA funding of the project and the ability of the MAGNET program platform to contribute to the creation of fruitful collaborations between the academia and the industry were seen by the consortia partners as key considerations for joining the program. Other notably mentioned motivations for joining the MAGNET consortia program are the support of research students, exposure to problems and challenges in the industry, access to data originating from the industry (academia only); the ability for mutual “brainstorming” and the development of new ideas, and the possibility of continuing the research with the academic or industrial partner at the end of the MAGNET project.

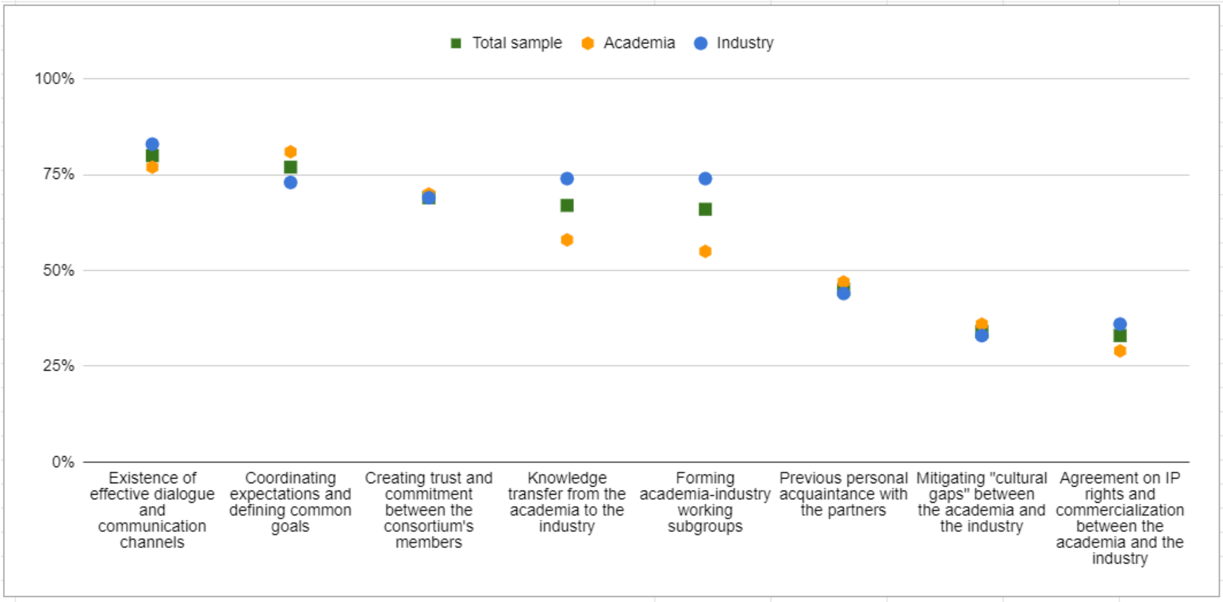
Figure 3: Considerations for joining the consortium (share of participants who attribute high or very high importance, parsed by sector)




## Catalysts and Obstacles for Academia-Industry Cooperation

This section discusses the main "push" and "pull" factors which were found to either facilitate or hinder cooperation between the academia and the industry in the framework of the MAGNET Consortia Program. Figure 4 presents the key catalysts which were associated with driving and promoting the collaboration between the two sectors. As can be seen from the illustration, the existence of effective dialogue and communication channels, coordinating expectations and the creation of trust and commitment between consortia members constitute the key factors for enabling productive and successful collaboration. About 80% of the surveys' respondents attributed high or very high importance to the dialogue and communication factor, as compared to 77% and 69%, respectively, to the coordination of expectations and trust factors as being the key drivers for inter-sectoral collaborations. Agreement on IP and knowledge commercialization issues were found to be a less important factor in driving collaboration (33%) between the academia and industry (although this factor constitutes a critical issue between different industrial partners), as opposed to the aspect of knowledge transfer which was identified as a crucial factor in facilitating cooperation (67% total sample, 74% Industry and 58% academia).

Figure 4: Catalysts for academia-industry cooperation (share of participants who attribute high or very high importance, parsed by sector)




The aggregated evaluation of the surveys' open-end questions revealed interesting insights with regards to the main factors which facilitate academia-industry collaboration. This analysis was performed by classifying each individual textual response into categories or groups of responses according to their content similarity. The frequencies of the categories within each theme were summed up and a mathematical transformation was performed in order to constrain each category to receive a value between 1 (low) and 5 (high). Table 3 presents the results of this exercise for the question "Please state the factors which act as catalysts for academia-industry collaborations in the framework of the MAGNET Consortia Program". For generalization and simplification purposes the transformed values were divided into "intensity levels", signifying how strong or weak each category is within each theme (open-end question). The values 5 and 4 denote "high intensity level", the value 3 represent "medium intensity level" and the values of 2 and 1 signify "low intensity level". As can be seen from the table, the strongest "high intensity" catalysts for facilitating academia-industry collaboration are the reduction of knowledge gaps between the parties and previous experience and familiarity with the partners. Some of the catalysts which were classified as being of "medium intensity" (the full list is presented in the table) include setting clear goals and mutual objectives, agreeing on IP and technology commercialization issues and promoting knowledge transfer between the parties. Less cited factors ("low intensity level") for fostering academia-industry collaborations within the MAGNET Consortia Program include conducting meetings between the parties on a regular base; ensuring systematic and orderly work procedures, promoting research students; the will on behalf of the academia to contribute to the Israeli society and the economy ("third mission"); the financial assistance of the Israel Innovation Authority; the reputation and excellence of the academic partner; and the quality of the professional management of the consortium.

Table 3: Catalysts for academia-industry cooperation (open-end questions)

| Catalysts for academia-industry cooperation | Intensity level | n |
|---|---|---|
| Reduction of knowledge gaps; promotion of complementary capabilities; problem solving | 5 | 26 |
| Previous experience and familiarity with the partners; good personal relationships | 4 | 18 |
| Setting clear goals and mutual objectives | 3 | 15 |
| IP and technology commercialization; economic benefit and utility | 3 | 14 |
| Understanding the mutual needs and interests of the partners | 3 | 12 |
| Knowledge transfer | 3 | 11 |
| Common interest and synergy in promoting the development of new products and services | 3 | 10 |
| Conducting meetings on a regular base; systematic and orderly work procedures | 2 | 9 |
| High motivation and commitment | 2 | 7 |
| Israel Innovation Authority funding and financial assistance | 2 | 6 |
| Reputation and excellence of the academic partner | 2 | 5 |
| Professional management of the consortium | 2 | 5 |
| Sharing of equipment, research infrastructure and data | 2 | 5 |
| Establishment of working groups | 2 | 4 |
| The ability to publish the findings in peer reviewed journals and to present in conferences | 1 | 3 |
| Promoting students and research students | 1 | 2 |
| Mitigation of R&D risks | 1 | 1 |
| The third mission of universities | 1 | 1 |
| The impact of the corona virus | 1 | 1 |

Additional open-end questions in the surveys addressed the factors which hinder cooperation between the academia and the industry (Table 4), between different companies (Table 5) and between the consortia members and the Israel Innovation Authority (Table 6).

The main high-intensity obstacles which were found to hinder academia-industry collaboration (Table 4) include differences in goals, objectives and expectations; misunderstanding of mutual needs; unwillingness to disclose or transfer knowledge; low commitment and motivation among one of the partners and cultural divides between the two sectors. Medium intensity factors include disagreement on IP and technology commercialization aspects; a large gap between theoretical knowledge (academia) and implementation (industry) and a lack of synchronization, focus, overall vision and coordination. Less cited obstacles (low intensity) include factors such as changing the goals, the objectives or the focus of the research in advanced stages of the work; communication problems between the partners and bureaucracy.

Table 5 presents the main factors which hinder cooperation (obstacles) between different companies in the framework of the MAGNET consortia. As can be seen from the table, issues relating to the protection of IP, business competition, confidentiality, and the reluctance to disclose knowledge constitute by far the greatest impediments for the promotion of intra-sectoral cooperation (between industrial partners) within a given consortium, overshadowing other obstacles. Other hindering factors such as having different goals, objectives and expectations; lack of interest and motivation among one of the industrial partners; knowledge gaps between the industrial partners and disagreement on the allocation of resources were classified as being of low intensity obstacles for collaboration.

Table 4: Obstacles for academia-industry cooperation (open-end questions)

| Obstacles for academia-industry cooperation (aggregated factors) | Intensity level | n |
|---|---|---|
| Different goals, objectives and expectations | 5 | 14 |
| Misunderstanding of the mutual needs of the partners | 5 | 12 |
| Confidentiality, unwillingness to disclose or transfer knowledge | 4 | 10 |
| Differences in work pace/speed | 4 | 10 |
| Trust aspects; low commitment, investment and motivation | 4 | 9 |
| Culture gaps between academia and industry | 4 | 8 |
| Disagreement on IP and technology commercialization aspects | 3 | 7 |
| Lack of synchronization, focus, overall vision and coordination | 3 | 7 |
| Large gap between theoretical knowledge and the possibility of implementation/validation | 3 | 6 |
| Problems in the management of the consortium | 3 | 5 |
| Changing the goals, objectives or focus of the research in advanced stages of the work | 2 | 4 |
| Communication problems and bad personal relationships | 2 | 3 |
| Lack of infrastructure and resources | 2 | 3 |
| Bureaucracy | 2 | 2 |
| Low research budget | 2 | 2 |

Table 5: Obstacles for cooperation between companies (open-end questions)

| Obstacles for cooperation between companies (aggregated factors) | Intensity level | n |
|---|---|---|
| Protection of IP; business competition: confidentiality; reluctance to disclose knowledge | 5 | 24 |
| Different goals, objectives and expectations | 2 | 8 |
| Lack of interest and motivation | 2 | 5 |
| Allocation of resources | 2 | 4 |
| Different work procedures | 1 | 2 |
| Lack of synchronization | 1 | 1 |
| Knowledge gaps | 1 | 1 |
| Changing the goals, objectives or interests of the research in advanced stages of the work | 1 | 1 |

Insights obtained from the analysis of the MAGNET Consortia reports and from the evaluation of the personal interviews support the findings of the aggregated open-end questions evaluation, but also add extra insights as to the factors responsible for hindering academia-industry collaboration within the framework of the MAGNET Consortia. In concordance with the aggregated analysis, the lack of clear goals (especially in projects that require complex infrastructure) and the abundance of bureaucracy (submission of large number of reports and reviews) were cited as factors which negatively impact the collaboration between the academia and the industry. Novel insights with regards to hindering factors, rising solely from the evaluation of primary source data include: Holding insufficient or infrequent meetings between academic and industrial partners; university TTOs which raise difficulties for faculty members who wish to accelerate their collaboration with a particular company; lack of feedback on behalf of the industry with regards to the work and outputs of the academia (focus is placed only on the deliverables or outputs which benefit the industry); and the dominance of large and strong companies in the consortia at the expense of smaller start-ups.

Table 6 presents the main obstacles for cooperation between the MAGNET consortia members and the funding organization, the Israel Innovation Authority. As can be seen from the table, the strongest factors which were cited by consortia members for being impediments for collaboration between the consortia members and the IIA are insufficient knowledge on behalf of the IIA technological evaluators; cultural and work practice differences between the business sector and the government sector and bureaucracy (e.g. the need to submit many forms and periodical reports).

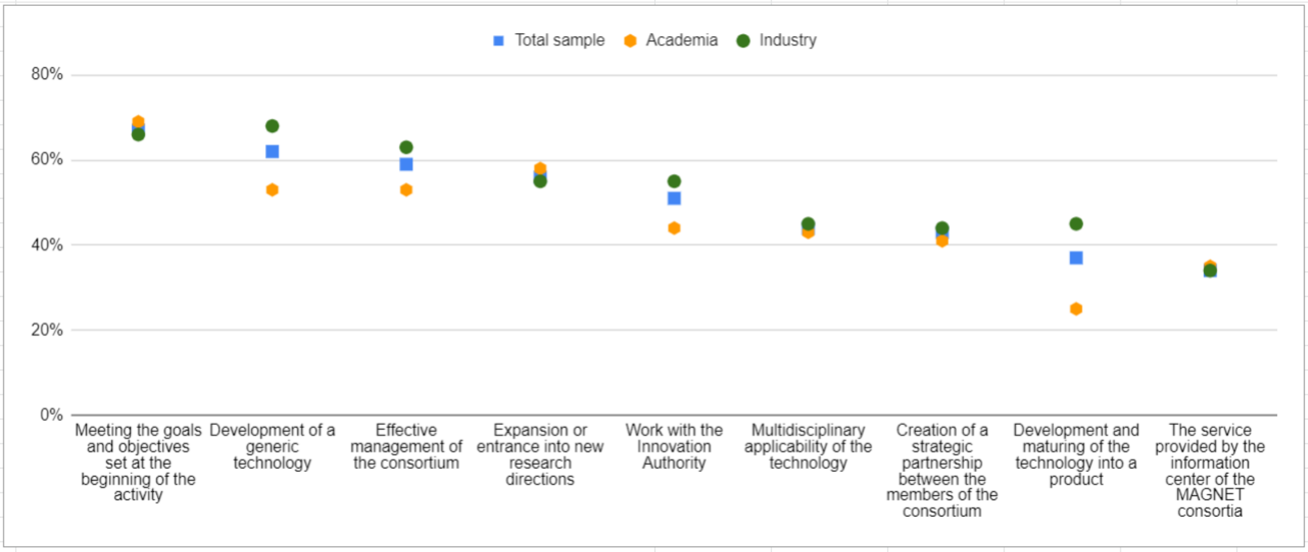
Table 6: Obstacles for cooperation between consortia participants and the IIA (open-end questions)

| Obstacles for cooperation between the consortia participants and the IIA (aggregated factors) | Intensity level | n |
|---|---|---|
| Insufficient knowledge on behalf of the technological evaluators | 5 | 10 |
| Differences in work practices and procedures; cultural differences | 5 | 10 |
| Bureaucracy | 5 | 8 |
| Lack of understanding of the special needs of the academia | 3 | 4 |
| Finance and Budget | 3 | 4 |
| Fear of failure | 2 | 2 |

## Success and Output Indicators

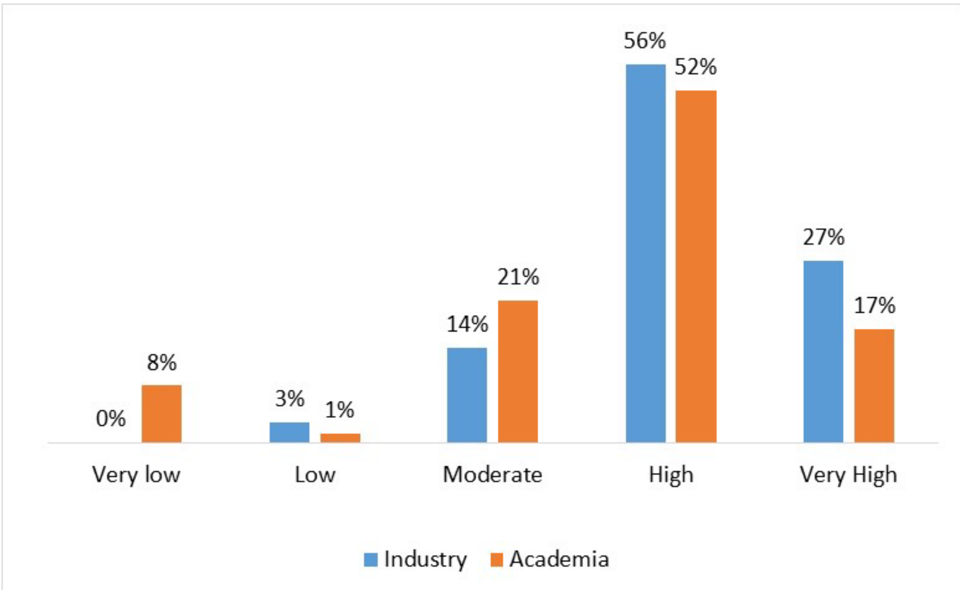
The MAGNET consortia participants were asked to evaluate and rank the main factors responsible for the success of the joint research. Figure 5 reports the results of series of statements (share of participants who attributed high or very high importance), parsed by participating sector (academia or industry). As can be seen from the illustration, three factors – meeting the stated goals of the consortium, the development of a generic technology and the effective management of the consortium were cited by the consortia members as highly important factors (over 60% high importance rating) in leading to a successful outcome of the joint project. A significant difference between the industry and the academia was found in one statement. Consortia members from the industry attribute substantially higher importance (45%) than Academia consortia members (25%) to the “development of technology into a product” as an indication of the project’s success ($P<0.05$). Insights obtained from the analysis of the MAGNET Consortia reports and from the evaluation of the personal interviews exposed additional success factors. These include the formulation of detailed work plans (a critical step for the success of a consortium as it forces its members to determine the planned products, as well as to coordinate expectations); defining project objectives according to clear indices; exposure to the perspective of the industry/academia and identifying and solving new problems relevant to the work of the academia and the industry.

Figure 5: Success factors (share of participants who attribute high or very high importance to a particular statement, parsed by sector)



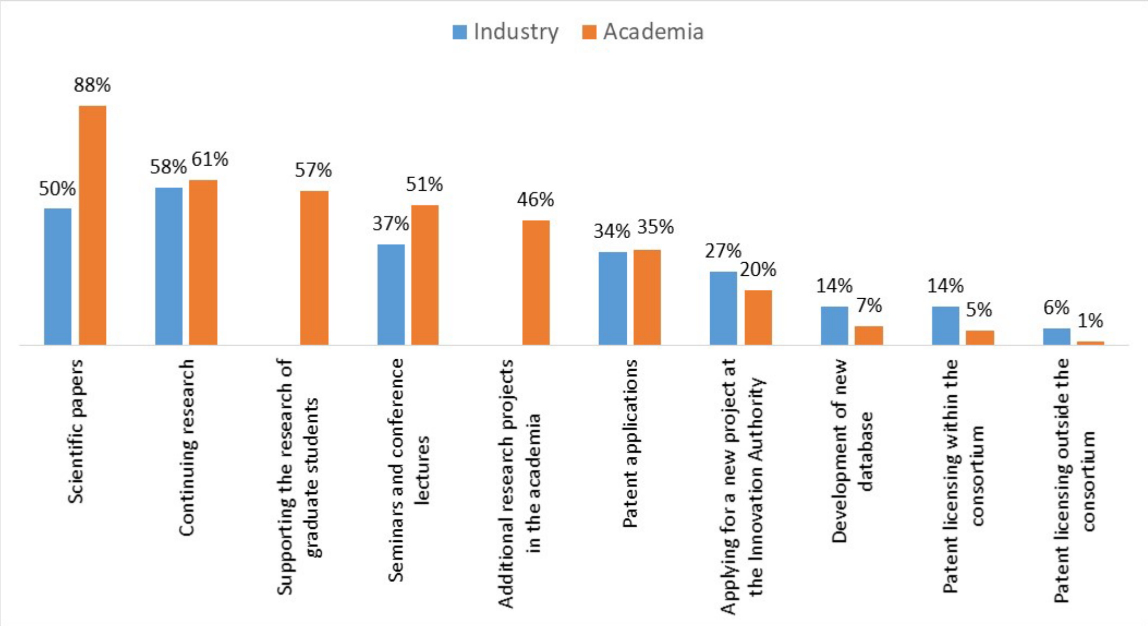

The quality of cooperation between the academia and the industry constitutes a key indicator for the success of any given consortium. Figure 6 reports the level of satisfaction from the quality of cooperation between the academia and the industry within the framework of the MAGNET consortia Program. As can be seen from the illustration, 83% of consortia members from the industry reported high or very high level of cooperation with their academia partner as compared to 69% of academia consortia members who reported either high or very high level of cooperation with their partners from the industry. The difference in the attributed cooperation level between the two sectors is significant at the 5% level (Z=-2.4, MWU test).

Figure 6: Quality of cooperation between the consortium's members



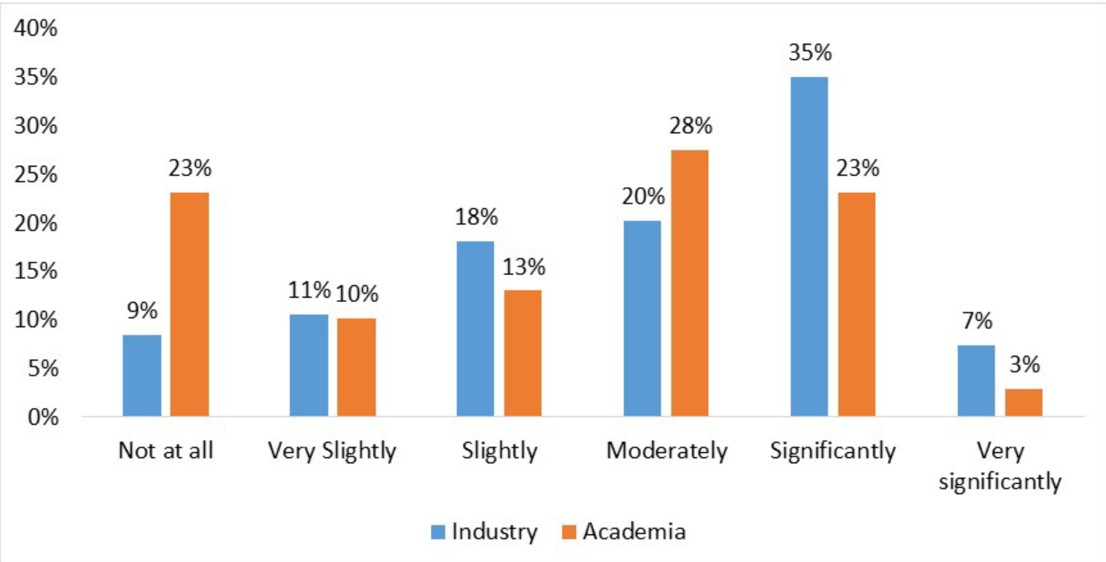

According to self-reported survey data, the main outputs of the MAGNET Consortia Program were scientific papers (noted by 88% of academia participants and 50% of the industry participants), continuing research (61% academia and 58% industry), the support of graduate students (noted by 57% of academia participants) and attending and presenting in conferences (51% academia and 37% industry). Surprisingly, patent applications were stated as an output only by one third of the MAGNET Consortia participants (Figure 7).

Figure 7: Stated outputs of the MAGNET Consortia Program




About 42% of industry participants believe that their collaboration with the academia has contributed to a large or very large extent to the establishment of the company's intellectual property. In comparison only 26% of the participants from the academia believed that their collaboration with the industry has contributed to the establishment of the university's IP (Figure 8). The difference in distribution between the two populations is statistically significant at the 0.05 level (MWU test).

Figure 8: Extent to which academia-industry collaboration contributed to the establishment of IP and long-term R&D outputs



About 36% of industry partners indicated that collaborating with other companies contributed significantly or very significantly to the establishment of IP and the long-term outputs of their company (Figure 9). In contrast, only about 10% of the partners from the academia indicated that collaboration with other universities contributed to a large or very large extent to the establishment of IP and long-term outputs of their university (Figure 10).

Figure 9: Extent to which collaboration between the various industry partners contributed to the establishment of the company's IP and long-term R&D outputs

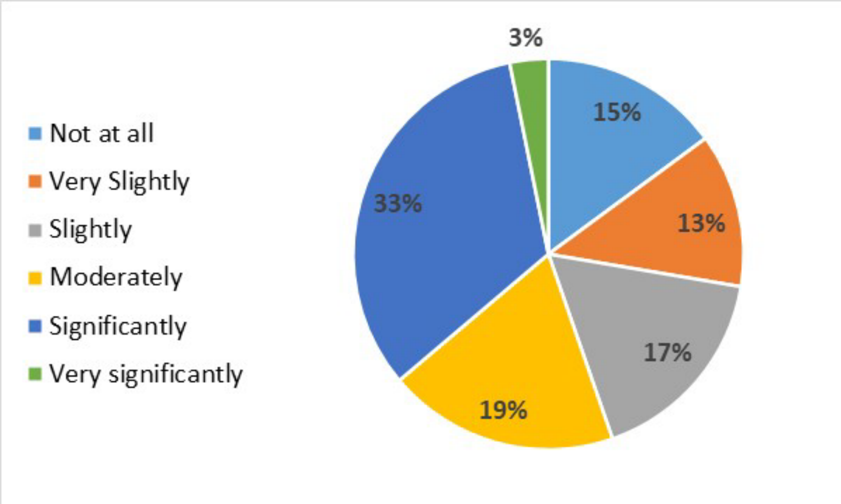
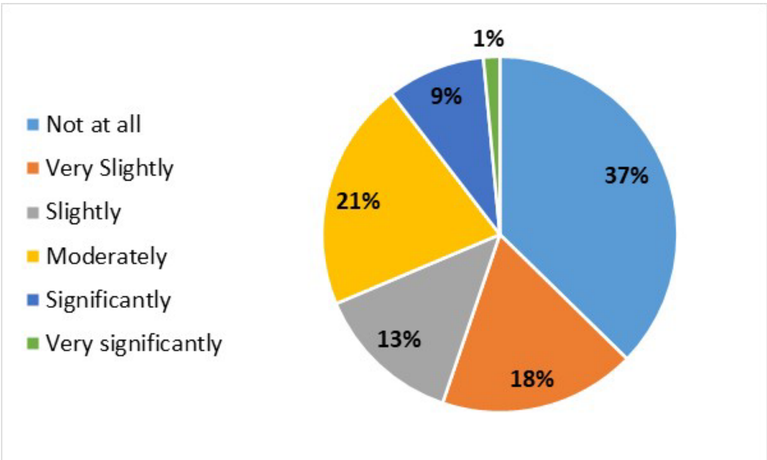



Figure 10: Extent to which collaboration between the various academia partners contributed to the establishment of the university's IP




The research also identified indirect benefits resulting from the participation in the MAGNET program (Table 7). These spillovers include the application of the technology developed in the framework of a specific consortium to other technological fields (high intensity); strengthening and expanding the cooperation to other research ventures (medium intensity); the exposure of university students to work in the industry; strengthening the human capital in the industry and boosting the local innovation ecosystem (low intensity). Additional insights obtained from the analysis of the MAGNET Consortia reports and from the evaluation of the personal interviews also mention the following spillovers: significant contribution to the company's IP;

contribution to the experience, visibility and reputation of the academic research groups (e.g. becoming world leaders in particular fields); attaining specialization in the field as a result of the participation in the consortium and reaching the market with more mature “market-tailored” products.

Table 7: Indirect benefits resulting from the participation in the MAGNET Consortia Program

| Consortium spillovers (aggregated factors) | Intensity level | n |
|---|---|---|
| Applying the knowledge/technology developed in the framework of the consortium to other fields and products | 5 | 31 |
| Economic utility to the company | 3 | 19 |
| Promoting, strengthening and expanding cooperation in other research ventures | 3 | 15 |
| Student training; exposure of students to the industry; learning from the industry | 2 | 6 |
| Fostering of the human capital in the industry | 2 | 5 |
| Continuing research | 1 | 4 |
| Establishment of a research infrastructure | 1 | 3 |
| Strengthening the ecosystems | 1 | 1 |

Finally, an important contribution of the research pertains to the possible adjustments that can be made in the MAGNET Consortia Program that may improve the instrument and further contribute to the formulation of public policy intended to promote knowledge transfer between the academia and the industry.

Insights obtained from the analysis of the MAGNET Consortia reports and from the evaluation of the personal interviews expose very high satisfaction from the MAGNET Consortia Program. Generally, the MAGNET Consortia Program was seen as an excellent and vital R&D instrument that allows the transfer of knowledge and knowhow from the academia to the knowledge-intensive industry and vice-versa. The cooperation between the academia and the industry within the MAGNET Consortia instrument boosts many benefits, including financial support for research groups in areas where it is difficult to obtain grants. The management of the consortia was carried out in a good and orderly manner. Most consortia conducted periodic group meetings and its directors performed a thorough job that included identifying and addressing opportunities and risks, monitoring projects, and directing efforts to projects that were the most relevant to consortia members.

In tandem with the expression of high satisfaction level from the MAGNET Consortia instrument, academia and industry partners made some noteworthy suggestions on how this instrument can be further improved. As can be seen from Table 8, which generalizes the participants’ open-question responses into aggregated categories and intensity levels, the themes of reducing the “red tape” and improving the interfaces with the Isreal Innovation Authority were seen as very high priority measures that could be taken for improving the program. Other measures such as sharpening and clarifying the goals of the consortium, allowing a more flexible budget, extending the R&D period of the consortium (back to five years) and improving management were seen as steps of medium importance. Less cited factors (“low intensity level”) for improving the MAGNET program include possible measures such as including external partners and consultants from Israel and abroad, being more flexible towards the special needs of the academia and improving of IP aspects.

Table 8: Suggestions for improving the MAGNET Consortia Program

| Suggestions for improving the Magnet Consortia Program (aggregated factors) | Intensity level | n |
|---|---|---|
| Reducing bureaucracy | 5 | 21 |
| Improving the interfaces with the Innovation Authority | 4 | 16 |
| Sharpening and clarifying the goals of the consortium | 3 | 9 |
| More flexible budget | 3 | 8 |
| Extending the R&D period of the consortium | 3 | 8 |
| Improving consortium management | 3 | 8 |
| Including external partners and consultants from Israel and abroad | 2 | 5 |
| More flexibility towards the special needs of the academia | 2 | 4 |
| Strengthening control mechanisms | 2 | 3 |
| Optimizing work meetings/work in small teams | 2 | 3 |
| Promotion of consortia characterized by "low technological maturity" projects | 2 | 3 |
| Improvement in commitment and trust | 1 | 2 |
| Promoting academia-industry cooperation via other channels and frameworks | 1 | 2 |
| Improving IP aspects | 1 | 2 |

Additional proposals for improving the MAGNET Consortia Program arise from the analysis of the MAGNET Consortia reports and from the evaluation of the personal interviews. They include the following suggestions:

- Allow flexibility in establishing the consortium
- Reduction of the size of the consortia (less partners and companies).
- Reduction of projects' overhead.
- Less bureaucracy and "micro-management".
- To address the inherent bias of the program towards big companies. Most of the R&D is conducted by the small companies and by the academia but the knowledge usually serves the big companies, but not vice-versa. Big companies rarely share their IP with the other partners.
- Improve the IIA financial subsidy given to smaller companies.
- Include more startup companies in MAGNET projects.
- Consider the possibility of joining external partners to MAGNET Consortia projects (e.g. special status partners).
- To return to a five-year project period (instead of a three-year period today) in order to allow MAGNET projects to reach maximal maturity level.
- Promote regular meetings between all consortia members for the purpose of advancing the consortium's work plans and to solve problems that arise during work.
- The IIA should support high-risk projects that are not ripe for industrial application and that industrial partners are hesitant to take upon themselves due to the high risk. It is important to develop the generic knowledge and the R&D infrastructure even at the expense of less tangible outputs or products.
- To provide a more prominent role and status to the academia in the establishment, guidance and leadership of the MAGNET Consortia.
- The fact that the chairperson is not part of the infrastructure arena, does not participate in its committees and does not vote at management meetings constitutes

a problem since he or she lacks important information that could be later passed to the consortia.

- Appoint group leaders who will coordinate the activities, manage engagement on technical issues, monitor progress and promote and coordinate dialogue between group participants.
- Develop a system for managing information and data for all MAGNET Consortia projects.

# Chapter 5: Summary and Recommendations

In this research, a triangulated approach for mapping, reviewing and evaluating R&D instruments for academia-industry collaboration in Israel and abroad was implemented. A special emphasis was placed on the evaluation of the MAGNET Consortia Program. The research employed a wide range of qualitative and quantitative research methods and tools including descriptive statistics and inferential statistic in order to identify, characterize and explain the key catalysts and obstacles for joint partnerships between the academia and the industry, as well as identifying and addressing the existing gaps for collaboration and technology transfer.

The findings of the research reveal a high degree of compatibility between the results of this study (MAGNET Consortia case study) and the findings reported in the literature with regards to the factors which hinder, on the one hand, and facilitate, on the other hand, academia-industry cooperation and technology transfer.

The main obstacles that were reported, both in the literature and in the framework of this research include:

- Lack of compatibility of goals and objectives
- “Cultural differences” between the academia and industry
- Misunderstanding of mutual needs
- Gap between theoretical knowledge and application and implementation of knowledge
- Disagreement on IP rights and commercialization aspects

The main catalysts for successful academia-industry partnerships that were identified in the literature and in this study include:

- Reduction of knowledge gaps and the promotion of complementary goals
- Understanding and accepting cultural differences
- Setting clear goals and objectives
- Having high degree of mutual commitment
- Previous experience and familiarity with the partners; good personal relationship
- Agreement on IP rights in the beginning of the project
- Understanding the mutual needs and interests of the partners
- Utilizing government support, mechanisms and policy tools

Insights gathered from a cross-national review of R&D policy instruments, tools and programs for promoting collaboration between the academia and the industry accentuate the differences in the scope, characteristics, goals and funding schemes of the different instruments. The overwhelmingly majority the reviewed tools and instruments were directed towards supporting either short-term or medium-term projects. Consortia type partnerships were found to place much more emphasis on multi-disciplinary thematic collaborations, whereas project-oriented projects were more limited to specific themes or objectives.

In order to tackle the research questions at hand, the research employed a triangulated methodological approach comprised of self-report (surveys and interviews) and primary sources (evaluation of MAGNET Consortia final reports) in order to identify repeating patterns and shared insights relating to the characteristics of academia-industry collaborations, the catalysts and barriers for cooperation and success indicators. The research population includes researchers from the academia and R&D personnel and executives from industrial companies who participated in 20 IIA MAGNET consortia between the years 2006 and 2020. The final output of the research was targeted at providing recommendations for stakeholders from the Government for improving existing policy and policy instruments.

Insights obtained from the analysis of the MAGNET Consortia reports and from the evaluation of the personal interviews expose very high satisfaction from the MAGNET Consortia Program. Generally, the Magnet Consortia was seen as an excellent and vital R&D instrument that allows the transfer of knowledge and knowhow from the academia to the knowledge-intensive industry and vice-versa. The cooperation between the academia and the industry within the MAGNET Consortia program was found to boost many benefits, including financial support for research groups in areas where it is difficult to obtain grants. The management of the consortia was carried out in a good and orderly manner. Most consortia conducted periodic group meetings and its directors performed a thorough job that included identifying and addressing opportunities and risks, monitoring projects, and directing efforts to projects that were the most relevant to consortia members.

Additional findings arising from the triangulated evaluation show that:

- The existence of effective dialogue and communication channels, coordinating expectations and the creation of trust and commitment between consortia members constitute the key factors for enabling productive and successful collaboration.
- Agreement on IP and knowledge commercialization issues were found to be a less important factor in driving collaboration between the academia and industry (although this factor constitutes a critical issue between different industrial partners), as opposed to the aspect of knowledge transfer which was identified as a crucial factor in facilitating cooperation.
- Consortia members from the academia attributed higher importance level (compared to industry members) to the IIA financial support for being a major driver for joining the MAGNET Consortia Program.
- Statistical difference between the academia and the industry was also found in the perceived ability of the program to promote knowledge commercialization, whereas industry consortia members attributed higher importance to this factor, as compared to academia consortia members.
- The main considerations for joining the program were the development of breakthrough technology, the financial support of the Israel Innovation Authority and the collaboration between the consortium's members.
- The main outputs of the MAGNET Consortia Program were scientific papers, continuing research, the support of graduate students and attending and presenting in conferences. Surprisingly, patent applications were stated as an output only among one third of the MAGNET Consortia participants.

The research also identified indirect benefits resulting from the participation in the MAGNET program. These spillovers include the application of the technology developed in the framework of a specific consortium to other technological fields, strengthening and expanding the cooperation to other research ventures, the exposure of university students to work in the industry, strengthening the human capital in the industry, boosting the local innovation ecosystem, contribution to the visibility and reputation of the academic research groups and attaining specialization in the field as a result of the participation in the consortium and reaching the market with more mature "market-tailored" products.

Procedural steps such as reducing bureaucracy, improving the interfaces with the Innovation Authority, sharpening and clarifying the goals of the consortium, allowing a more flexible budget, extending the R&D period of the consortium and improving management were seen as measures that could be taken for improving the program.

The findings of this research can supply various government actors in Israel (e.g. Israel Innovation Authority) key insights for the formulation of public policy in the field of R&D instruments. Our recommendations for the improvement of the MAGNET Consortia Program are as follows:

- Eliminate excessive bureaucracy (e.g. reduce paper work and the number of mid-term reports).
- Address the bias of the program towards big companies and include more startup companies in MAGNET projects.
- Improve the IIA financial subsidy given to smaller companies.
- Consider the possibility of joining external partners to MAGNET Consortia projects (e.g. special status partners).
- Consider reinstating the "five-year project period" (instead of a three-year period today), especially in selected high-risk projects, in order to allow MAGNET projects to reach maximal maturity level.
- Continue and intensify the support for high stake projects that are not ripe for industrial application and that industrial partners are hesitant to take upon themselves due to the high risk, even at the expense of less tangible outputs or products.
- Provide a more prominent role to the academia in the establishment, guidance and leadership of MAGNET Consortia projects.
- Promote the development of a structured database on MAGNET Consortia projects, which will equip both Consortia partners and decision makers at the IIA with valuable technical and procedural data on MAGNET projects.

## References

Bentur, A., Getz, D., & Shacham, O. K. (2021). System Analysis of Technology Transfer Policies and Models in Higher Education. In Handbook of Operations Research and Management Science in Higher Education (pp. 241-262). Springer, Cham.

D'Este, P., Iammarino, S., Savona, M., & von Tunzelmann, N. (2012). What hampers innovation? Revealed barriers versus deterring barriers. *Research policy*, *41*(2), 482-488.

De Wit-de Vries, E., Dolfsma, W. A., van der Windt, H. J., & Gerkema, M. P. (2019). Knowledge transfer in university–industry research partnerships: a review. *The Journal of Technology Transfer*, *44*(4), 1236-1255.

Ergas, H. (1987). The importance of technology policy. *Economic policy and technological performance*, *51*, 96.

Freeman, C. (1995). The 'National System of Innovation' in historical perspective. *Cambridge Journal of economics*, *19*(1), 5-24.

Freeman, R. B. (2015). Immigration, international collaboration, and innovation: Science and technology policy in the global economy. *Innovation Policy and the Economy*, *15*(1), 153-175.

Geiger, R. L. (2017). *Research & relevant knowledge: American research universities since World War II*. Routledge.

Godin, B., & Schauz, D. (2016). The changing identity of research: A cultural and conceptual history. *History of Science*, *54*(3), 276-306.

Grimpe, C., & Hussinger, K. (2013). Formal and informal knowledge and technology transfer from academia to industry: Complementarity effects and innovation performance. *Industry and innovation*, *20*(8), 683-700.

Guan, J. C., Yam, R. C., & Mok, C. K. (2005). Collaboration between industry and research institutes/universities on industrial innovation in Beijing, China. *Technology Analysis & Strategic Management*, *17*(3), 339-353.

Huggel, C., Scheel, M., Albrecht, F., Andres, N., Calanca, P., Jurt, C.& Zappa, M. (2015). A framework for the science contribution in climate adaptation: Experiences from science-policy processes in the Andes. *Environmental Science & Policy*, *47*, 80-94.

Laredo, P. (2007). Revisiting the third mission of universities: Toward a renewed categorization of university activities?. *Higher education policy*, *20*(4), 441-456.

McKelvey, M., & Saemundsson, R. J. (2018). An evolutionary model of innovation policy: conceptualizing the growth of knowledge in innovation policy as an evolution of policy alternatives. *Industrial and Corporate Change*, *27*(5), 851-865.

Miller, K., McAdam, R., & McAdam, M. (2018). A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. *R&D Management*, *48*(1), 7-24.

Molas-Gallart, J., & Castro-Martínez, E. (2007). Ambiguity and conflict in the development of 'Third Mission'indicators. *Research Evaluation*, *16*(4), 321-330.

Newberg, J., & Dunn, R. J. A. B. L. J. (2002). Keeping secrets in the campus lab: law, values and rules of engagement partnerships for industry-university R&D. *American Bussines Law Journal, 39*

OECD (2013). Commercialising public research - new trends and strategies. Organization for Economic Cooperation and Development, Paris.

Piirainen, K. A., Andersen, A. D., & Andersen, P. D. (2016). Foresight and the third mission of universities: the case for innovation system foresight. *foresight*.

Rajalo, S., & Vadi, M. (2017). University-industry innovation collaboration: Reconceptualization. *Technovation*, *62*, 42-54.

Ranga, M., & Etzkowitz, H. (2015). Triple Helix systems: an analytical framework for innovation policy and practice in the Knowledge Society. *Entrepreneurship and knowledge exchange*, 117-158.

Rubens, A., Spigarelli, F., Cavicchi, A., & Rinaldi, C. (2017). Universities' third mission and the entrepreneurial university and the challenges they bring to higher education institutions. *Journal of Enterprising Communities: People and Places in the Global Economy.*

Ryan, L. (2009). Exploring the growing phenomenon of university-corporate education partnerships. *Management Decision*.

Rybnicek, R., & Königsgruber, R. (2019). What makes industry–university collaboration succeed? A systematic review of the literature. *Journal of business economics*, *89*(2), 221-250.

Schaeffer, V., Öcalan-Özel, S., & Pénin, J. (2020). The complementarities between formal and informal channels of university–industry knowledge transfer: a longitudinal approach. *The Journal of Technology Transfer*, *45*(1), 31-55

Schein, E.H. (2004) Organizational culture and leadership. 3rd Edition, Jossey-Bass, San Francisco.

Schot, J., & Steinmueller, W. E. (2016). Framing innovation policy for transformative change: Innovation policy 3.0. *SPRU Science Policy Research Unit, University of Sussex: Brighton, UK*.

Spiel, C. (2017). How education can promote social progress. *International Association of University Presidents 5th-8th July*.

Trigger-Foresight (2011). Fostering knowledge transfer processes from the academia to the industry.

UNESCO (2016). *Mapping research and innovation in the State of Israel* (Vol. 5). Leck, E., Lemarchand, G. A., & Tash, A. (editors). UNESCO Publishing.

## Annex 1: R&D instruments for industry-academia collaboration in selected countries

**Israel**

**MAGNET Consortiums Track** [3] -
**Industrial companies and research institutions Consortium for technology development, R&D grant track** (MAGNET program can be continued in Knowledge commercialization program). This track includes 3 types of consortiums: a. industry consortium; b. knowledge building consortium; c. maagadon

| Field | Goal | Target groups | Program budget | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Generic technologies | Development of generic technologies in important areas in the global market, where Israeli industry has a competitive advantage; Distribution of knowledge and cooperation between companies operating in the same field, which was difficult to maintain in any other way | Israeli manufacturing companies, Israeli academic research groups | Budget: Industry consortium: up to 66% of approved budget for an industrial company and 100% of the approved budget for a research institution (80% grant, 20% industrial companies); Knowledge building consortium: 100% of approved budget (80% grant, 20% members in the association); Maagadon: up to 55% of approved budget for an industrial company and 100% of approved budget for a research institution (80% grant, 20% industrial companies)<br>Period: 3 years | Sectoral | Manufacturing companies developing competitive products and innovative technologies, for new and advanced generation of products; Academic research groups (scientific or technological research) interested in promoting applied research, collaborate with the industry, and learn market needs<br>. | Free use of the knowledge developed for consortium's members (for knowledge developed by the academic research group, granting a license to use will be in accordance with the research institution); products for wide industrial application; products with a commercial prospect in the global market; new technology; Designed technologies for the development of civilian products for the global market | Israel innovation authority |

[3] https://innovationisrael.org.il/infrastructure/rnd/maagad

**Academic Knowledge Direction**[4] -
Applied research with innovative technological feasibility, originated in academia, bringing it to a stage where an Israeli industrial commercial company will adopt it in order to develop a product, **R&D grant track**

| Field | Goal | Target groups | Program budget | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Innovative technologies | Bridging the knowledge gap in academia and the needs of industry; bringing the project to the stage of interest of business entities until a commercialization agreement with the research institution or accompanied by the support of a corporation until a business entity will sign on a commercialization agreement with the research institution | Research groups from research institutions, research institutes and medical centers | Research institutions unaccompanied by a corporation budget (for 1 year): one institute-75%/85% up to 440K; two collaborating institutions-75%/85% up to 660K; three collaborating institutions-75%/85% up to 770K<br>Research institutions accompanied by a corporation budget (for 1 year): one institute-80%/90% up to 550K; two collaborating institutions-80%/90% up to 700K; three collaborating institutions-80%/90% up to 810K<br>Period: 1-2 years<br>Extension: 3rd year 66%/75% from approved budget | Sectoral | For research groups from research institutions in Israel, research institutes and medical centers that are interested in conducting applied research as a continuation of previous basic research conducted by the same research group; The research must demonstrate innovation and originality in the aspect of the industrial application; research results should be applicable in Israeli industry and have a impart high added value to the entire economy | High technological innovation based on preliminary basic research conducted at the applicant institution; research program developed into applied research in Israeli industry; the possibility for commercialization and economic potential; contribution of the research program for the development of industry in Israel; the quality of the existing conditions for carrying out the research plan; research time allocated by the researcher; accompanied corporation serves as a partner in professional guidance and in setting research goals, and also participates in funding at a rate of 10% of the project cost | Israel innovation authority |

[4] https://innovationisrael.org.il/infrastructure/rnd/knowledgedirecting

**Knowledge commercialization**[5] **- from a research institution to an industrial corporation**[6] -
Developing groundbreaking products through commercialization of knowledge from a research institution to an industrial corporation. This track includes three sub-tracks: a. Magneton - Encouraging the transfer and commercialization of technologies from research institutions to an industrial corporation (through collaboration); b. Import of knowledge - Encouraging collaboration in which the research findings are repeated and proving the feasibility and adapting the knowledge to the applicant's needs for technological advancement. Technology development is based on cooperation between an applicant and one or more foreign research institutions/Israeli research institutions; c. Continuation of MAGNET program- Applications for research and development continued program, **R&D grant track**

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Innovative technologies | Magneton and Import of Knowledge sub-tracks: validating, adapting and encouraging transfer of knowledge from research institutions to industry; Continuation of MAGNET sub-track - continuation of R&D activities in cooperation between industrial corporation (in the consortium) and a research institution | Industrial corporation , research institution (university, or non-university) | Budget: up to 66% from approved budget, up to NIS 3.4 million<br>Period: 24 months | Sectoral | Industry and academia collaboration; Magneton and Import of Knowledge sub-tracks: industrial corporation interested developing a product/improving an existing product; Magneton and knowledge import sub-tracks: academic research groups interested in conducting innovative and original applied research in relevant feasible technology; Continuation of MAGNET sub-track: industrial corporation who's a consortium member of the for at least 1 year | This track must include academic research groups and an industrial corporation; the proposed technology must be after initial validation and laboratory experiments; maturity of the technology for knowledge assimilation and validation of the industrial corporation; commercial potentiality; the industrial corporation must complete the funding of the research group's activities (up to 100%) | Israel innovation authority |

[5] https://innovationisrael.org.il/infrastructure/rnd/knowledgeCommercialization
[6] https://innovationisrael.org.il/infrastructure/rnd/knowledgeCommercialization

**MEIMAD - Military, security and commercial dual R&D leverage**[7]
Supporting the development of innovative solutions for the defense and commercial markets. This track includes 3 sub-tracks: a. knowledge orientation: dual applied R&D in academia accompanied by an industrial corporation; b. knowledge commercialization: validation, adjustment and transfer of dual knowledge from a research institution to a company; c. prototype development: R&D before products to prove technological capability (for a company), **R&D grant track**

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Innovative technologies | Promote military/defense and commercial R&D of dual use technologies, which on the one hand constitute a contribution to national security, and on the other hand possess financial potential | Small and medium companies, University research institutes, research centers, entrepreneurs | Knowledge orientation budget: 80%-90% of approved budget knowledge commercialization budget: budget: 55%-66% of approved budget prototype development budget: 50% of approved budget | Sectorial | Israeli small and medium companies that are up to US$100 million in sales per year; entrepreneurs who have not established a company, yet | Level of technological innovation and the technological challenge; level of functional innovation; intellectual property and patents; economic aspects; the ability of technological, financial, managerial and business ability of the company and the team; quality of collaboration | Israel innovation authority, Ministry of Finance, Ministry of Defense, Maf'at |

**TELEM Forum (national R&D infrastructures)**[8]
Advancement of R&D programs for scientific / technological areas and projects, through the establishment of national R&D infrastructures and inter-organizational and international collaborations, **Infrastructure grant track**

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Science and technology | Establishment of R&D infrastructure in the process of initiating, coordinating, testing, allocating resources, and determining the responsibility for implementation and control regarding the establishment and operation of national infrastructure for R&D | Forum members, external entities | n/a | Horizontal | The forum addresses its members as well as external entities with whom it will enter into official agreements detailing the commitment of each of the parties | Application submission will be done in according to a tender for infrastructure | Israeli Government through TELEM |

[7] https://innovationisrael.org.il/infrastructure/rnd/meimad
[8] https://innovationisrael.org.il/content/מסלול-פורום-תלם-תשתיות-לאומיות-למחקר-ופיתוח

**Entrepreneurial incubators in the periphery**[9] -
Promoting local entrepreneurship in the periphery through dedicated incubators that will encourage and assist in establishing companies to carry out research, development and commercialization. Incubators activities will include the formation and promotion of projects in the periphery developed by entrepreneurs, students, joint ventures between industry and entrepreneurs, start-up companies, and projects of institutions of higher education, **Start-Up Division**

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Research, development and commercialization, technological initiative | Encourage the development and strengthening of innovation systems (ecosystem), technological entrepreneurship and employment in the periphery area by collaboration between incubators and institutions of higher education, students, entrepreneurs and start-ups through research, development and commercialization of incubator companies based on local ventures | Private entrepreneurs, start-ups, research institutions | Entrepreneurs and companies' budget: 85% of the approved budget of the incubator, up to NIS 1M<br>Period: 1 year<br>Incubators franchisees budget: up to NIS 500K per franchise; Incentive grant up to NIS 1M per franchise<br>Period: 1 year; a concession period of 5 years to operate the greenhouse, extend for 3 years | Horizontal | Private entrepreneurs who are interested in establishing start-up companies; new Israeli start-ups owned by private entrepreneurs interested in developing a commercial product; researchers and research institutions interested in establishing start-up companies for groundbreaking research | The degree of project innovation and the technological depth; technological applicability of the product; business potential of the product, including the global market | Israel innovation authority |

[9] https://innovationisrael.org.il/startup/programsrnd/peripheryincubators

## Switzerland

**SCCER** -Swiss Competence Centers for Energy research[10]
The centers bring together academia and industry, ensuring the transfer of knowledge and technology

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Industrial efficiency, energy-saving, renewable energy, waste heat recovery | Solutions to the technical, social, and political challenges relating to the 2050 Energy Strategy[11] | Academia and industry | Budget: CHF 120 million (+ CHF 19 million from Innosuisse) Period: 4 years | Sectoral | Projects carried out by SCCERs working together (known as joint activities). These projects are intended to reinforce interdisciplinary cooperation between the centers | Solutions to the technical, social and political challenges relating to the 2050 Energy Strategy. | Innosuisse[12], SNSF[13], and SFOE[14] |

[10] https://www.innosuisse.ch/inno/en/home/thematic-programmes/energy-funding-programme.html
file:///C:/Users/sima/Downloads/KTI_Themenheft_Energie_en_170817_Web.pdf
[11] https://www.bfe.admin.ch/bfe/en/home/policy/energy-strategy-2050.html
[12] Innosuisse - The Swiss Innovation Agency
[13]SNSF - The Swiss National Science Foundation
[14] SFOE - The Swiss Federal Office of Energy

**NTN**[15] – Innovation Boosters
NTN brings together interested teams from universities, business and society at national level around a defined innovation theme and stimulate the emergence and testing of concrete innovation ideas

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Manufacturing. Economy, Energy, Decarbonization, Food Photonics, Technology, Medtech | Develop concrete, verifiable solution, product and service concepts | Academic groups, Implementati on partners (SMEs, Start-ups, larger companies, Non-for-profit organizations ), and end customers | Budget: Max annual promotion budget: 500K CHF (Activity funding: ≤250K, Ideas funding≥250K) Period: 4 years | Horizontal | Potential to create sustainable economic added value, Potential to reduce social costs and create economic added value? Does the idea involve a novel technological and/or economic approach? Transparent accounting system, orderly reporting and financial audits | Theme is highly relevant and attracts a great deal of interest among both universities and implementation partners. Themes of economic relevance are to be addressed in an innovative manner; The novel applications can impact both industry and the services sector | Innosuisse[12] |

[15] https://www.innosuisse.ch/inno/en/home/be-connected/ntn/ntn-innovation-booster.html

## Denmark

**Technological services and knowledge-based networks**[16]
17 innovation networks and clusters offer companies access to the latest research and innovation trends within their respective fields of expertise just as they provide inspiration on tendencies within new technology, product innovation and innovation methods

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Lifestyle & Design, Healthtech, Materials, Security, Environmental Technology, Energy, knowledge-intensive technologies, Bio- and Life Science, Food, Transport, ICT, Biomass, economy, Digitalization | Strengthen public-private collaboration and knowledge transfer between public universities and private companies on research and innovation | Universities and companies | Budget: total of DKK 190 million (for 17 networks)<br>Period: 2 years | Horizontal | The Innovation Networks are open to all interested companies in Denmark | Companies finance their own participation; The Ministry of Higher Education and Science finances up to half of the Network activities; The funding is used for the professional operation of a network, facilitating matchmaking activities as well as for running specific collaboration projects within e.g. research, education, knowledge dissemination; The networks have to obtain the other half of the funding from private companies, regional funds, etc. | Ministry of Higher Education and Science |

[16] https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/collaboration-between-research-and-industry/innovation-networks-denmark

**Commercialization and entrepreneurship-The Innovation Incubator Scheme**[17]
Four innovation incubators operate at the earliest stage of the investment chain, where venture capitalists and other private investors are reluctant to engage; the innovative incubators can engage financially three successive stages: a. Pre-investigation; b. Primary project funding; c. Secondary project funding;

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| All disciplines | incubators provide professional counselling, pre-seed and seed capital for entrepreneurs and new innovative enterprises | Researchers, students, craftsmen, specialists, companies | Budget: Pre-investigation- average of 80K DKK; Primary project funding- up to 3,5 million DKK; Secondary project funding- up to 2,5 million DKK | Horizontal | Researchers, students, craftsmen, specialists and others who have made an invention, who own the rights to the invention and who intend to commercialize their invention through a licensing agreement with an existing company | The innovation incubators are private limited companies approved as operators by Ministry of Higher Education and Science; successful commercialization of invention | Ministry of Higher Education and Science |

**Research infrastructures**[18]
A wide variety of equipment, measuring instruments, test facilities, databases, laboratory facilities, test plants, supercomputers and other tools and resources employed in research processes and in generating new knowledge; up-to-date research infrastructure that also serve as hubs for knowledge, innovation and technology transfer between research and industry

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Biotech, Health and Life Sciences; Energy, Climate and Environmental Sciences; Physical Sciences; Humanities and Social Sciences; Materials Technology and Nanotechnology | strengthen Denmark's international competitiveness within research, education and innovation; Denmark by 2020 should be an international front-runner within research infrastructures | Research institutions, companies | Budget: DKK 420 million Period: 5 years | Horizontal | According to each infrastructure | Research infrastructure that tend in favor of national-level coordination, according to 2015 Danish Roadmap for Research Infrastructures (22 specific proposals for national infrastructures) | Ministry of Higher Education and Science |

[17] https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/commercialisation-and-entrepreneurship/the-innovation-incubator-scheme
[18] https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/research-infrastructure

## United Kingdom

**ISCF- Hub pre-announcement** [19]
Transforming Foundation Industries; Research and Innovation Hub in six sectors

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Multidisciplinary Research, six separate sectors: metal, glass, ceramics, paper, cement, and chemicals | Enable the foundation industries to work together to address their common challenges of competitiveness and sustainability. | Academia and industry | Budget: up to £4.7m Period: 36 months for 1 Research and Innovation Hub | Horizontal | Multidisciplinary team; Principal Investigator supported by Co-Investigators and Project Partners; academia and industry working together | Multidisciplinary Research and Innovation program; linking innovators with industry; transfer of knowledge from universities to industry, early stage 'proof-of-concept' projects; generate credible and engaging impact; develop commercial opportunities; research grounded in 'real world' and have close involvement with potential users | UKRI[20] - ISCF |

**ISCF- Network Plus** [21]
Transforming Foundation Industries; The program enables transformational change by raw materials and energy industries in how materials are sourced and processed, and the types of products manufactured

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Raw materials, energy | Address common challenges and accelerate the development and adoption of new technologies and business models within the Foundation Industries | Academia and industry | Budget: Up to £2M (approximately 50% should be allocated to the flexible fund) | Sectoral | UK's Foundation Industries: Glass, Metals, Cement, Ceramics, Bulk Chemicals and Paper; academic leadership across the sectors and engagement with business, industry business, policy makers; organize networking activities (workshops, events, communications, etc.); the should include a substantial flexible fund for small projects | Adoption of new technologies and business models; a wide range of expertise, knowledge and experience across business and research stakeholders; knowledge transfer between the sectors; breadth of expertise in relevant fields; strategic contribution vision; | UKRI - ISCF |

[19] ISCF (The Industrial Strategy Challenge Fund), https://www.ukri.org/funding/funding-opportunities/iscf-transforming-foundation-industries-hub-pre-announcement/
[20] UKRI - Engineering and Physical Sciences Research Council
[21] https://www.ukri.org/funding/funding-opportunities/iscf-transforming-foundation-industries-network-plus/

| Norway |
| --- |
| **Knowledge-building Project - for Industry**[22] |
| Collaborative and Knowledge-building Project - for Industry is available for basic and applied research activities alike |

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Energy, transport and low emissions, Oceans, Petroleum | Develop new knowledge and generate research competence needed by society or the business sector to address important societal challenges | Research organizations, industry and any potential partners from other sectors | Budget: NOK 278 000 000. Funding is distributed across three thematic areas<br>Period: 24-60 months | Sectorial | Research organization (project Owner) collaborates with at least two funding partners (industry and other sectors); A project participant may not be assigned two different roles in the project; Steering committee or reference group; The combined cash contribution from Norwegian partners forms the basis for the maximum amount of funding that the Research Council can provide | Promotion and utilization of new knowledge; the benefit of knowledge developed for wider user groups; archiving of research data | Research Council |

22 https://www.forskningsradet.no/en/call-for-proposals/2020/knowledge-building-project-for-industry/

**Collaborative Project to meet Societal and Industry-related Challenges**[23] Collaboration between research organizations and stakeholders from outside the research sector that represent societal and/or industry needs for knowledge and research competence in 11 thematic areas

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Antimicrobial resistance, land under pressure, renewable, energy, transport and low emissions, global development, oceans, health, climate and polar, land-based food, environment and bioresources, enabling tech., education and competence welfare, culture and society | Develop new knowledge and generate research competence needed by society or the business sector to address important societal challenges | Norwegian research organizations, public sector, non-governmental organizations, trade and industry | Budget: NOK 1.3 billion<br>Period: 24-48 months | Horizontal | At list one research organization cooperating with at least two partners (public sector, non-governmental organizations, trade and industry). Projects are to have a steering committee or reference group. project manager must have doctorate or equivalent qualifications; project manager and project administrator may not be filled by the same individual. | Benefits of knowledge development for wider user groups | Research Council |

[23] https://www.forskningsradet.no/en/call-for-proposals/2020/collaborative-project/

## Sweden

**SIO Grafen** [24]

Collaboration on commercial graphene applications, autumn 2020

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| biotechnology, electronics, energy, composite, manufacturing, and coating | A need that could be met with material development of graphene | Companies, research institutes, academia, or other legal entities | Budget: SEK 300K - SEK 4M and 50% of project costs | Sectoral | Project consortia consisting of companies, research institutes, academia or other legal entities. | Industrial driven cooperation in either Feasibility studies, Research and Innovation projects or Innovation and Demonstration Projects; Graphene or other two-dimensional materials should contribute with improved material properties or functionalities | Vinnova[25] |

[24] https://www.vinnova.se/en/calls-for-proposals/the-strategic-innovation-program-for-graphene/sio-grafen-collaboration-on-2020-02308/

[25] Vinnova- Sweden's innovation agency https://www.vinnova.se/en/

| Austria |
| --- |

BRIDGE[26]
Funding is made available for basic research projects conducted by consortia of partners involved in scientific research and industrial commercialization. National program.

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Aeronautics and Space, Bottom-up, Environment and energy, Further research areas, Human Resources, Information technology, Life Sciences, Material and manufacturing, Mobility and Transport, Security and Defense, Service innovation, Society | Development and transfer of basic research findings to industrial application; Extending research collaboration between science and industry; Facilitating access to scientific research for small and medium-sized enterprises; Promoting the transfer of researchers from universities to industrial research; High-level industrial research and experimental development; Innovations in social and economic sciences; Promoting the commercialization of high-tech innovations | Researchers and companies from all scientific disciplines and sectors. | Budget: 80 % for small companies, 70% for medium-sized and 60 % for large enterprises, up to a max funding of €360K per project.<br>Period: 12 - 36 months | Horizontal | Research institutes defining a consortium together with Start-ups, small and medium-sized companies, major companies or centers of expertise. A consortium is requested of single application by research institution (non-university research institutions and universities) - at least two partners (1 from science, 1 from industry).<br>The consortium must consist of at least two partners (one each from science and industry respectively). | Evaluations are conducted by internal experts of the FFG and external evaluation processing. | Federal ministry republic of Austria[27], FTE[28] |

[26] FFG-The Austrian Research Promotion Agency https://www.ffg.at/en/programme/bridge
[27] Federal ministry republic of Austria-climate action, environment, energy, mobility, innovation and technology https://www.bmk.gv.at/en.html
[28] National Foundation for Research, Technology and Development http://www.stiftung-fte.at/die-stiftung/

COIN[29]

COIN contributes towards fostering Austria's innovation performance by the better and broader transposition of knowledge into innovation. National and international program.

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Aeronautics and Space, Bottom-up, Environment and energy, Further research areas, Human Resources, Information technology, Life Sciences, Material and manufacturing, Mobility and Transport, Security and Defense, Service innovation, Society | The COIN "Network" funding line encourages technology transfer within entrepreneurial cooperation schemes, thus raising the level of innovation within businesses and strengthening their cooperation capacities. It focuses on output-oriented cooperation projects to develop and improve innovative products and processes. | Companies<br>Intermediaries / institutions for technology transfer<br>Research institutions (universities, technical colleges, non-university research institutions) | Budget: up to €500K<br>Small companies: 60%; Medium-sized companies: 50%; Large companies: 35%; Research institutions and intermediaries: 60%<br>Period: 1 to 2 years | Horizontal | Partner is required.<br>Project implementation in a consortium with at least 4 companies, including 3 SMEs (optional FEI institutions and / or intermediaries as consortium partners); Max. 40% third party costs based on the total project costs; The consortium leader has a seat in Austria | The focus of the COIN "Aufbau" (capacity building) funding line is on building RDI competence and infrastructure at universities of applied sciences and research institutes. COIN "Aufbau" aims at strengthening providers of applied research, who are core partners for enterprises in terms of RDI, and increasing the cooperation between applied sciences and companies, especially SMEs. | Federal ministry republic of Austria[30] |

[29] FFG-The Austrian Research Promotion Agency https://www.ffg.at/en/program/coin-cooperation-and-innovation-0

[30] Federal ministry republic of Austria-digital and economic affairs https://www.bmdw.gv.at/en.html

| Beyond Europe[31] |
|---|
| The "Beyond Europe" Program supports Austrian companies, research and university institutes and other organizations in creating and extending collaborations. |

| **Field** | **Goal** | **Target groups** | **Program budget/ duration** | **Instrument's approach** | **Conditions to apply** | **Selection criteria** | **Source of funding** |
|---|---|---|---|---|---|---|---|
| Aeronautics and Space, Environment and energy, Further research areas, Human Resources, Information technology, Life Sciences, Material and manufacturing, Mobility and Transport, Security and Defense, Service innovation, Society | Development of R&D competence and improvement of innovation performance in strategic subject areas; Deepening the cooperation relationships in the innovation system, especially between science and business; Contributions to meeting socio-economic challenges | Austrian companies, research and university institutes and other organizations | Budget: €100K to €2M<br>Period: 3 years | Horizontal | The consortium consists of at least one company. In addition, at least one SME or a research institution or a partner from another EU member state is represented in the consortium; No corporate partner bears more than 70% of the total project costs; The research institutions have a maximum of 70% share of the fundable project costs; The consortium leader has a seat in Austria | Cooperative research and development projects are collaborations between several consortium partners who work together in a joint project with defined R&D goals. The R&D project can be set up either as industrial research (further away from the market) or experimental development (closer to the market). | Federal ministry republic of Austria[32] |

[31] https://www.ffg.at/en/program/beyond-europe-programme
[32] Federal ministry republic of Austria--digital and economic affairs https://www.bmdw.gv.at/en.html

| COMET Competence Centers for Excellent Technologies - COMET Projects[33] |
|---|
| COMET Projects aim to carry out high-quality research in science - industry collaboration. They are characterized by a medium-term perspective and clearly defined topics having the potential for further development. COMET Projects contribute to initiating product, process and service innovations. COMET Projects open access to the COMET Program for new consortia and topics. They may also develop into COMET Centers over the long term. |

| **Field** | **Goal** | **Target groups** | **Program budget/ duration** | **Instrument's approach** | **Conditions to apply** | **Selection criteria** | **Source of funding** |
|---|---|---|---|---|---|---|---|
| Service innovations, society, information technology, life sciences, materials and production, mobility, security and defense, environment and energy, space | The aim of the COMET projects (formerly K projects) is to carry out high-quality research in cooperation between science and industry with a medium-term perspective and clearly defined topics with future development potential. | Consortia in cooperation between science and industry | Budget: up to €0.675 million / year, up to max. 45% of the eligible costs<br>Period: 3 - 4 years | Horizontal | The consortium must include at least one partner from science and at least three partners from business. | A research project formulated jointly by science and business, which has a high level of research competence and science connection with simultaneous high implementation relevance in the corporate sector. | Federal ministry republic of Austria[32,27] |

[33] https://www.ffg.at/content/comet-compentence-centers-excellent-technologies-comet-projects

## Belgium

**Thematic ICON project artificial intelligence**[34]

Bridge the gap between research results in the field of artificial intelligence and its applications in Flemish business

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Artificial intelligence | (I) a research part, aimed at strengthening top AI strategic basic research in Flanders, (II) an implementation part, aimed at implementation in the Flemish business community, and (III) a part Flanking policy | Flemish companies & research organizatio n | Budget: €32M (all projects) per year | Sectoral | Priority is given to projects with great added value for Flanders, to projects that are closely related to the AI Flanders research program, and to projects that are strongly related to A | Interdisciplinary Cooperative Research, multidisciplinary research teams of scientists, industry partners and / or social profit organizations can jointly conduct research into developing innovative solutions that then find their way into the market offer of the participating partners and beyond | The Agency for Innovation & Entreprene urship (VLAIO)[35] |

[34] https://www.vlaio.be/nl/subsidies-financiering/thematisch-icon-project-artificiele-intelligentie

[35] https://www.vlaio.be/nl/over-ons/agentschap-innoveren-ondernemen

## UNITED STATES

**PFI - Partnerships for Innovation program**[36]

Translational research and technology development, catalyze partnerships and accelerate the transition of discoveries from the laboratory to the marketplace for societal benefit

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| All NSF-funded disciplines of science and engineering | Identify and support research and technologies with potential for commercialization; promote partnerships between institutions, industry, and the private sector for accelerating the transfer of technology; develop multi-disciplinary innovation ecosystems | NSF-funded institutions, industry, and academia | 1. Budget: $250K Period: 18 months<br>2. Budget: $550K Period: 36 months. | Horizontal | Academic/Research institutions, universities and colleges; Public or non-profit, non-academic U.S. organizations that are associated with technology transfer activities; Non-profit U.S. organizations that partner with an institution of higher education or a U.S. consortium of two or more of the organizations. The PI/co-PI must have had an NSF award that (ended no more than seven (7) years prior to the proposal or a current NSF award recipient). Or been a member of an award under the NSF I-Corps™ Teams Program | Outcomes of new intellectual property; creation of new or broader collaborations with industry; entrepreneurship and innovation. | NSF |

[36] https://nsf.gov/eng/iip/pfi/about.jsp

**GOALI**[37]
Grant Opportunities for Academic Liaison with Industry Proposal

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Interdisciplinary research and education projects | The program seeks to stimulate collaboration between academic research institutions and industry | Academia and industry | n/a | Horizontal | Academic scientists and engineers request funding either in conjunction with a regular proposal submitted to a standing (NSF) program or as a supplemental funding request to an existing NSF-funded award | Proposals should focus on research that addresses shared interests by academic researchers and industrial partners. The research should further scientific and engineering foundations to enable future breakthrough technologies with the potential to address critical industry needs | NSF[38] |

[37] https://www.nsf.gov/eng/iip/goali.jsp
[38] NSF- National Science Foundation

**IUCRC-** Industry–University Cooperative Research Centers [39]

The centers program accelerates the impact of basic research through close relationships between industry innovators, world-class academic teams, and government leaders

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Advanced electronics, advanced manufacturing, and advanced materials, biotechnology, civil infrastructure systems, energy and environment, health and safety, Information, communication and computing, sensing and information systems, system design and simulation | IUCRCs are designed to help corporate partners and government agencies connect directly and efficiently with university researchers to achieve primary objectives | Academia and industry | Budget: $20K<br>Period: 12 months | Horizontal | IUCRCs eligible to apply for two five-year Phases of funding | High-impact research to meet shared industrial needs; global leadership in driving innovative technology development | NSF-IUCRC |

[39] https://iucrc.nsf.gov/

| Belarus |
|---|

**Innovative infrastructure** [40]
It is a set of entities engaged in support for innovative activities: material and technical, financial, organizational and methodological, informational, consulting and other

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Innovative activity in accordance with the priority areas of scientific, technical and innovative activity in the Republic of Belarus | Creation of a system of business entities capable of ensuring the effective implementation of innovative activities in the interests of the whole society | Companies, research institutes, academia | The planned amount of financing for 2020 is 44 652,3 thousand BYN (about 17 374,4 thousand USD), including 21 067,3 thousand BYN (about 8 197,4 thousand USD) from the state budge | Sectoral | Legal entities may be registered as subjects of the innovation infrastructure if theirs' subject is to promote the implementati | - the relevance and significance of the project for the development of innovative activities;<br>- the possibilities and feasibility of implementing the project in the planned activities of a legal entity;<br>- the competitiveness of manufactured goods (works, services), the prospects of sales markets, the effectiveness of the marketing strategy of a legal entity. | State budget |

**SSTP**[40] – State scientific and technical program.
The applied research and R&D phase is funded by the state through state scientific and technical programs. These programs are financed from the republican budget with the subsequent transfer of the obtained scientific and technical results to manufacturing enterprises. Enterprises, as a rule, co-finance the execution of tasks of these programs on an equal footing with the budget (up to 50% of the funds required for the implementation of projects). In accordance with the procedure for the formation and implementation of assignments for programs and innovative projects, contracts for their implementation after the completion of the R&D stage provide for the commercialization of the obtained scientific and technical results, as a rule, for 2-3 years.

| Field | Goal | Target groups | Program budget/ duration | Instrument's approach | Conditions to apply | Selection criteria | Source of funding |
|---|---|---|---|---|---|---|---|
| Scientific, technical and innovative activities in the field of information, medical, biological, machine-building, agro-industrial technologies, energy, construction, rational use of natural resources, ensuring the safety of man and society | Development of technologies and creation of innovative industries | Research institutes, academia, companies | Budget: the planned expenditure for 2020 is 38 778 thousand BYN (15 088,7 thousand USD).[40] | Sectoral | Any organization can propose a project if the National Academy of Sciences or one of the ministries agrees to act as the customer.[40] | Development of programs and preparation of draft lists of programs are carried out on a competitive basis. Draft lists of programs are considered by the Commission on State Scientific and Technical Policy under the Council of Ministers of the Republic of Belarus[40] | State budget |

40 http://www.gknt.gov.by/deyatelnost/innovatsionnaya-politika/the_state_duma/

Science & Technology

**Samuel Neaman Institute**
for National Policy Research

Tel. 972-4-8292329 | Fax. 97-4-8231889
Technion City, Haifa 3200003, Israel
www.neaman.org.il