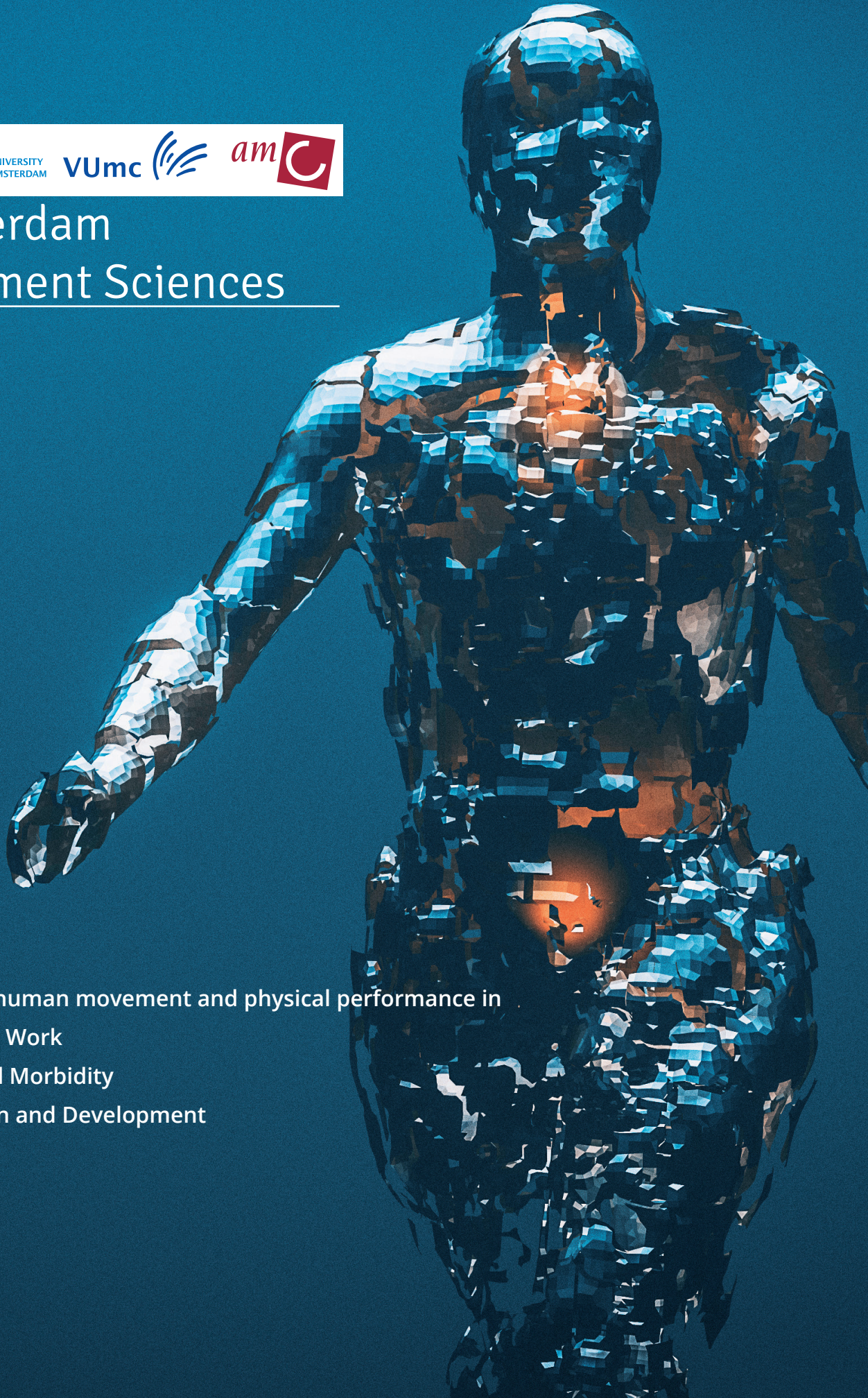


# Institute Plan 2017-2020



## Amsterdam Movement Sciences

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Optimizing human movement and physical performance in

- Sports and Work
- Ageing and Morbidity
- Restoration and Development



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# 1. Mission and Vision

## *Mission*

Amsterdam Movement Sciences strives to optimize physical performance in health and disease to contribute to well-being and societal participation, based on a fundamental understanding of human movement.

## *Vision*

Daily life activities and social participation critically depend on our ability to move. Physical activity contributes to health and enjoyment of life. Staying fit, and active becomes increasingly important, as life expectancy rises, survival after severe disease increases and the incidence of multimorbidity and chronic diseases grow. Societal changes put increasing demands on physical performance and independence of individuals. Therefore, optimizing human movement becomes increasingly important to improve physical performance in daily life, in work and sports, to prevent injury and to reduce disability due to medical conditions that impair movement.

The research within Amsterdam Movement Sciences is driven by questions arising from the clinic, from society, and from our interest in the nature of the human motor system and human movement. The research of the institute focuses on improving, preserving and restoring the human motor system to allow optimal physical performance in work, sports, aging and disease, based on fundamental knowledge of underlying mechanisms and principles. Interventions subserving these aims span physical training and learning, technical devices and implants, pharmaceutical and surgical treatments as well as musculoskeletal tissue repair and tissue engineering.

Amsterdam Movement Sciences performs excellent, interdisciplinary research in all of these areas. Moreover, the institute facilitates the exchange of knowledge between different applications, such as between elite sports and rehabilitation, and between basic and applied science, based on the conviction that integrating knowledge from different disciplines and from different biological scales on the continuum from molecules to physical performance of individuals, fosters innovation. The institute strives to cover the full research range from fundamental studies, translational proof-of-concept studies, to clinical studies on effectiveness and implementation of results.

## *Aim*

Amsterdam Movement Sciences focuses on human movement, a key issue for today's society, and approaches this in a broad interdisciplinary composition, covering from fundamental to clinical and from cellular to population research, which is unique in the world. The institute aims at being world leading in the field of interdisciplinary translational research on human movement and physical performance, and to disseminate its results to end-users so that society benefits optimally from our research results.

## 2. Research Programs

Amsterdam Movement Sciences studies human movement and physical performance in healthy individuals and in individuals with disorders causing movement impairments. The research of the institute is organized in three programs: Sports and Work, Ageing and Morbidity, and Restoration and Development.

### Sports and Work

The program Sports & Work aims at life-long healthy participation in sports, and work, by healthy and disabled individuals including those with chronic diseases. Optimization of physical performance is key in this program, that encompasses elite sports and talent development, recreational sports and work activities. Unfortunately, participation in physical activities entails a risk for adverse musculoskeletal effects and threatens sustainability; i.e. by injury and/or illness. Research in this program addresses (1) fundamental questions underpinning the etiology and pathways by which physical (in)activity optimizes, benefits, or harms musculoskeletal health and physical performance; (2) optimization of physical performance through health monitoring, early diagnostics, as well as training and learning strategies; (3) multidisciplinary clinical treatment and training guidelines, and improvement of interventions; and (4) effects of interventions targeted at injury/illness prevention, training and work and sports performance optimization, including the (cost-) effectiveness and implementation of such interventions. Interdisciplinary collaboration is actively pursued within the program to deepen our understanding of contemporary issues and to optimize impact of interventions.

The research in this program is grouped in 3 themes:

1. **Elite Sports Performance** addresses performance optimization, in elite sports of healthy and disabled individuals and talent development.
2. **Sports and Health** addresses injury prevention and treatment in elite and recreational sports and physical activity to optimize musculoskeletal health and physical fitness.
3. **Work Performance and Health** addresses work issues in different professions and work environments to optimize performance and sustainability.

### Ageing and Morbidity

The program Ageing and Morbidity aims to combat the negative effects of ageing and age-related disorders, such as osteopenia and sarcopenia, osteoarthritis, and of chronic diseases such as cancer, diabetes and cardiovascular diseases, on musculoskeletal health, movement and physical performance. Movement is sub-served by our musculoskeletal system, which relies on the neural, endocrine, immune, respiratory, and cardiovascular systems that control and support it. The interactions of these systems are studied, to reveal how physical performance can be maintained with ageing and optimized in chronic diseases. Since physical activity is also crucial for the maintenance of the underlying systems, the aim is to understand how physical stimuli can optimize structure and function of the musculoskeletal system in order to sustain adequate mobility and physical performance. Research addresses (1) the biological mechanisms underlying declines in physical performance and the effect of interventions preventing/reducing these declines, (2) diagnosis and prediction of declines in physical performance and the underlying impairments, (3) efficacy and (cost-)effectiveness of interventions to prevent/reduce declines in physical performance.



The research in this program is grouped in 3 themes:

1. **Musculoskeletal Health** addresses common musculoskeletal disorders. Targeted in this theme are frequent (painful) musculoskeletal conditions among the population and osteoarthritis.
2. **Mobility and Ageing** addresses musculoskeletal tissue quality, physical performance and safety in mobility during ageing.
3. **Physical Functioning in Major Diseases** addresses the beneficial effects of movement in critical illness and chronic diseases, especially post-intensive care syndrome, diabetes (including foot complications), oncologic and cardiovascular diseases.

## **Restoration and Development**

The program Restoration and Development aims to optimize physical performance of individuals, including children, with musculoskeletal injuries and neurological disorders affecting movement abilities. Consequences of these disorders become apparent at the three WHO-ICF levels of functioning: impairments in function of body structures (tissues and organs), limitations in functional activities, and restrictions in participation in society. Translational research comprises all these three levels and their interrelationships to understand and improve movement and physical performance in the context of personal and environmental factors. Interventions cover musculoskeletal tissue regeneration, surgery, pharmacological interventions and rehabilitation interventions, including learning and training strategies, assistive devices and (care giver) support. Precision diagnostics of movement impairments, based on etiology, will be developed to personalize therapies that restore, adapt, or support the neuro-musculoskeletal system to optimize the restoration, development and preservation of movement abilities and physical performance.

The research is organized in three themes according to classes of conditions that are associated with impaired movement:

1. **Trauma and Reconstruction** addresses regeneration and repair of acute and chronic musculoskeletal tissue damage. This theme includes lesions of muscles, bones, joints and the covering soft tissues and skin, specifically burn wounds and scar tissue.
2. **Activities and Participation** addresses the optimization of functioning through rehabilitation interventions in pathologies that affect the central and/or peripheral nervous system resulting in movement impairments and associated disability. The focus lies on stroke, multiple sclerosis, movement disorders and neuromuscular diseases.
3. **Growth and Development** addresses the normal motor and musculoskeletal development of children during growth into adulthood and the development of children with disorders. The focus lies on cerebral palsy, premature born infants, scoliosis, obstetric plexus injuries and connective tissue disorders.

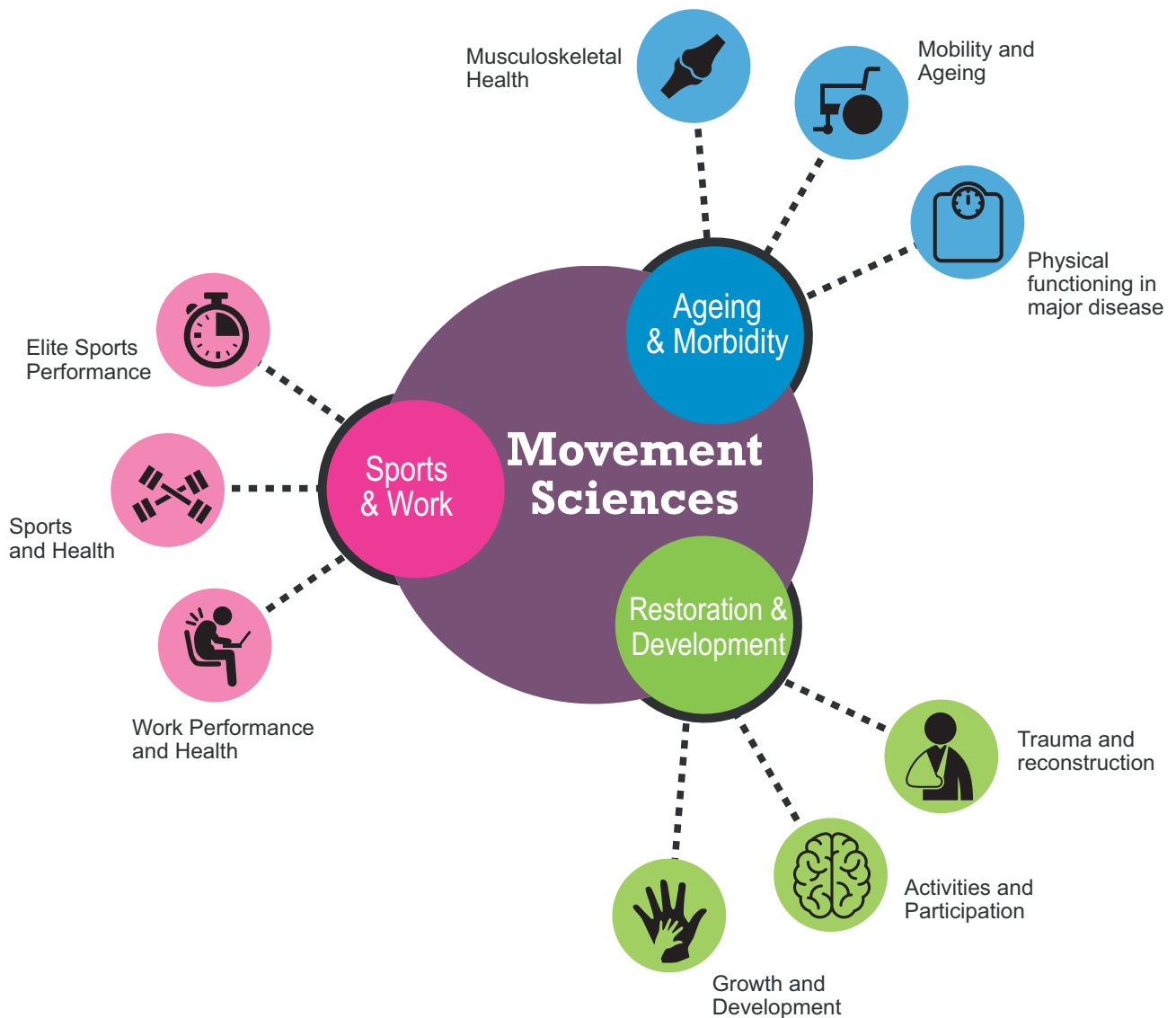


Figure 1: Research Programs and Research Themes

### ***Translational research expertise***

Amsterdam Movement Sciences conducts interdisciplinary translational research that brings knowledge from bench to bedside and community to solve clinical and societal problems. Therefore, the institute actively builds on a strong interdisciplinary background in molecular biology, mechanobiology, physiology, biomechanics, motor control, biomedical engineering, musculoskeletal imaging and clinical epidemiology.

### ***Connection between programs***

Although Amsterdam Movement Sciences organizes its research in three distinct programs, these are interconnected and profit from their complementary expertise. Whereas programs differ with respect to target groups consisting of healthy individuals, older adults, individuals with diseases or disabilities and consequently in context and activities, the joint topic is optimization of movement abilities and physical performance. Also, disease and injury play a role in sports and work and contribute to or aggravate age-related declines of physical performance.



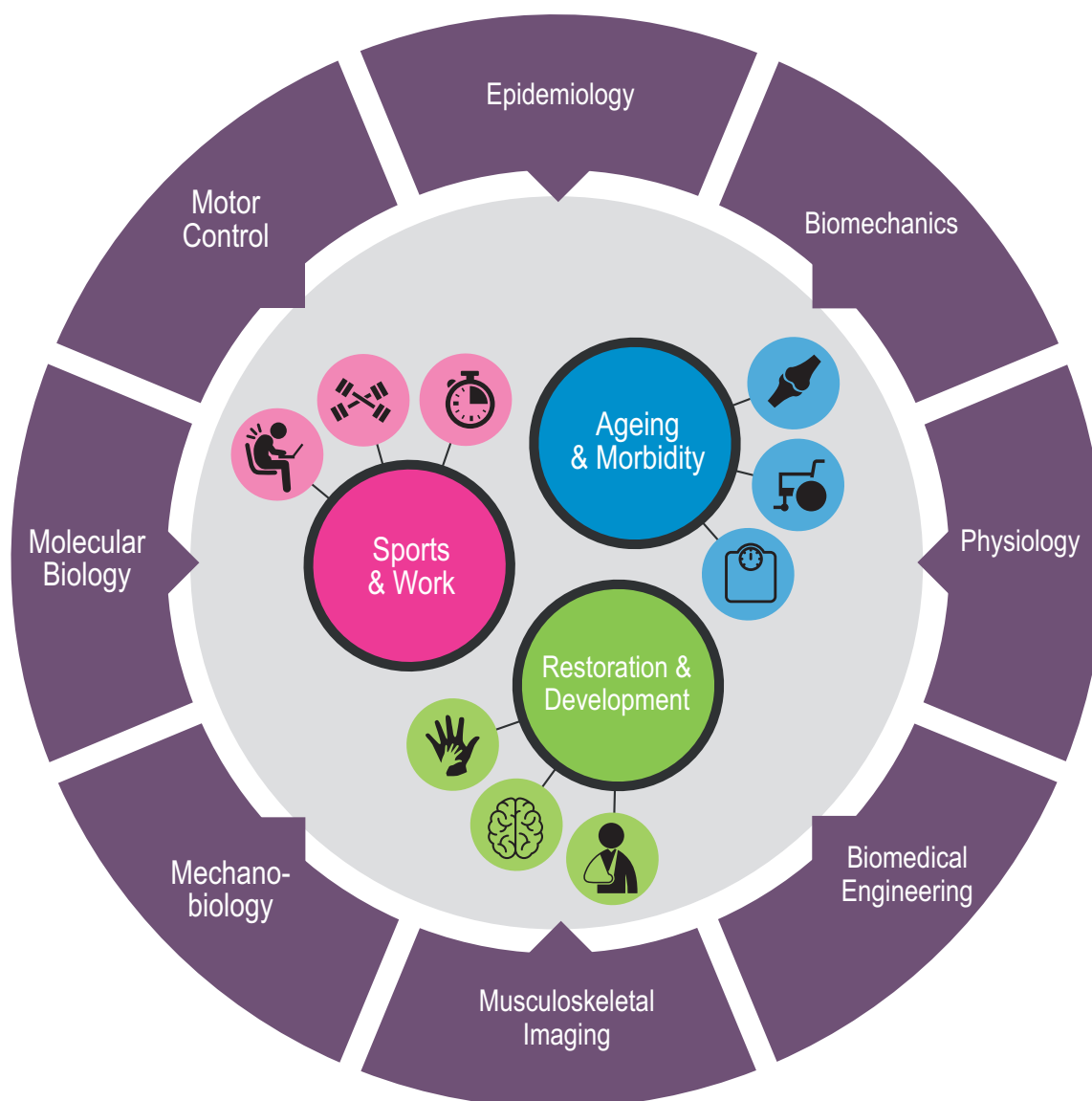


Figure 2: Research expertise

A major aim of Amsterdam Movement Sciences is to foster innovative translational research by the integration of knowledge from different fields of expertise covering the range from the cellular level to the performance of individuals, ranging from elite athletes to patients. Therefore, researchers are stimulated to engage in projects of different programs or projects that bridge across programs and to involve end users in their research projects.

### ***Collaboration with other Amsterdam research institutes***

Many health conditions negatively impact on the neuro-musculoskeletal system and hence hamper physical performance with adverse consequences for societal participation and well-being. Conversely, physical activity has a large beneficial effect on general health and on specific disorders in a wide range of diseases. Therefore, the institute strives towards collaboration with the other Amsterdam research institutes in the VUmc-AMC alliance based on a joint interest in addressing movement and physical performance related issues in public health and in diseases with worldwide large impact on health. In Sports and Work and in Ageing and Morbidity collaborative research with Amsterdam Public Health can for instance be incorporated to preserve general health and with respect to occupational health.

In Ageing and Morbidity joint research will be housed within Cancer Center Amsterdam, Amsterdam Cardiovascular Sciences, Amsterdam Gastroenterology & Metabolism, and Amsterdam Infection & Immunity. Restoration and Development will include shared research with Amsterdam Neuroscience and Amsterdam Reproduction and Development. In these shared research projects, the added value of Amsterdam Movement Sciences will be its fundamental expertise on human movement to improve interventions with respect to physical performance and by that to health outcomes.

Behavioral aspects influence daily life physical activities of patients and healthy individuals. To address behavioral and psychological issues we will collaborate with Amsterdam Public Health and other institutes such as the Institute of Brain and Behavior Amsterdam of the Faculty of Behavioural and Movement Sciences of the VU Amsterdam. The research of Amsterdam Movement Sciences underlies various collaborative initiatives with other parties such as the Amsterdam Institute for Science in Sports in which the Amsterdam University of Applied Science also participates. Depending on shared interest and complementary expertise joint research with other institutes at VU and UvA is also possible.

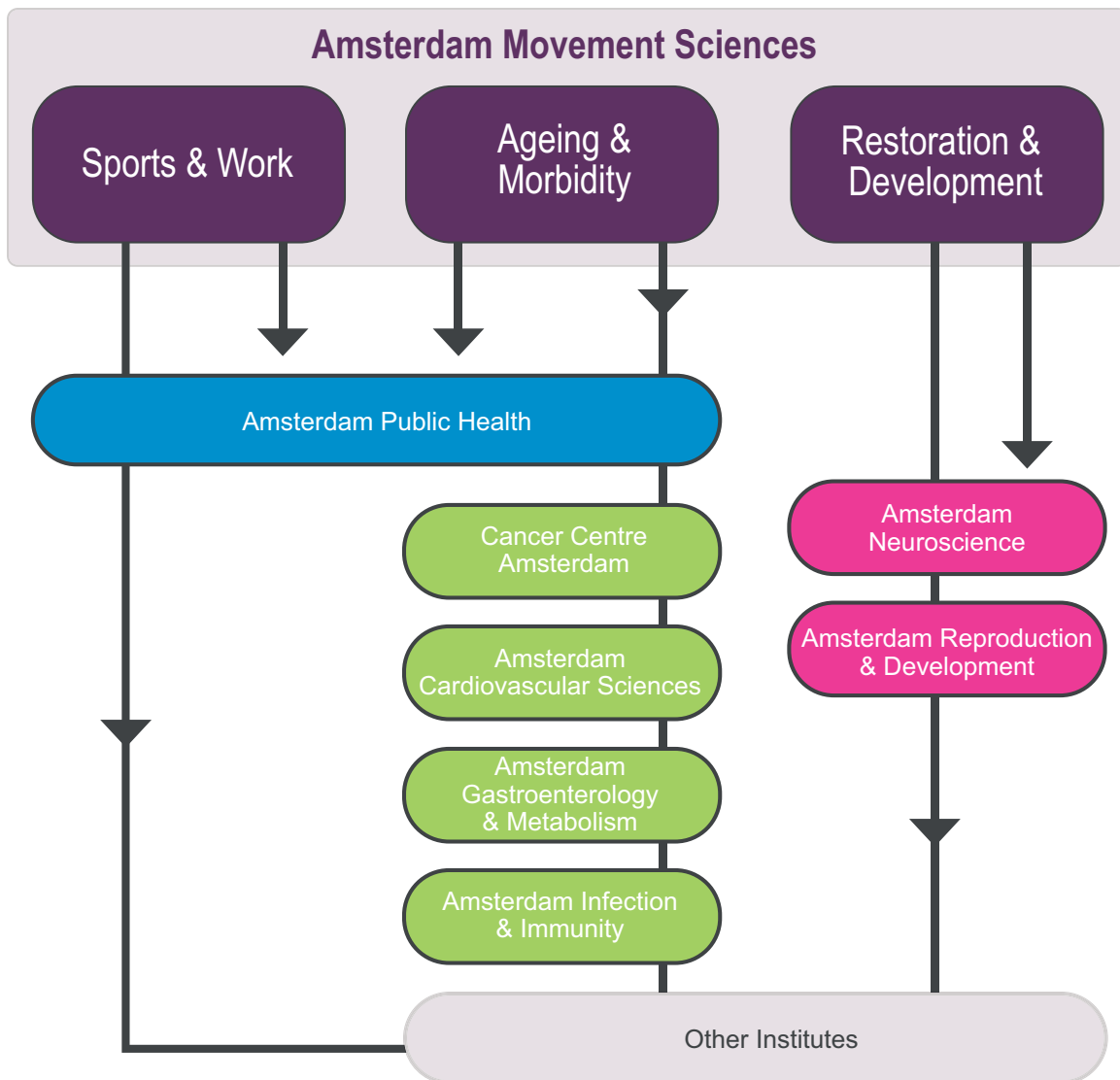


Figure 3: Research Programs in relation to other VUmc- AMC Alliance Institutes



### **3. Membership Base**

The member base comes from the three participating institutions, the Faculty of Behavioural and Movement Sciences (FGB) of the VU Amsterdam, the VU University Medical Center (VUmc) and the Academic Medical Center, University of Amsterdam (AMC) (table 1). The members from the FGB come from the Department of Human Movement Sciences. The members of the AMC and VUmc are dispersed over a wide variety of departments, which illustrates the broad base of the institute and the enormous possibilities to cooperate with a variety of researchers. Being a member of Amsterdam Movement Sciences is also profitable for researchers embedded in other institutes that do not have human movement in their core, but want to share expertise and collaborate in research on movement. To illustrate several members are embedded in the Academic Center for Dentistry Amsterdam (ACTA) with which Amsterdam Movement Sciences closely collaborates in research on musculoskeletal regenerative medicine. In addition, researchers from the Faculty of Earth and Life Sciences and Faculty of Sciences, VU Amsterdam are also member of the institute.

Faculty/UMC	Department/Section	Sc. Core Staff*	Other Sc. Staff*	Visiting fellows*	PhDs (int)	PhDs (ext)	Total
<b>AMC</b>	Anatomy, Embryology and Physiology	2	0	1	3	0	6
	Biomedical Engineering and Physics	2	1	0	2	1	6
	Endocrinology and Metabolism	0	1	0	0	0	1
	Orthopedics	10	10	7	13	26	66
	Plastic, Reconstructive and Hand Surgery	1	5	0	4	0	10
	Radiology	2	5	0	6	0	13
	Rehabilitation	4	3	0	14	8	29
	Trauma Unit	1	1	0	4	0	6
	<b>AMC total</b>	<b>22</b>	<b>26</b>	<b>8</b>	<b>46</b>	<b>35</b>	<b>137</b>
<b>VUmc</b>	Anesthesiology	0	0	0	1	0	1
	Clinical Chemistry	0	2	0	2	1	5
	Clinical Genetics	1	0	0	0	0	1
	Dermatology	1	2	0	2	3	8
	Epidemiology and Biostatistics	1	0	0	0	0	1
	Gastrointestinal and Liver Diseases	0	1	0	0	0	1
	Internal Medicine (Endocrinology)	1	2	0	1	0	4
	Neonatology	1	0	0	0	0	1
	Neurosurgery	0	1	0	0	0	1
	Obstetrics & Gynecology	1	0	0	0	0	1
	Oral and Maxillofacial Surgery**	4	4	2	9	8	27
	Physics and Medical Technology	1	1	0	0	0	2
	Plastic, Reconstructive and Hand Surgery	2	2	2	3	1	10
	Public and Occupational Health	2	1	2	7	2	14
	Radiology & Nuclear Medicine	1	1	0	0	0	2
	Rehabilitation Medicine	4	11	7	6	3	31
	Rheumatology	1	1	0	0	0	2
	Surgery	1	0	0	1	0	2
	Directorate Division	0	0	0	1	0	1
<b>VUmc total</b>	<b>22</b>	<b>36</b>	<b>13</b>	<b>41</b>	<b>21</b>	<b>133</b>	
<b>VU/FBMS<sup>1</sup></b>	Coordination Dynamics	6	1	1	9	4	21
	Motor Learning & Performance	6	1	2	3	7	19
	Neuromechanics	13	4	3	12	26	58
	Physiology	9	1	2	8	5	25
	Sensorimotor Control	8	4	1	6	3	22
<b>VU/FELS<sup>2</sup></b>	Health Sciences	2	0	0	0	0	2
<b>VU/FS<sup>3</sup></b>	Dept. of Physics and Astronomy	3	0	0	0	0	3
<b>VU total</b>		<b>47</b>	<b>11</b>	<b>9</b>	<b>38</b>	<b>45</b>	<b>150</b>
<b>ACTA***</b>	Oral Cell Biology / Anatomy	4	0	0	0	0	4
	Oral Implantology	1	0	0	0	0	1
	Oral Kinesiology	2	0	0	0	0	2
	<b>ACTA total</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7</b>
<b>Total</b>		<b>98</b>	<b>73</b>	<b>30</b>	<b>125</b>	<b>101</b>	<b>427</b>

Table 1. Membership Base

\* Scientific core staff: Hgl, UHD, UD

Other scientific staff: Researchers senior, postdoc and junior), other scientific staff incl. med. doctors with research task and med. specialists

Visiting fellows: Guest researchers, visiting professors and endowed chairs

PhD-candidates: (internal and external)

\*\* ACTA & VUmc collaboration department

\*\*\* The membership base from ACTA is subject to change

1: FBMS: Faculty of Behavioural and Movement Sciences

2: FELs: Faculty of Earth and Life Sciences

3: Faculty of Sciences



## 4. Strategic Partners

To strengthen our position as an international leading institute on human movement the aim of Amsterdam Movement Sciences is to intensify our national and international partnerships, with research institutes, organizations for (elite) sports, health care institutes, health organizations, governmental authorities and industry.

All researchers within Amsterdam Movement Sciences have strongly developed (inter-)national networks to facilitate the formation of consortia for funding applications, collaborative research, and exchange of knowledge, infrastructure and expertise. Our senior scientists and PIs are on a yearly basis invited as key-note speakers at international congresses, they publish in top notch journals and are highly cited. As strategic partners, we have listed a selection of EU based collaboration partners per research program, in addition the individual researches all have their own selection of collaboration partners. We see the EU funded Initial Training Networks (ITN) as excellent means to develop strategic collaboration at a sufficient scale and therefore aim for at least one of these networks within each of the three programs.

We aim to involve industry in joint research projects. Cooperation ranges from the early development of technology on human movement and physical performance in the broadest sense for our target populations to the development of prototypes to products for the market. Cooperation with industrial partners will serve both innovation in research and valorization. To achieve this, we will work closely together with Innovation Exchange Amsterdam (IXA).

### *Sports and Work*

Researchers participate in collaborations around applications in sports, such as the Amsterdam Collaboration for Health and Safety in Sports (ACHSS), which has been accredited by the International Olympic Committee (IOC) and the Amsterdam Institute of Sport Science (AISS), in which the Amsterdam University of Applied Sciences participates and field parties such as the Center for Topsports & Education Amsterdam (CTO). The aim is to further integrate these collaborations, to strengthen identity and cooperation between fundamental and applied research and to facilitate valorization. There is also cooperation with Delft University of Technology.

Amongst others, international collaborations exist with Boston Sports Medicine Group Harvard, Hospital for Special Surgery New York, and Orthopedic Surgery University of Basel. On musculoskeletal imaging collaborations exist with Heraklion University of Crete, Boston, University of California, San Francisco, Hadassa Hospital, Israel.

When it comes to performance in/at work, researchers participate in the Body@Work, Research Center on Physical Activity, Work and Health, a joint initiative partnered by TNO, VU University and VUmc. In addition, The Netherlands Police & Science has over the past years represented a solid collaboration partner on research into the effects of acute stress on performance. We are also part of the Desmond Tutu Training Program, a collaboration between VU Amsterdam and South African universities which aims to bridge diversity for academic advancement.

### *Ageing and Morbidity*

In the Ageing and Morbidity program there are several strong (inter)national collaboration projects and partners. The European funded Erasmus Mundus MOVE-Age collaboration project with KU Leuven and

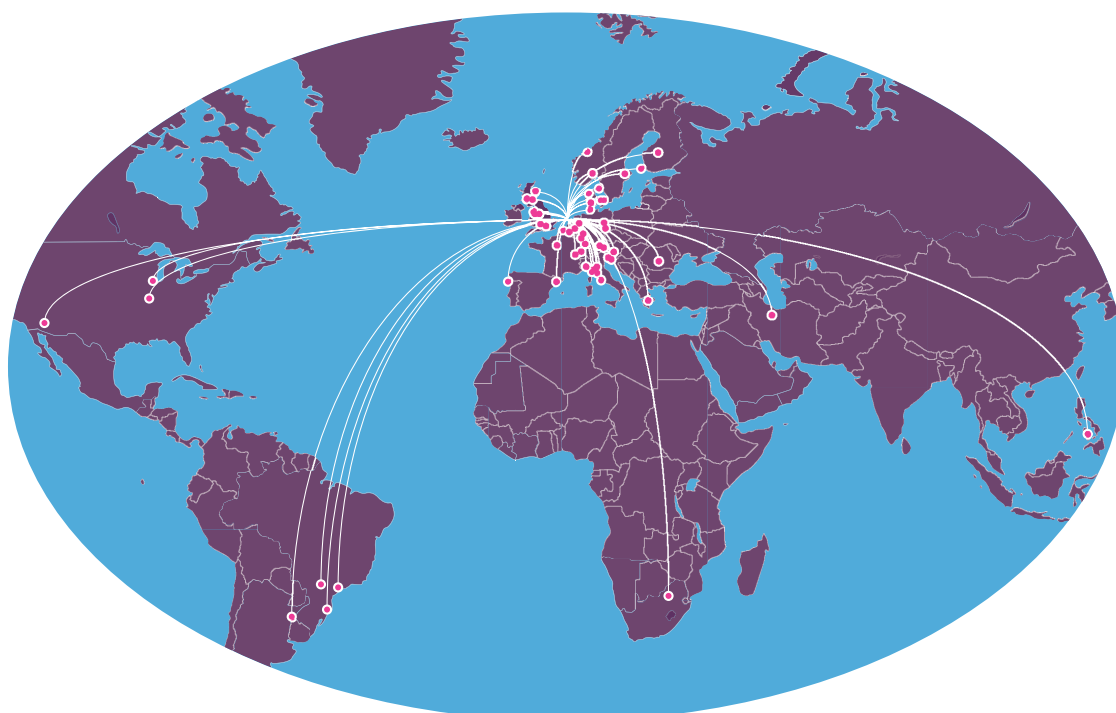
Manchester MMU will, when it has been completed, have funded approximately 35 joint PhD projects. The grant has laid the basis for a solid collaboration, which will continue long after the grant has expired. There are collaborations involving several EU consortia, such as PANINI on nutrition and mobility for the elderly and PreventIT on prevention of mobility loss. There are also several other EU funded ITN MC projects such as COSMOS, Euroclast, PACE and KneeMo. Structural collaboration exists with industrial partners that develop and market tools for diagnostics and training in relation to mobility and with Delft University of Technology.

### ***Restoration and Development***

Within the program Restoration and Development there are a number of EU financed collaboration projects including the International Trauma Research Network, Euroskingraft, SPEXOR and the Mobility in Cerebral Palsy project that is part of the EU network MD-Paedegree and where both clinical partners as well as biomechanics collaborate. In addition to the EU partners there are several national collaboration partners, e.g. the Dutch Burns Center in Beverwijk and the Dutch Arthritis Foundation, both of which are regular partners on a selection of research projects. Furthermore there is cooperation with several rehabilitation centers (RC). These are RC Reade in Amsterdam, RC Heliomare in Wijk aan Zee, and RC De Trappenberg in Huizen. Amsterdam Movement Sciences is also in the process of joining the Dutch Institute for human Organ and Disease Model Technologies Dutch (hDMT), a collaboration of several Universities to form public-private partnership on the development and valorization of 'Organ-on-a-Chip' technology.

### ***Collaboration with developing and BRIC countries***

There is collaboration with the University of San Carlos in Cebu, Philippines on the project Cells in Gels. In Brazil there is cooperation with the engineering University Center of FEI in Sao Bernardo do Campo, with the Federal University UNIPAMPA in Uruguaiana, with the federal University of Santa Catarina (UFSC) in Florianopolis within Ciencia Sem Fronteiras (Science Without Borders), with the Department of Physical Education of UNESP University in Bauru, and with the post-graduate education program CAPES of the Ministry of Education. There is furthermore collaboration with the Tehran University, Iran.





## 5. Talent Development

Within the framework of the universities and departments, Amsterdam Movement Sciences strives to attract excellent PhD candidates with a background in medicine, human movement science, engineering, epidemiology, and other health or life sciences, and to train them to become excellent researchers with broad, interdisciplinary insight with respect to human movement and physical performance in all its aspects and cutting-edge expertise in their specific domain. The Institute in particular aims at attracting and nurturing talented clinician-researchers, to further develop and strengthen translational clinical research. The institute strives to support the scientific development from student to senior researchers by the following supportive initiatives.

### *Bachelor and Master students*

To capture talented researchers early in their careers, the institute aims to attract Bachelor students of the participating faculties, especially those who follow the Honors curriculum and to facilitate multiple collaborations with this group of talented students. In addition, the institute will support projects performed by Master students from the programs offered by the participating faculties. The focus in the scientific internships for medical students will be on translational aspects, where clinical partners within the institute line up with basic scientists and together convey basic science into clinical practice or vice versa. This early pick-up of talented students should result in obtaining prestigious MD-PhD Scholarships and PhD Scholarships, to initiate an individual tenure track. The 2-year research master Human Movement Sciences: Sport, Exercise & Health, has proven to deliver excellent PhD candidates, with solid knowledge on all levels of human movement, from the molecular to the whole human level, and strongly developed research skills. These students can gain a full year of research experience within the institute as part of their Master program. Although the focus is on students from the participating faculties, the institute aims to expand its vision on the support of students from related disciplines and faculties.

### *PhD Development Program*

The Institute will develop a specific, interdisciplinary Amsterdam Movement Sciences PhD program with added benefit of being a PhD student within the institute and allowing for the required ECs for completion of the PhD program. This development program will also encourage the formation of social and scientific networks between PhD students embedded in the institute. The Institute will provide training and guidance for PhD candidates in close cooperation with the research master program on Human Movement Sciences: Sport, Exercise & Health. Any PhD student may follow the courses of the aforementioned research master Human Movement Sciences: Sport, Exercise & Health to complete any deficiencies. The PhD candidates also follow training courses as set out in the requirement of each participating faculty. The Institute will monitor the progress of PhD students and their research projects through annual progress reports and will keep an eye on the well-being of the PhD students. During the annual research meeting, prizes will be awarded to PhD candidates for outstanding publications and for the best poster presented at the meeting, as well as travel grants to visit research groups abroad. Amsterdam Movement Sciences strives to offer PhD candidates and postdocs international opportunities, not solely to reinforce collaboration, but to strengthen their profiles as international researchers and to build their own network.

### ***Postdoc Program***

For postdocs, the institute offers a postdoc network to support them in expanding their scientific career path. The institute will develop a mentoring program in which talented postdocs will be coached by senior researchers that are not directly involved with their project to make sure that they can get independent advice and can benefit from a broader national and international network than that of their supervisors. Postdoc research fellows and talented PhD candidates are spurred on to apply for the NWO VI-grants or the EU financed ERC grants. Talented PhD candidates and postdoc fellows who want to continue in academia are offered training courses on grant proposal writing to help them maximize their chances for obtaining grants. As an added value the Institute offers independent reviewers from within its own ranks to serve as additional mentors and advisors.

### ***Supervisory and Teaching Skills***

Both senior researchers, as well as their PhD students, supervise students in a constructive and supportive manner, with attention for both the progress of the scientific project and for the individual development of each student. The supervisors are guided in this role and will actively receive feedback from the students, in order to be able to offer an excellent level of training and to ensure a secure educational environment. Supervisors will be encouraged to follow training aimed at personal development and to enhance their teaching skills by obtaining a BKO certificate (Basis Kwalificatie Onderwijs), and to follow training aimed at professionalize their supervisor skills when relating to PhD candidates and postdocs. Courses on project management will also be encouraged, to ensure smooth management of research projects. Personal development of both (PhD) students and supervisors is the backbone of education within the institute.

## **6. Quality Policy**

The Institute will fully comply with the quality policy as set out by the participating faculties and board of Deans. The institute will provide quality control of the research projects as described in the policy note Quality Care. All PhD candidates and staff will be periodically trained in Scientific Integrity. Annual PhD progress will be monitored through yearly self-reports and interviews with independent senior staff.

Data management and monitoring will be implemented on a faculty level, as set out by the executive board by the University. Additional regulations will be made for the safe use of data across the different faculties in interfaculty research projects. The institute's performance will be periodically assessed according to the national requirements as set out by the Royal Netherlands Academy of Arts and Sciences (KNAW).

## 7. Institute Specific Facilities and Infrastructure

The Institute houses a broad spectrum of labs and research facilities that are mainly located in the departments participating in Amsterdam Movement Sciences. These facilities cover the full range from cell biology labs to field labs to study movement in real life situations. Besides the available facilities within the institute a number of core facilities at the VU campus and the AMC are of particular importance for our research.

For a comprehensive overview, our research facilities are classified in accordance with the International Classification of Functioning of the WHO in those who primarily concern the study of (patho)physiology from molecules to tissue at the ICF-level of Body Functions and Structures and those that primarily concern the study of human movement and physical performance at the ICF-level of Activities and Participation.

### *Body Functions and Structures*

These research facilities focus on musculoskeletal tissue regeneration and reconstruction with a strong focus on mechanobiology. They cover at VUmc the Stem Cell and Nanolab (Dept. Oral and Maxillofacial Surgery (OMS)), the 3D-Innovation lab (OMS), the 3D-Bioprinter lab (OMS and Dept. Plastic, Reconstructive and Hand Surgery), the dermatology skin tissue engineering and organ-on-chip lab (located at O2), at the Faculty of Behavioural and Movement Science (FGB), the Myology lab (located at O2), at ACTA the Oral Cell Biology lab and the new micro computed tomography scanner, and at AMC the Biomedical Engineering and Physics department, and the Musculoskeletal Imaging Quantification Center (MIQC) and the Preclinical MRI facility (Dept. Radiology).

Core facilities of particular importance for the institute at the VU campus include the animal laboratory, which houses the biomechanical test lab with loaded organ culture systems, stem cell lab and skills lab, the department of Physics and Medical Technology (FMT), the endocrinology lab at the clinical chemistry lab and at the O2 building the new Advanced Imaging core (AO | M2). Additionally, in LaserLab VU, the Biophotonics and Medical Imaging section and the Physics of Living Systems section of the Dept. of Physics and Astronomy of the Faculty of Sciences VU provide state-of-the-art optical imaging techniques including novel micro- and nanoscale devices.

### *Activities and Participation*

These facilities enable the in-depth study of human movement and physical performance, in laboratory conditions in relation to body functions, and in field facilities for real-life research conditions where environmental factors are also taken into account. At VUmc they cover the Clinical Gait & Movement Analysis lab, the Clinical Exercise Physiology lab, the Dual Belt Treadmill lab, the Virtual Reality Gait lab (Dept. Rehabilitation Medicine), at AMC the Human Performance lab (Dept. Rehabilitation) at FGB, the Main Experimental hall, the Musculoskeletal Physio lab, the Exercise Physiology lab, the Neuromuscular Function lab, the Postural Control lab, the Trunk Control lab, the Sensomotor lab and the Visuomotor lab.

Field labs for elite-sports and talent development can be found at various locations in Amsterdam and at national sports centers. Mobile test facilities are also available. Research collaboration exists with the Amsterdam University for Applied Sciences (HvA) for the domains of Sports and Health, especially Physical Therapy and with several Rehabilitation Centers (RCs) such as RC Reade in Amsterdam, RC Heliomare in Wijk aan Zee and RC Trappenberg in Huizen. All these institutes have varying research facilities available on site.



## ***Future Requirements***

To further strengthen the institute's research, the available (core) facilities need to be coherently continued and further developed. For musculoskeletal tissue engineering, the 'lab-on-a-chip'-technology needs to be strengthened further. For this, the institute will, together with other alliance institutes participate in the Dutch Institute for Human Organ and Disease Model Tissues (hDMT) a public-private initiative of knowledge institutes and industry.

Since we aim to expand our research on clinical interventions and the implementation of results, we will further strengthen our epidemiological expertise with respect to clinical studies and health technology assessment.

## ***Housing***

The institute incorporates researchers from various faculties and institutions. Initially it will constitute a network organization, but in the long term it aspires to achieve a clustering in a limited number of accommodations according to patient and end user populations, in order to offer the researchers the facilities and benefits of a compactly housed institute. Since labs, in particular, are meeting places for researchers, the priority of the institute will be on the concentration of its facilities in (interdisciplinary) labs on a limited number of locations. In this way, the institute aims to optimize the use of all facilities and enhance collaboration between researchers from different departments and backgrounds, to realize the full research potential of the core facilities and other shared infrastructure.

# **8. External Funding and Acquisition**

Continued abundant external funding is vital for an institute within the current era. Our members have excellent track records in obtaining both major Dutch grants including the Netherlands Organisation for Scientific Research (NWO) Innovative Research Incentives, Technology Foundation STW grants and grants from the Netherlands Organisation for Health Research and Development (ZonMw), and in obtaining European Research Council grants including Marie Skłodowska-Curie Innovative Training Networks (ITNs), Horizon 2020 and formerly Framework Program 7 grants. External funding will become even more important in the years to come and Amsterdam Movement Sciences therefore aims to increase external grant funding, both research grants as well as contract based funding, either from industry and/or charitable organizations. Furthermore, to increase success the institute aims to expand its (inter)national research collaborations both with public and private partners.

## ***Acquisition strategy***

Confirming the relevance to society, the research scope of Amsterdam Movement Sciences fits well with external agendas. For future grants, the Dutch Science Agenda (Nationale Wetenschapsagenda) will be leading the way on a national level. This scientific agenda has grouped themes in a limited number of research routes. We see excellent options for our research to fit in the tracks 'regenerative medicine', 'personalized medicine', 'sports and movement', 'the individual and his environment, health and disease' and 'brain, cognition and behavior'. We will strive for active engagement in the further development of these tracks to programs and calls in which the NWA will eventually culminate. The NWA tracks connect

with the EU Horizon 2020 priority areas and our research programs fit excellently with the current European priority research area of Health, Demographic Changes and Wellbeing.

Another important target is to increase the number of industry partnerships and especially strive for partnerships with international leading industries that are active in the medical, occupational and sports fields of human motion. Such partnerships will also strengthen the valorization of our research results.

We further aim to enhance and improve our current (inter)national collaboration networks, to increase attractiveness for public and private research funding. These excellent and first class well-established international collaboration networks will also provide a head start in preparing grant proposals when national and European calls are set out.

### ***Funding support***

The institute actively pursues to increase the acquisition of prestigious national and international grants by informing, stimulating and supporting applications in collaboration with the VU/VUmc and AMC grant support. Support consists of information meetings on European grants and extensive advice in calls increasing the chance of success. We further aim to cooperate with other (alliance) institutes, in grant applications on movement as an additional factor when improving and recovering from diseases such as diabetes and cancer.

Talented PhD and postdoc candidates will be stimulated and supported to continue their career within academia and will be offered training in how to write successful grant applications. Furthermore, mid-career and senior scientists are stimulated to create new and extend current international consortia for European grant applications through sabbaticals and international cooperation.

## **9. Societal Impact and Valorization**

Many health conditions affect neuro-musculoskeletal functioning and jeopardize physical performance needed for adequate societal participation. Medical advancements lead to increased survival, for instance after critical illness, yet recovery to full physical functioning and societal participation is even today not commonly targeted as the ultimate aim of medical treatment. Movement is increasingly considered beneficial for many health conditions such as for the recovery from cancer, to combat diabetes, to postpone dementia and to treat depression. Furthermore, movement is of major importance to maintain musculoskeletal integrity with ageing and safe mobility for independent living. Practicing sports is a major leisure time activity for millions of people with positive effects on health and quality of life. Yet, injuries should be prevented. Outstanding elite sports performance is key for national prestige and public enjoyment, and strengthens societal unity. Improving work performance in increasingly demanding environments and yet maintaining healthy work participation until retirement, presently shifting to older age, while avoiding physical harm, has large relevance for efficiency and well-being, and has huge societal and economic impact.

The three research programs of Amsterdam Movement Sciences are all firmly rooted in the main challenges of an aging society moving on towards more individual physical immobility. Our scientists have the key to how society can maintain and improve mobility and quality of life at this particular stage. We strive towards effective interventions, derived from our research, being applied in health care

and society to maintain musculoskeletal health at highest achievable levels for independent ageing, to warrant healthy sports and work participation, to improve elite sports performance, and to achieve the highest possible movement abilities in neuro-musculoskeletal health conditions.

The institute approaches valorization as set out in EriC (Evaluating research in Context) published by the KNAW's Rathenau Institute – disseminating research to the broader society by productive interactions with stakeholders.

### ***Stakeholder involvement***

The institute's members incorporate valorization into their research, by involving patients, patient groups, healthy individuals, sports organisations and other end-users from the early stage on in our projects, by keeping these groups up to date on new research output and together with stakeholders, include implementation as final stage in our research plans. We aim to work closely together with professional organizations, industry, charities and patient's societies in our research.

### ***Dissemination of results***

We disseminate research results by informing and educating (inter-)national professionals ranging from students to medical specialists, professionals working in the relevant fields, patients and healthy individuals. Researchers within our institute are involved in many relevant networks, linking research to practice, education and policy making. Being members of a broad selection of policy boards, committees and user groups, research output can be disseminated and valorized first hand. The institute's members also contribute to writing policy notes and disseminating the research output through written and online publications to professionals and layman groups.

### ***Patents and IP***

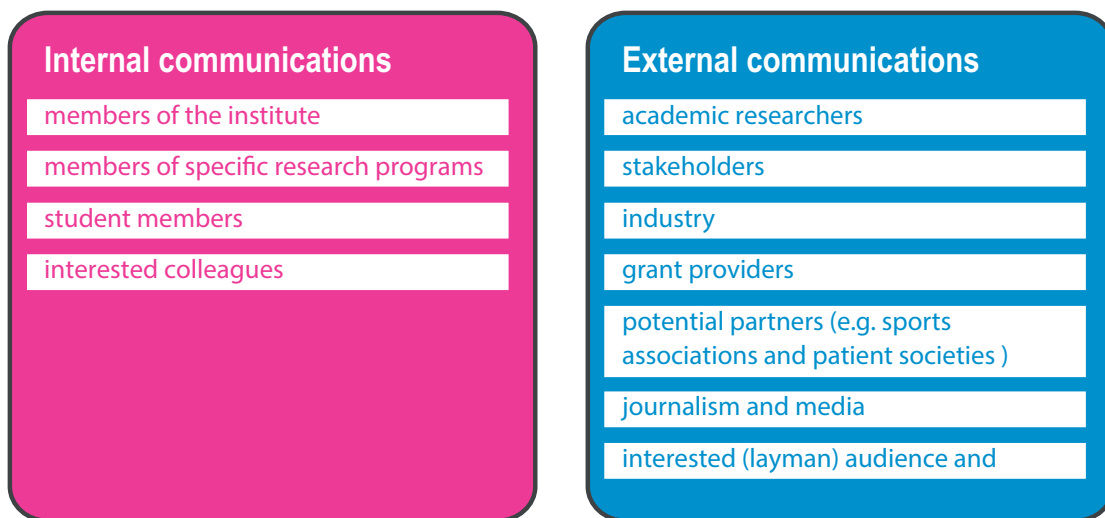
Amsterdam Movement Sciences aims to expand its cooperation with industry and other parties such as TU Delft in the development of new technology and applications. We aim to set out a strategy with IXA (Innovation Exchange Amsterdam), which acts as an interface on valorization and technology transfer, to best capitalize on our research results in terms of patents and IP. In order to close the full valorization chain, we aim, together with relevant parties, to close the gaps that impede the introduction to the market of new products based on our research.

# 10. Communication and Marketing

Communication with our members and beyond is priority for several purposes: 1) to disseminate knowledge, 2) to build a community of research professionals, 3) to enhance our reputation, 4) to promote our skills and resources, 5) to inspire and engage collaboration with academic partners or third parties, 6) to improve internal and external visibility, coherence, and engagement.

## Audiences

The target audiences of our institute are numerous and can be distinguished as internal or external.



## Means

- Website: For internal as well as external audience. Main portal for research communication as evidence of societal impact and academic excellence, dissemination, promotion and education. List of researchers with informative and attractive personal pages. Overview of research programs, projects, publications, news and events.
- Newsletter: For internal communications. Bimonthly e-mail newsletter with the latest research news, reports grants news, prizes, personnel changes, fun facts and events calendar.
- Mails: For internal as well as external audience. For bringing to the attention / advertisement of meetings and occasional big news.
- Meetings: For internal as well as external audience. The institute communicates activities such as institute broad or program research meetings, colloquia and meetings, symposia or congresses of interests.
- Corporate identity and resources: The recognizability of an institute is an indispensable asset in a crowded environment of institutes, partnerships, groups and associations. For that reason, a well-defined corporate identity is an asset. Business cards, scientific posters, books and dissertations, stationery, writing materials and other promotional material all contribute to the institute's visibility and recognizability.



## *Future developments*

- Further investment in a journalist network. The research of Amsterdam Movement Sciences is socially relevant. There is a vast potential of interesting newspaper articles and other media resources that will contribute to the visibility and good reputation of our institution.
- Social media: Many audiences make use of more than one medium to keep themselves informed or to keep connected. For this purpose, some social media are relevant for our communication strategy and beneficial to our communication objectives.
- Broader engagement of scientists for research communications. As grant providers increasingly stress the importance of valorization and dissemination, scientists themselves have an interest in communicating in an attractive manner what they do and find. For that they must have writing skills and technical means, such as a personal page they can edit themselves and one or more project pages. Among the latest generation of PhD students these means are indispensable for their reputation and academic future. And the knife cuts both ways: meanwhile the institution is showcasing its increasingly interesting research portfolio.

# **11. Organization, Management and Budget**

The Board of Deans of the three participating faculties (FGB VU Amsterdam, VUmc, AMC) governs Amsterdam Movement Sciences. Two co-directors will initially head the institute, one from the VU, the director of the former MOVE research institute Amsterdam (the joint institute of FGB VU Amsterdam, VUmc and ACTA), and one from the AMC. Eventually, there will be one director according to the policy of the Board.

A Managing Board (MB) consisting of the two co-directors, the six leaders of the three programs, a PhD and a postdoc representative will together run the institute. The MB manages the direction, quality and progress of the research, the educational activities and communicates with the research boards/committees of the participating faculties, and with the heads of departments and divisions. The MB meets monthly. The two program leaders for each of the three programs communicate with the participating research staff in a program council.

For the daily running of the Institute there is one director, supported by the Office that consists of a manager/policy officer, a communication officer and a secretary. Overhead size will be kept minimal, in balance with the duties.

There is an independent External Advisory Board of non-affiliated members that meets annually to reflect and advice on the progress of the direction of the Institute. A Resonance Group of researchers at different levels (from senior to PhD), representative of the institutions and departments participating in the institute, will be installed to advice the MB, whether asked for or not.

The Scientific Committee ensures the quality of the research is guaranteed, by judging the research protocols before these are submitted to the METC, monitoring the quality policy, the execution of studies and PhD progress.

To support PhDs and postdocs in their development and for advice, a PhD committee and postdoc committee will be established. The Institute aims to involve PhDs and postdoc research fellows in the development of its policies and activities, by giving them a position in the MB of the institute and in the Resonance Group.

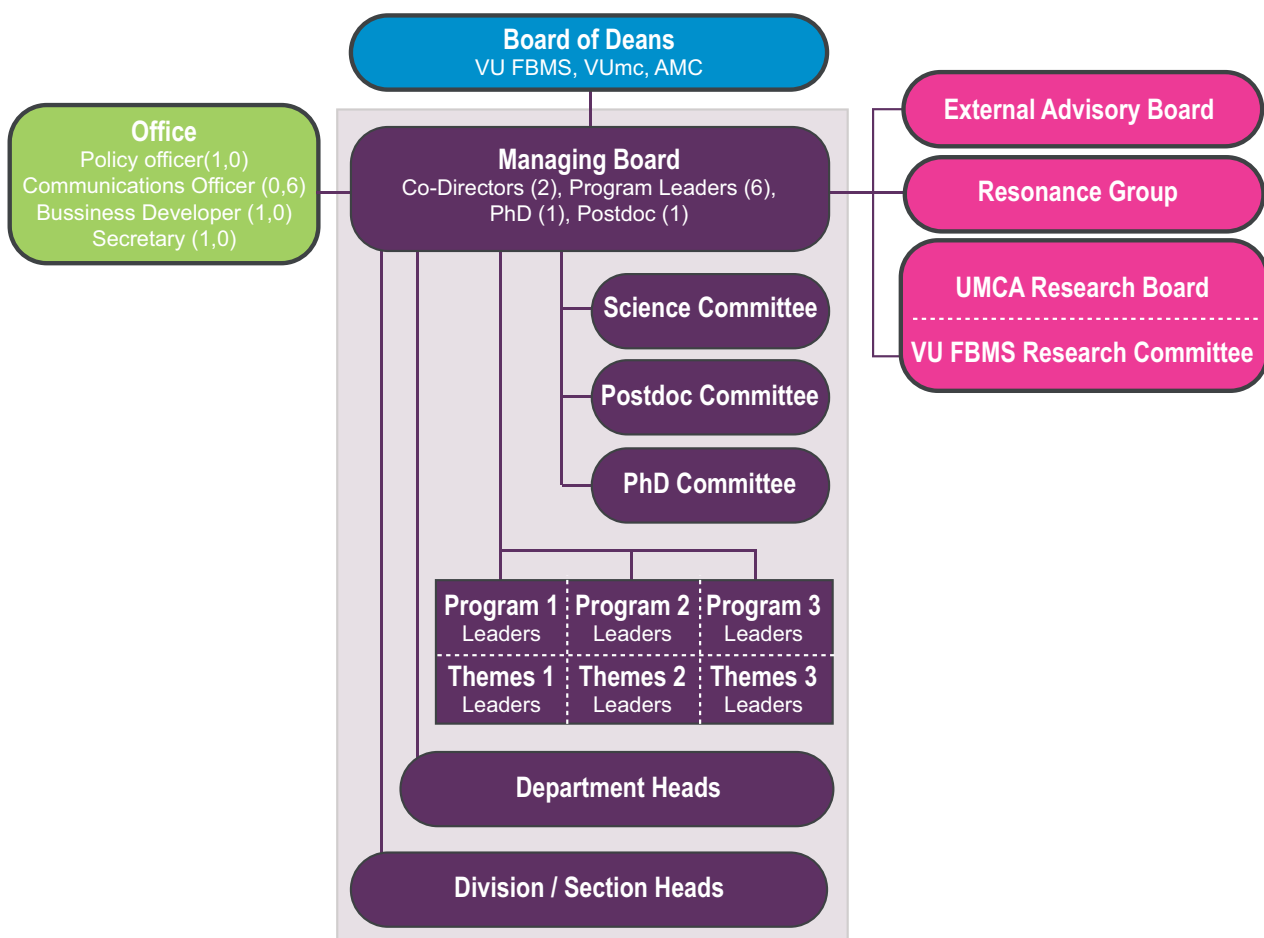


figure 5: Organizational Chart of Amsterdam Movement Sciences

The institute promotes that the appointed PhD students, postdoc fellows and staff members represent Dutch society in general, and thus advocates that the number of female staff in the upper echelons as well as more overall (ethnic) diversity on all levels of the Institute is increased.

Research meetings will be encouraged within the institute based on common interest. Besides the meetings within each of the programs, interest groups that bridge programs will be supported, to promote knowledge exchange and joint research. In addition to the institute's annual research meeting, members of the institute will organize (inter)national conferences per research program, to enhance collaboration and share knowledge. International educational activities will be organized, such as summer schools, in collaboration with the IFMSA (International Federation of Medical Students' Associations – the Netherlands) in which sharing knowledge within the institute as well as with other faculties and international students is one of the key objectives.

## Management Structure Amsterdam Movements Sciences

Management Team	Position	Affiliation
Prof. Frans Nollet, MD	Director	VU, VUmc, AMC
Prof. Mario Maas, MD	Director	AMC
Ms. Solveig Lund, MA	Policy Officer	VU FBMS
Prof. Geert Savelsbergh	Program Leader P1 Sports and Work	VU FBMS
Evert Verhagen, PhD	Program Leader P1 Sports and Work	VUmc
Prof. Raymond Ostelo	Program Leader P2 Ageing and Morbidity	VU FELS
Sicco Bus, PhD	Program Leader P2 Ageing and Morbidity	AMC
Prof. Theo Smit	Program Leader P3 Restoration and Development	AMC
Erwin van Wegen, PhD	Program Leader P3 Restoration and Development	VUmc
Richard Jaspers, PhD		VU FBMS
Vacancy	Post Doc Representative	
Vacancy	PhD Representative	

Table 2: Management Team

P1 Sports and Work	Elite Sports Performance	Sports and Health	Work Performance and Health
<i>Program leaders</i>	<i>Theme leaders</i>	<i>Theme leaders</i>	<i>Theme leaders</i>
Prof. Geert Savelsbergh	Prof. Geert Savelsbergh Motor Control FBMS VU	Evert Verhagen, PhD Public & Occupational Health VUmc	Prof. Maurits van Tulder Health Sciences FELS VU
Evert Verhagen, PhD	Jos de Koning, PhD Physiology FBMS VU	Prof. Mario Maas, MD Radiology AMC	Idsart Kingma, PhD Neuromechanics FBMS VU
P2 Ageing and Morbidity	Musculoskeletal Health	Mobility and Ageing	Physical Functioning in Major Diseases
<i>Program leaders</i>	<i>Theme leaders</i>	<i>Theme leaders</i>	<i>Theme leaders</i>
Prof. Raymond Ostelo	Prof. Raymond Ostelo Health Sciences FELS VU Epidemiology & Biostatistics VUmc	Prof. Mirjam Pijnappels Neuromechanics FBMS VU	Sicco Bus, PhD Rehabilitation AMC
Sicco Bus, PhD	Leendert Blankevoort, PhD Orthopedics AMC	Peter Bisschop, PhD Endocrinology and Metabolism AMC	Irene Bultink, MD, PhD Rheumatology VUmc
P3 Restoration and Development	Trauma and Reconstruction	Activities and Participation	Growth and Development
<i>Program leaders</i>	<i>Theme leaders</i>	<i>Theme leaders</i>	<i>Theme leaders</i>
Erwin van Wegen, PhD	Astrid Bakker, PhD Oral Cell Biology ACTA	Erwin van Wegen, PhD Rehabilitation Medicine VUmc	Annemieke Buizer, MD, PhD Rehabilitation Medicine VUmc
Prof. Theo Smit	Margriet Mullender, PhD Plastic, Reconstructive and Hand Surgery VUmc	Richard Jaspers, PhD Physiology FBMS VU	Prof. Theo Smit Anatomy, Embryology and Physiology AMC

Table 3: Program and Theme Leaders

Research Area	Coordinator
Molecular Biology	Richard Jaspers, PhD
Mechanobiology	Astrid Bakker, PhD
Physiology	Richard Jaspers, PhD
Biomechanics	Sicco Bus, PhD
Motor Control	Prof. Geert Savelsbergh
Musculoskeletal Imaging	Prof. Mario Maas
Biomedical Engineering	Prof. Theo Smit
Epidemiology	Prof. Raymond Ostelo

Table 4: Coordinators Research Areas

### **Budget**

The Board of VUmc and AMC have each set aside 250k€ innovation budget per annum from January 1st 2017 for a period of four years. This is in addition to the running costs the participating faculties contribute to the institute. The innovation budgets, in total 2.000 k€ will be used to stimulate research, by supporting high-potential clinician-researchers in their development, the strengthening of high-quality research projects, and by initiating new interdisciplinary projects with high priority for the institute. A call will be issued in which the frame of reference will be further specified.

## **12. SWOT Analysis**

### **Strengths**

- Amsterdam Movement Sciences is a unique interdisciplinary research institute in the Netherlands and worldwide, by its comprehensive research scope that captures the full range of human movement in health and disease and integrates research expertise from cell to society.
- Research is addressed that is societal relevant and has broad connections with stakeholders.
- Amsterdam Movement Sciences is successful in obtaining grants and has a large international research network.
- In the plan for the new institute, research is organized in three thematic programs that share translational, interdisciplinary expertise.
- Recently methodological expertise has been expanded to strengthen clinical research to improve valorization.
- The recent changes in participations in the institute result in stronger and more comprehensive focus on the musculoskeletal system and human movement in health and disease.
- By merging with researchers from the AMC, clinical mass has increased as well as access to patient groups.
- Amsterdam Movement Sciences contributes to the interdisciplinary Research Master “Human Movement Sciences: Sport, Exercise & Health”, which is embedded in the Faculty of Behavioural and Movement Sciences, and is important for talent development.



## ***Weaknesses***

- Clinical leadership is limited, due to fact that clinical participation is scattered across multiple and relatively small departments. However, the prospects with AMC now being partner of the institute are good. A priority is to foster the development of clinical scientists.
- The research assessment committee report of MOVE end 2015 criticized the communication between basic and applied science and between the former programs within MOVE. By redefining the research programs and by more active management at the program level, this communication will be enhanced. Communication will be facilitated within the programs, between programs, and at the level of expertise by organizing meetings and the active engagement of researchers in different programs.
- The research assessment committee found the valorization chain incomplete in some areas. Adding methodological expertise on clinical and implementation studies will partly improve this. Another measure is that the institute contributes to the recent participation of VUmc in the Dutch human Disease Modelling Tissue (h-DMT) consortium of several universities and industrial partners.
- The interfaculty composition of the institute hampers unity in the institute with respect to research regulations, cooperation, education and strengthening of the institutes profile.
- Although PhD candidates can participate free of charge in the Research Master program, education of PhD candidates and support in career development of post docs was mainly left to the departments where researchers were appointed. In the new plan of Amsterdam Movement Sciences, the aim is to set up a PhD Course and to initiate a Post Doc network, to add value to being a researcher in the institute.

## ***Opportunities***

- The societally acknowledged importance of movement, reflected in the NWA and Horizon 2020 programs, offers excellent opportunities for obtaining future research grants.
- Stronger collaboration with Universities of Applied Sciences, in domains of Health and Sports and Nutrition will be pursued to improve clinical relevance and implementation in education.
- Participation in the h-DMT consortium offers possibilities to further develop and valorize musculoskeletal regenerative medicine research.

## ***Threats***

- Amsterdam Movement Sciences brings together scientists who are embedded in different (interuniversity) faculties, in different academic hospitals (not merged yet), and within hospitals in many relatively small departments. Prioritizing the interests of the participating parties in choosing directions, in handling budget reductions, and in external profiling are the major threats for the institute.

## **13. Towards the Proposed Organization / Deliverables**

The blue print in this plan will take several years to accomplish. The aims for this 4-year period is to build up the network institute and to foster fruitful interdisciplinary research with the ultimate aim to create excellence in focused translational research programs.

# Deliverable Timeline







