



Future Skills & New Solutions for Education & Training

Results of
Global Education Futures Kazan
22-23 May 2015, Kazan, Russia



GEF Kazan Forum: highly productive convention of business, regulators, and educators



94 participants from 33 countries representing manufacturing and service sectors, regulatory bodies, think-tanks, TVET & higher education institutions*. The majority of the attendees were official and technical delegates of WorldSkills International.

Forum was conducted in partnership with WorldSkills Russia National Competition 2015 in Kazan, attended by more than 500 contestants and experts.

Facilitation team has used innovative methods of collective creative work, including Rapid Foresight methodology

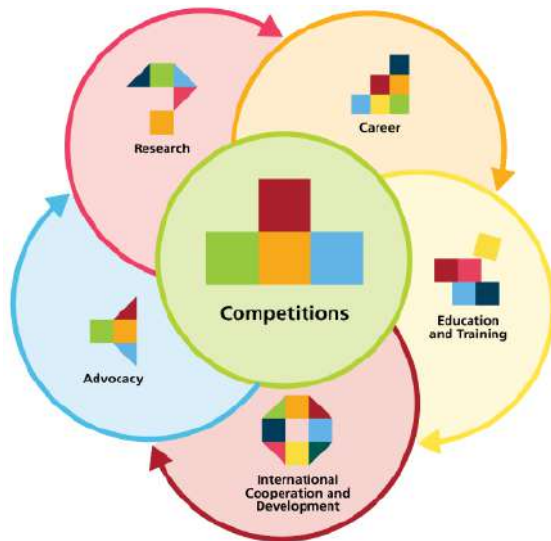
4 'maps of the future' were created, charting skills of the future for major sectors of economy and society. Specific initiatives were offered to develop WorldSkills movement

* See Appendix for details



Held in conjunction with WorldSkills

Established in 1946, WorldSkills today unites 74 member countries and regions, positioning itself as the global hub for skills excellence and development. The mission of WSI is to raise the profile and recognition of skilled people, and show how important skills are in achieving economic growth and personal success.



Operations of WorldSkills include 6 focus areas. The central one is a system of regional, national, and international skills competitions (international competition includes 50 skills). Other areas include: support in Career Building, Promoting Skills, Education and Training, International Cooperation and Development, and Research in skill-related topics. WorldSkills International has one of the largest knowledge base of practitioners in the area of industrial and service skills in the world.

Russia has joined WorldSkills movement in 2013. Currently, World Skills Russia joins 60 regions of the country, with 8 thousand competitors and 10 thousand experts. National competitions include innovative WorldSkills Hi-Tech (skills in advanced manufacturing) and JuniorSkills (skills competition for children age 10-17)



GEF Kazan: Main Subject & Expected Outcomes

Future Skills & New Solutions in Education & Training

We explore

- changes in specific domains of the global economy driven by technological innovation and social transformation,
- future global demand for skills that will ensue from such change, and
- transformation that will be required in education & training systems across the world to accommodate to such demand.

Globally competitive skills

Recognizing the diversity of economic & social practices in different countries, we suggest to look at **globally competitive technologies & practices in manufacturing & services** (as manifested e.g. by WS GIPs*), and **skills that can support them**

From 'knowns' to 'unknowns'

The Forum is a collective exploration, a learning lab

It is not to seek opinion of few experts but to co-create

Our main outputs are

- Shared vision of future skills and education & training formats that support them
- Ideas of systemic innovation in skills development, including those that can be implemented within WS movement

* WS GIPs = WorldSkills Global Industry Partners that help to communicate needs of industry and best industrial technological practices



Challenge of Future Skills

Push of global technological, financial & environmental **standards** – and possible redefinition of global governance structure



Future Skills: skills that will make workers competitive in the future socio-economic & technological environment



Techno-social transition: up to 70% of traditional jobs in manufacturing and services may become obsolete in next 20 years due to application of AI, robotics, automated logistical systems etc. (but many new may be created)

Accelerating changes in industrial & economic practices (driven by technologies, esp. ICT) and **growing complexity of global markets**



Search for **new sources of national competitiveness** in industrialized countries through creation of new & emerging industries

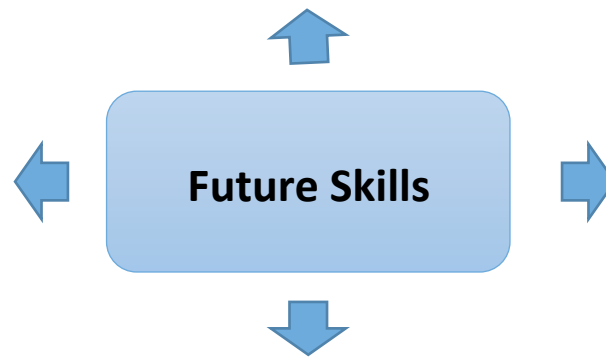




New Answers Within Education & Training?

'Industrialized' educational & training
(often cumbersome, rigid and slow to respond) – how does it have to change to address new skills?

Global professional standards governing international education & labor markets



Rise of **new players** (e.g. global online learning platforms) – how does it affect the world of professional education?

Learning in practice (on-job training, apprenticeship, communities of practice, etc.) – what forms will thrive, what tools should arise?



GEF Kazan Group Topics & Tentative Questions

Group 1: **Automation & Digitalization**

Scenarios for the future of manufacturing:
cyberphysical, highly localized, or?
Future of digital work
Role of AI in manufacturing & digital work
Role of human workers

Group 3: **Education & Training**

Accommodation of 'future skills' agenda in
education & training
Role of ICT in transfer of knowledge / skills
and assessment
Organization of learning & career
trajectories (incl. new financial & investment
mechanisms to support them)

Group 2: **Human focused services**

Sectors vulnerable vs. sectors prone to
automation (robotics, AI etc.)
Growing segments & needs they address
Role of creativity in 21 century services
Dominant models of service provision

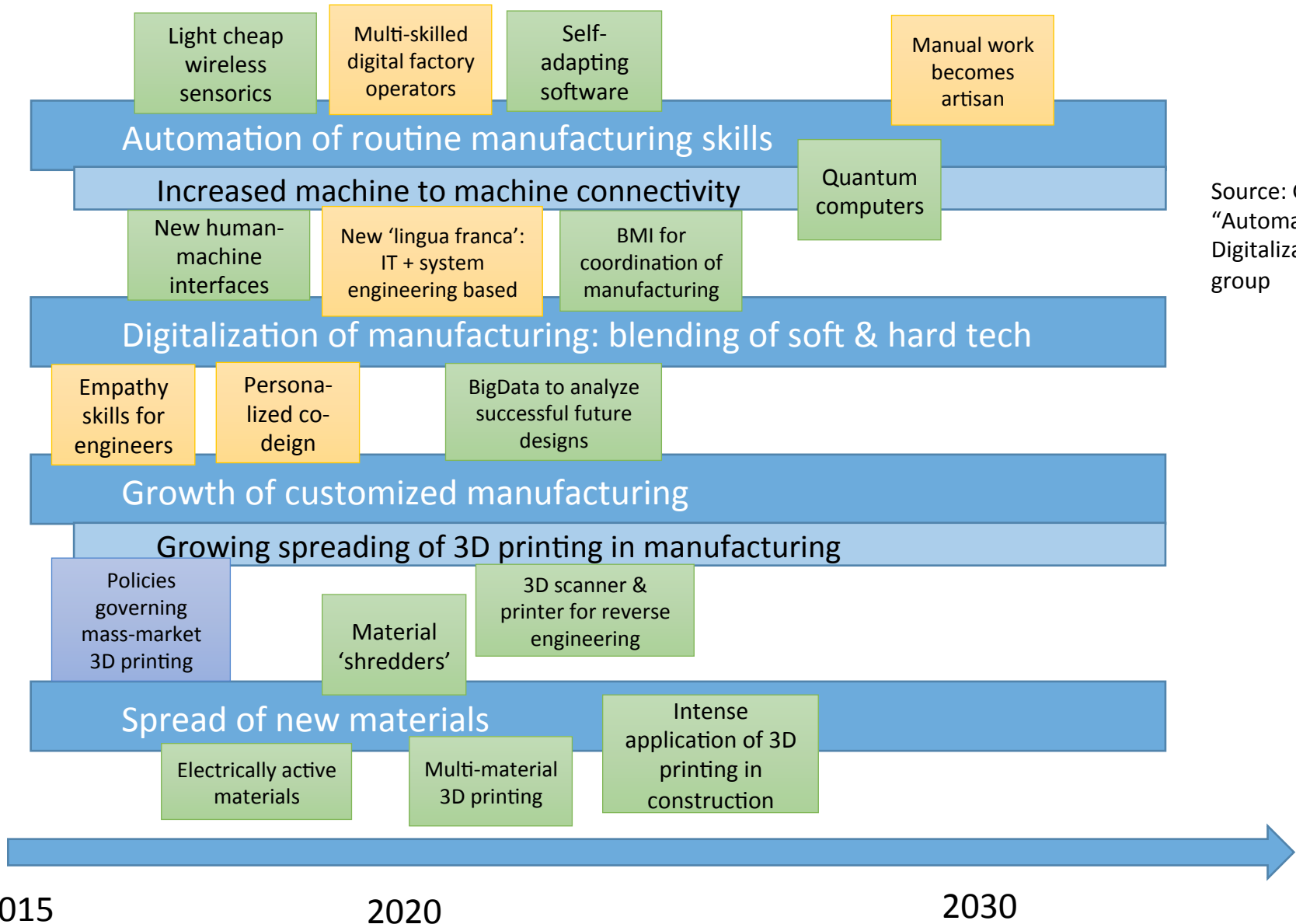
Group 4: **Global Agenda**

Urbanization & transformation of cities
Green agenda
Global market & technological standards
Global security (incl. cybersecurity)



Future of Manufacturing

- Hard technology
- Soft technology / format
- Policy / governance mechanism



Source: GEF Kazan, "Automation & Digitalization" group



Key processes that shape future of manufacturing

- **Automation of manufacturing** – a robust trend that leads towards wide spreading of cyber-physical manufacturing systems (involving industrial robotics, automated sensory systems, and self-adaptive artificial intelligence) that will be fully autonomous. Massive use of **machine-machine communication** (supported by **digitalization of manufacturing processes**) will be required to coordinate industrial logistics and control production within and between such manufacturing systems. Human operators will be *high-skilled production experts*, and in 10-15 years they will control manufacturing processes via *brain-machine interfaces* (even before that, *human-machine interfaces* will continue to develop to allow greater flexibility and larger set of tools to cope with unpredictable situations)
- **Growth of customized manufacturing**, supported by wide use of **3D printing technologies**, will allow for increasingly personalized manufacturing. *Co-design between engineers & customers* will gradually dominate manufacturing, and will be supported by *BigData analysis* that will allow to predict potentially successful designs. **Application of new materials** (including electrically active materials) will become an enabler of wide use of 3D printing (including multi-material printing). *'Material shredding'* technology may become a possible solution to localized recycling that will allow to break worn objects for re-use. In the view of the wave to transformations brought by 3D printing into economy & society, governments will introduce *a set of regulations* for this new practice (alike to 'traffic code', and possibly accompanied by '3D-printer license').



Future manufacturing sectors and future skills

Manufacturing of the future will be dominated by two types of production systems

Manufacturing sector

Mass-scale industrial manufacturing (e.g. natural resources, energy, food, chemistry & new materials, machinery & equipment etc.): highly autonomous cyber-physical manufacturing systems

Networks of unmanned transport for industrial & consumer logistics

Customized end-user manufacturing (apparel, consumer electronics, consumer transport, furniture etc.): localized personalized production based on 3D manufacturing

Sector specific skills

- Cyberphysical manufacturing facility operation & maintenance
- Skills for Internet of Things: system engineering, dynamic programming, etc.
- AI development / training of AI
- Skills in chemistry / new materials (e.g. for electric materials)
- Flexible supply chain management
- Technology ethics

- Product co-creation with customer
- Creativity for unique product creation
- 3D-scan-supported reverse engineering for customization (“same watch, different color”)
- ‘Beautiful exceptions’ of manual work dominated by artisans

Universal skills

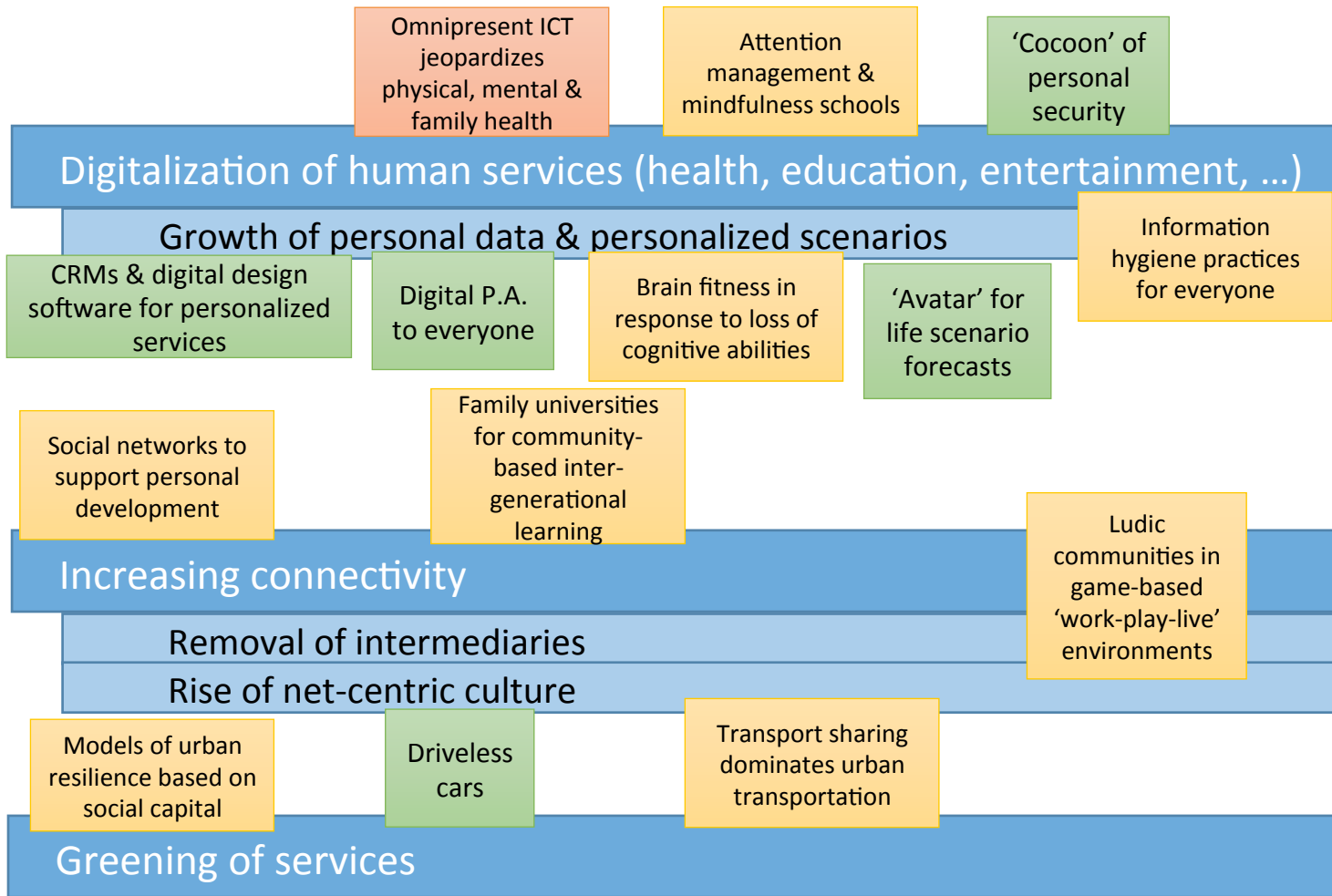
- Information worker skills (search, programming, etc.)
- Collaboration
- Working in dynamic / high-uncertainty environment
- Working in multidisciplinary environments
- Creativity
- System engineering
- ‘Green thinking’
- Languages: foreign + universal ‘lingua franca’ (based on IT + finance + system engineering?)
- Ability to unlearn / relearn (supported by mind-stimulation)

Source: GEF Kazan



Future of Services

- Hard technology
- Soft technology / format
- Risk factor



Source: GEF Kazan, "Human-Centered Services" group



Key processes that shape future of services

- **Digitalization of human life** is a strong trend in the majority of service sectors (e.g. transportation, finance, retail, healthcare, etc.), coupled with the **growth of personal data**. It allows to achieve personalization of services on mass scale (including provision of personalized assistance & personalized security to virtually every member of the society). **Digital ‘avatars’** (simulations of personal behavior) will allow to predict potentially beneficial & risky strategies for personal health, learning, entertaining etc.
- Digitalization allows to **remove layers of intermediaries**, thus making provision of services more efficient in economic and environmental terms. In particular, it helps give boost to *sharing economy* (including, in particular, sharing of transportation)
- Personal does not deny social: increasing **connectivity** helps rise of network-based communities of interest, including *social networks that support self-guided personal development*, and *family universities* that support inter-generational community learning. In 15-20 years, many professional, hobbyist, gaming and personal development communities may converge to become ‘communities of being’ (often built around shared ‘playing’ practices)
- Among the major risks of this scenario is that omnipresent information technologies may become increasingly **‘toxic’** to human physical, mental & social health, including friendship & family (as manifested by recently emerged phenomenon of *‘nocializing’*, spending all time on mobile device while in company of other people and in public places). Practices dealing with negative effects of ICT, including *attention management*, *brain fitness* to keep cognitive function, and ultimately *‘information hygiene’*, should become literacies of the future.



Future service sectors and future skills

Services of the future will largely break into two types (but unlike in manufacturing, these service sectors can be largely independent from each other)

Service sector

Digitalized & machine-assisted massive use services (e.g. digital health, digital entertainment, unmanned transportation, post-retail distribution, etc.)

Customized highly-personalized services (e.g. wellness, psychotherapy, fitness & tourism, hospitality, personalized art & entertainment, etc.)

Sector specific skills

- Engineering of socio-technical systems
- Sustainable design (incl. balance between personal & social structures)
- Green design
- New skills for working with 'smart machines' (e.g. human-machine psychiatrist)
- Authentic serving (serving others as a personal 'quest')
- Psychology skills
- Ethics of service including the principle of "We belong, we care, we serve"(also, principles that serve local communities, e.g. 'slow food')
- Storytelling ("every personalized service is a story")

Universal skills

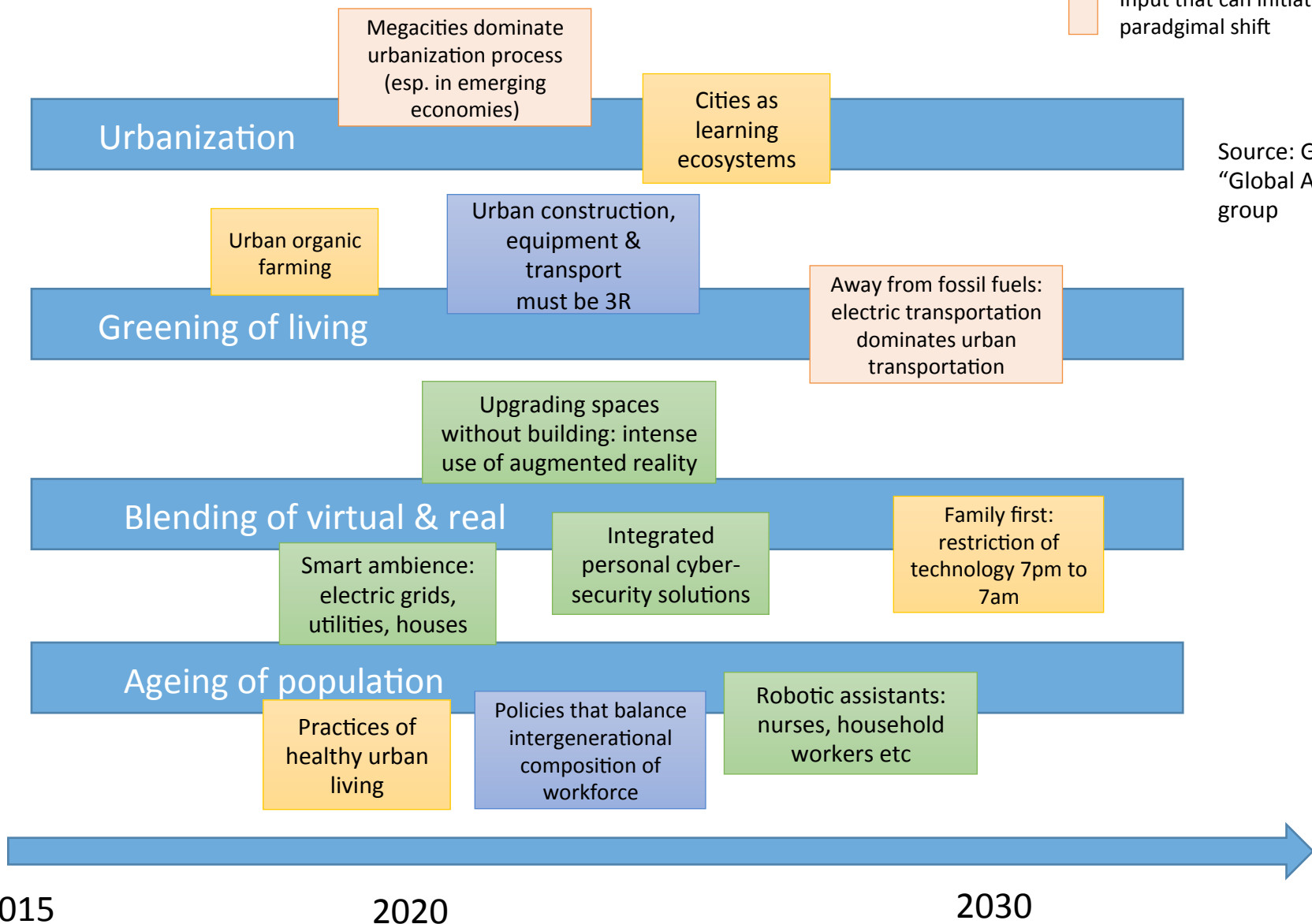
Similar to those for Manufacturing sector plus:

- Concentration / attention management
- Empathy / bonding ("I am a person because of another person")



Future of Sustainable Urban Societies

- Hard technology
- Soft technology / format
- Policy / governance mechanism
- Input that can initiate paradigm shift



2015

2020

2030



Key processes that shape future of urban sustainable living

- **Urbanization** is a dominant trend in the global agenda that shaped the focus of discussion of this group. Within next decade, the agenda of urbanization will become increasingly dominated by theme of *megacities*, especially due to city growth in Asian & emerging economies.
- **'Greening' of living** is another very robust trend that sets *new standards* of city constructions, transport & equipment (*3R*: reduce-reuse-recycle), and gradual *phasing out of non-electric transport*. *Urban farming* may become a wide spread practice that, in addition to shortening the supply chain in food industry, will also contribute to urban greening.
- Increased connectivity will lead to **blending of virtual & real** in all urban practices: every object in the city will be connected to the Internet of Things (including smart energy grids & utilities, city transportation, city lights, security systems, and smart houses). Spreading of *augmented reality* will allow for multiple use / upgrade of city spaces (esp. public spaces) without rebuilding them. Connectivity will call in for new urban habits, including 'information hygiene' which may require highly *limited use of connected devices in 'family time'*
- **Ageing of population** across the world will affect all aspects of our living, including composition of the workforce. It will lead to the increased demand for *practices of healthier living*, including healthy food, fitness & wellness. Increase of senior population share will lead to wide use of *home robotics* such as nurses and household workers.



New skills for urban sustainable living

Transformation of cities will create variety of jobs in different areas of city life, catering to needs of various population groups. Some of these are new skills, while others are existing skills that will increase in importance.

Jobs that support ...

Green city living

Healthy city living

Connected city living

Harmonious city living

Some skills that will be required in this sector

- Sustainable design
- Smart grid design & maintenance
- Electric transport repairing
- Urban farming
- Environmental law

- Personal wellness advising / healthy habits coaching
- Healthy aging consulting
- Adaptation psychology

- Cyber-security management
- IoT design / maintenance
- Home robotics maintenance

- Re-education for adults
- Smart political design
- Inter-cultural communication
- Cloud police
- Cyber law



World 2035: where are we going *

WHAT GOES UP

- Highly autonomous industrial cyber-physical manufacturing
- Highly local manufacturing, food production & energy generation on demand
- Green production, energy & services
- Highly personalized services in healthcare & wellness, education, entertainment etc.
- Unmanned transportation is ubiquitous
- Total connectivity + hybrid reality + wide use of brain-machine communication
- Smart human-centered technological environments
- Human practices of 'ludic' communities that naturally blend working, living, and creativity

WHAT GOES DOWN

- Large industrial facilities as employers
- Cities as centers of industrial mass production
- Centralization of infrastructure, coordination & development
- Manual labor in the majority of manufacturing operations (and in many service operations)
- Middle management and many industry-related services (incl. jobs in sales & marketing, supply chain management, accounting & finance, IT support etc.)
- Boundaries between work, creativity, learning, play, and life

* This description focuses on 'global best practices'. We acknowledge the diversity of geopolitical & economical scenarios that different countries of the world may face in next 20 years



Future skills: what do 21 century economy & society want?

Skills of the future are needed not only for employability & successful career-building, but also for good citizenship and higher quality of personal life.

Management + knowledge work as complex problem solving with dynamic collective intelligence

Domain of support to **lifelong education** (that expands to include personal development, body & mind fitness, therapy etc.) becomes a new large economic sector with dozens of new types of jobs

Expanding domain of **'new service economy'** focused on creating unique human experiences through

- personal connection (empathy / bonding)
- creativity

21 century literacies:

- attention management / mindfulness
- information hygiene
- programming (as task-setting)

Omnipresent
ICT

Robotics / IoT /
autonomous
energy / ...

New urban jobs created around

- green cities
- healthy cities
- distributed & connected cities

Design, coordination & maintenance of complex tech environments (ca.5% of jobs)



Future skills: what new skills are highlighted?

In comparison with existing models of 'future skills' (one of the most developed is used by the Partnership for 21 century skills), GEF Kazan session highlights several important skills of the future:

21 century skills

1. Content knowledge
 - English & other languages, arts, mathematics, economics, science, geography, history)
2. 21 century themes
 - global awareness, financial literacy, civic literacy, health literacy, environmental literacy
3. Learning & Innovation Skills
 - Creativity & Innovation
 - Critical Thinking & Problem Solving
 - Communication & Collaboration
4. Information, Media & Technology Skills
5. Life & Career Skills
 - Flexibility & Adaptability
 - Initiative & Self Direction
 - Social & Cross-Cultural Skills
 - Productivity & Accountability
 - Leadership & Responsibility

Future skills (GEF Kazan)

- Concentration & attention management
- Information hygiene
- Empathy
- Collaboration (as a critical skill that should be embedded in many aspects of work & learning)
- Working multi-disciplinary environments + emerging 'lingua franca' (incl. system engineering & economics)
- System thinking
- Green thinking
- Ability to unlearn / relearn
- Ethics of human work / human service


Skills that can be highlighted as 'universal' in addition to 21 century skills



What is How: adaptation of education to future skill demand

The current educational model is flawed by design: it prepares people for skills of the past, not skills of the future!

- We cannot teach people to be creative by giving them standard tasks
- We cannot teach people to be collaborative by putting them in competition against each other
- We cannot teach people to be lifelong learners if we deprive them of self-exploration and courage to learn, if we blame them for mistakes
- We cannot teach people to be empathic / emotionally intelligent by removing emotion and focusing on cognitive abilities only
- We cannot teach people to use IT properly if we remove it from the school
- We cannot teach people to be mindful if we are not mindful

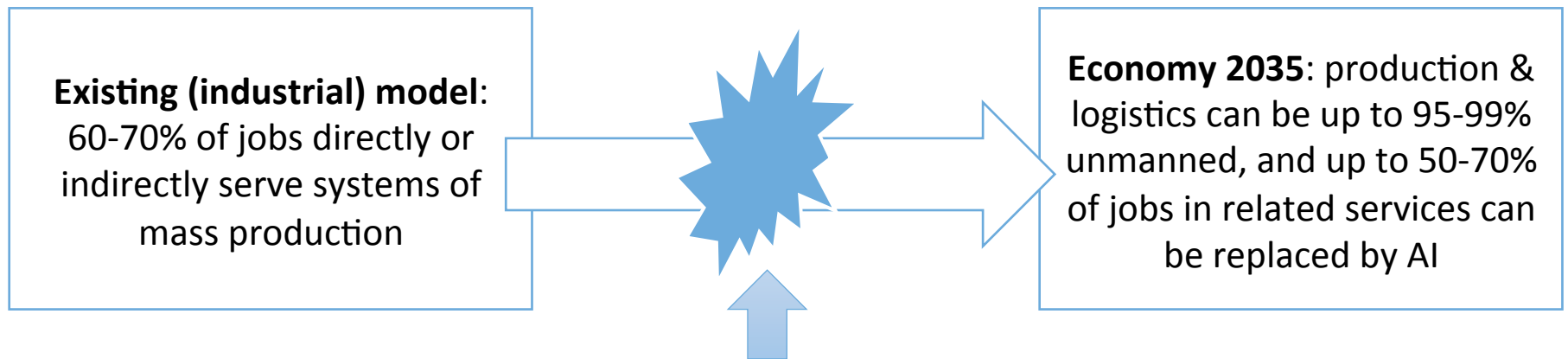


Educational processes and formats need to be redefined to enable the development of 21 century workers / citizens / humans



A challenge to be taken: explosive automation & automation

We require new education & training models not only to provide new workers & citizens with skills of the future, but to help smoothing out transformation of our societies for economically active & senior population.



Technologies of automation & automation (2015-30):
robotics, Internet of Things, Big Data & Artificial Intelligence, autonomous energy generation & smart grids, unmanned transportation & logistics, designed bio ecosystems, etc.



Transformation of Education & Training Systems

Green box: Hard technology
Yellow box: Soft technology / format

Differentiation of degrees to cover more skills

Automated real-time skill assessment done by AI 'observers'

Shortening of technology / working practice lifecycles

Increasing skills gap between education & practice

New & emerging technologies not accessible to majority

Peer-to-peer learning & mentorship

Independent skill assessment with competence centers

'Technology for all' network for makers

Growth of learning by doing / practice-oriented education

Teaching practitioners

Dual education system dominant in professional education

Fablabs permeate cities

Kaizen park

Growth of gamification in education

Mind training in online games

Mass AR platforms with open API for professional skill training

Lifelong 'avatar' for personalized education

Virtual tutors in multi-user games support real skill training

Delocalization of education

Number & diversity of education providers is growing

Google.Education: search engine on education providers

Global learning platform for skills development

Global culture learning platform

Source: GEF Kazan, "Education & Training" group + recommendations of other groups



2015

2020

2030



Key processes that shape future of professional education & training

- **Life cycle of technologies is shortening** in almost any industries, and that makes many skills obtained during ‘long’ education cycle (e.g. university degree) increasingly irrelevant – which may require *differentiation of degrees & certificates* to help cover more skills (and distinguish between ‘fundamental’ and ‘professional’ education).
- Reduction of skills gap can be obtained through wide application of **practice-oriented learning / learning by doing**. Elements of *dual education systems* can be gradually implemented across the world, including on-job training for students, *practitioners teaching* at school and university level, and *independent assessment centers* (incl. companies & corporate universities) that can award degrees based on demonstrated skill (this may also give rise to ‘credential market’).
- New technologies are often more sophisticated and expensive, creating **‘technology gap’** within and between nations – which can be covered with help of *maker* movement and *networks* (incl. peer-to-peer) that help *teach technology to anyone interested*. *Augmented reality platforms* can be used to reduce cost of training.
- In a more distant perspective, skill training & assessment of teams & individuals can be accomplished in real time by Artificial Intelligence ‘observers’ that will replace human observers. Such ‘observers’ can also act as virtual tutors that provide feedback & help create better skill.



Key processes that shape future of professional education & training (2)

- **Game-based education for all ages & stages of education** helps motivate people for skill training and keep them engaged in the process. Various edutainment formats (e.g. *Kaizen park* with Disney-like experience to try different professions, such as 'Masterville' in Russia) will help to create motivation. Training can be conducted in *multi-user gaming environments* (specially designed as well as generic gaming universes), with *real & virtual tutors using augmented reality to develop real skills*
- **Growth of new providers**, enhanced by **delocalization of education** (as it moves from real to virtual space), accelerates the proliferation of new education & training models. It can be anticipated that, within 5-10 years, a *global online learning platform for skill development* emerges, that will play important role in professional education & training across the world. Another anticipated *platform* (that will most likely be combined with language training) will help study *cultural diversity* (and cultural unity on global level, as well as global society inclusiveness principle) & acquire cross-cultural communication skills.
- In order to organize the online learning space, it is anticipated that a major search engine (e.g. Google) will launch a *specialized search on courses and online learning tools* available from existing institutions and new providers.



Design of learning environments & skills of teachers

Learning environments & pedagogy principles

- Transition from competitive to collaborative learning processes
- Focus on self-development & self-guidance, collaborative design of learning process & content to be explored
- Personalized learning trajectory that combines
 - Learning in virtual environments (online courses, virtual reality lectures, social & AR simulators etc.)
 - Practice-based learning in real-life settings
 - Peer-based learning (face-to-face & online) with mentors & community
- Learning built around real-life problems & challenges rather than subjects
- Environment for physical exercises & interaction, emotional / artistic interaction etc.

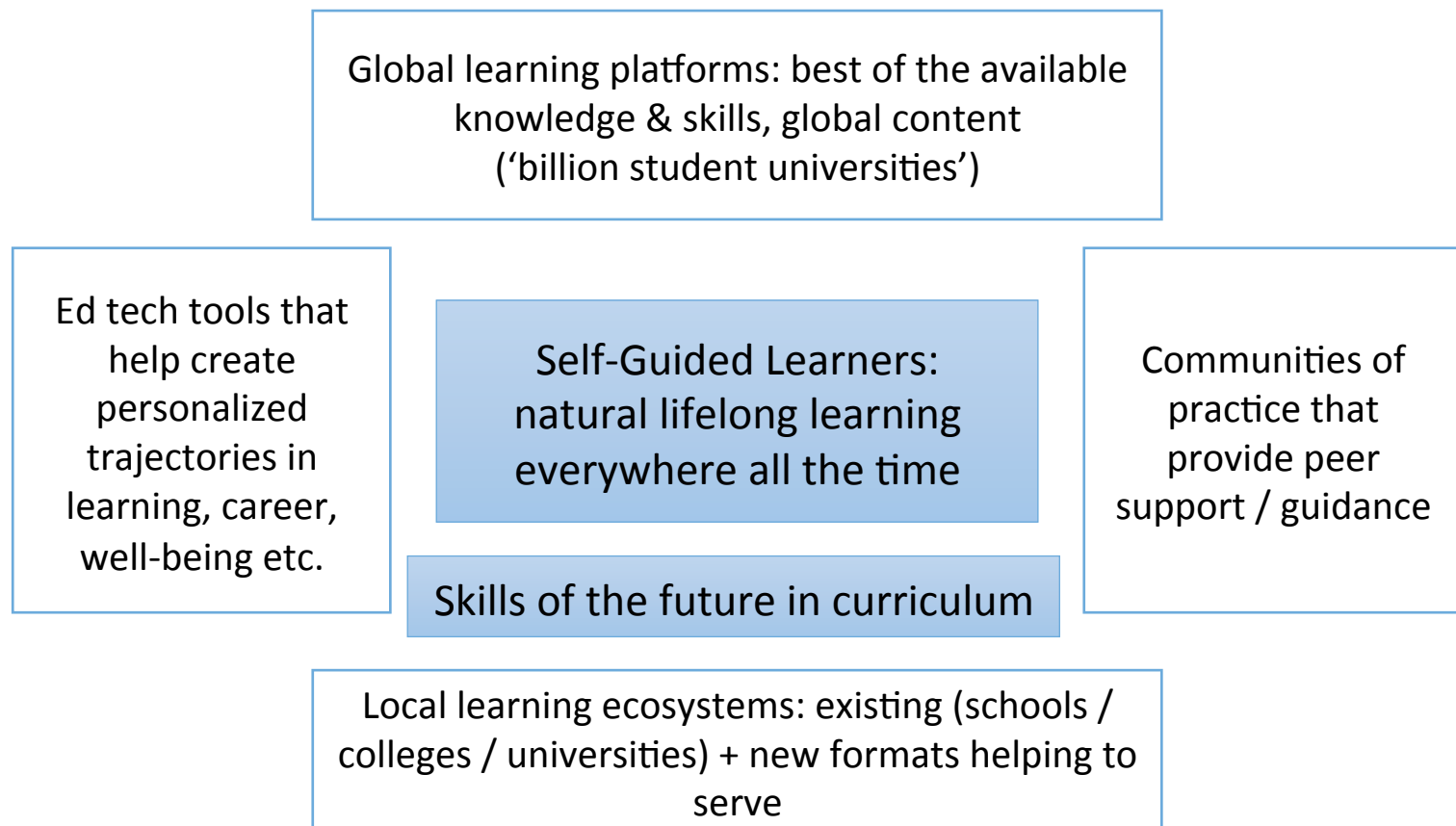
Skills of teachers

- Blended pedagogy
- Collaborative & connected pedagogy, including peer-type instruction (collaborative exploration rather than 'schooling')
- Gamification of learning:
 - game-design
 - game-based teaching
 - in-game acting (teacher as NPC)
- Mentorship & coaching (based on learner's own goals)
- Entrepreneurship
- Research-driven pedagogy
- Project-based pedagogy
- 'Holistic' teaching that recognizes various needs of learner's mind & body
- 'Skills archive': practice of storying disappearing skills and retrieving them when necessary



Big shifts ahead: learner-centered lifelong education

Transformation of professional education & training systems should play along with the larger transformation of 'industrial' educational systems into 'network-based' educational eco-systems that cater to learner needs on the lifelong basis





Proposals for WorldSkills movement: competitions of the future

Proposals made by forum attendees in response to the question “What new types of competitions, general or skill-specific, could be introduced by WSI in next 4-6 years?”

New types of competitions that could be conducted by WSI

- Product lifecycle management (PLM) competitions (for teams)
- Problem-solving challenges
- Various competitions for collaboration / teamwork
- Soft skills competitions, including:
 - Cross-cultural communication skill competition, culture-specific & traditional skills
 - Public presentation challenge
- Competitions for WS experts:
 - Assessment challenges (best skill validation practices)
 - Communication challenges (“skill of developing skills”)
- Challenge for educators (themes defined every year))

New skills that could be introduced in WSI competitions around 2020

- Cyber security
- Mobile app development
- Industrial Internet analysis / configuration
- Recycling management
- Smart grid design
- Electric vehicle repair



Proposals for WorldSkills movement (2)

Forum attendees have also made proposals regarding the future development of WSI in the context of transforming world of skills, and have indicated themes that could be explored further.

New role of WSI

- Massive WS competitions (on national & international level) can become skill validation centers (to award professional certification)
- WS can provide international industry credentials for student participants
- WS can provide training on validation & skills analytics methodology to countries & companies
- WS can help build global online learning platform for skills (with use of AR technology) and use it for international skills validation (in more distant perspective)
- WS can become a 'skill archive' for traditional & disappearing skills
- WSI could launch its own WorldTeach Forum (not for competition but for sharing the best education & training practices)
- How to promote creative aspect of skills?
- How to aspire to manual work? And is it necessary?
- How to increase sustainability / green component in skills?
- How can a system of transnational competences be organized?
- How to enhance and globalize WorldSkills assessment / validation practices?
- How to involve WorldSkills competition winners into co-design of WorldSkills movement development?

Some topics for future discussions

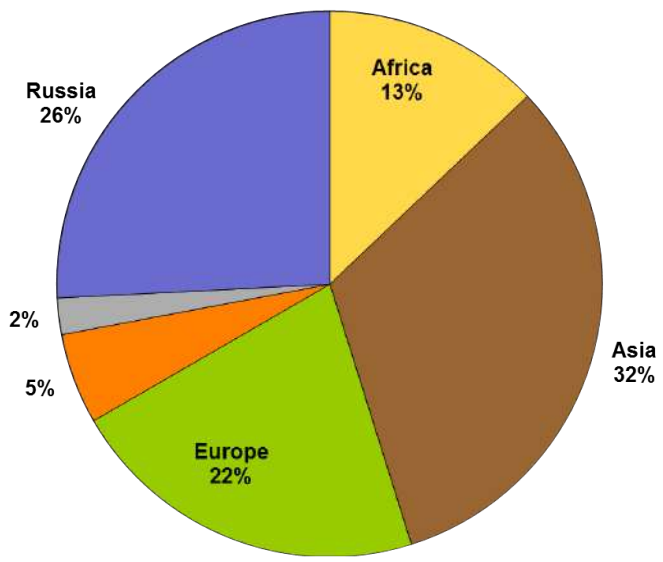
APPENDIX



Composition of the Participants Group

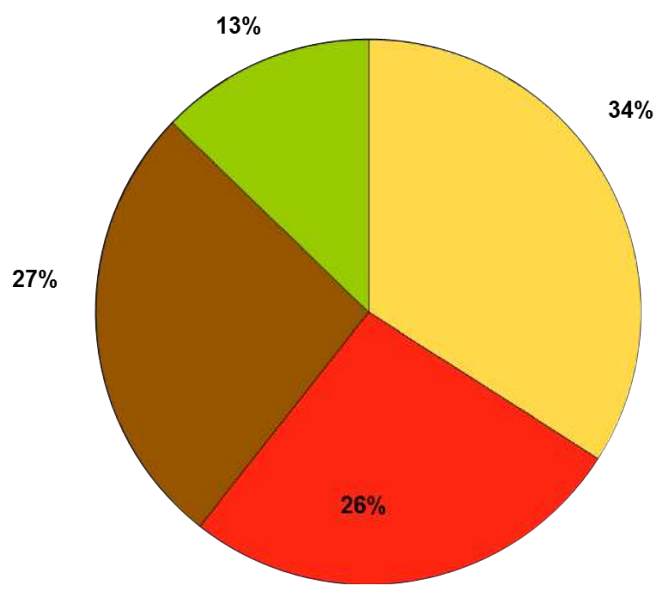
Regional representation

Africa Asia Europe Latin America North America Russia

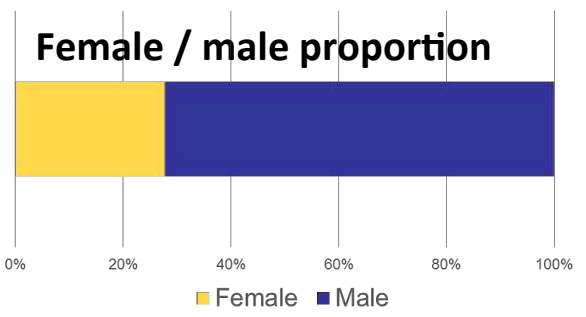


Organizational representation

* Education & training Industry Regulators NGOs



Female / male proportion



Number of attendees N=94



GEF Kazan: Key Process

May 22

May 23

Inputs from
key experts

Plenary:
Future skills for
economic & social
development

Plenary:
Solutions in education
& training for changing
skill demand

Participatory
group work

Skills Foresight
Future of sector +
Future Skills

Group Work:
New solutions in E&T
for future skills

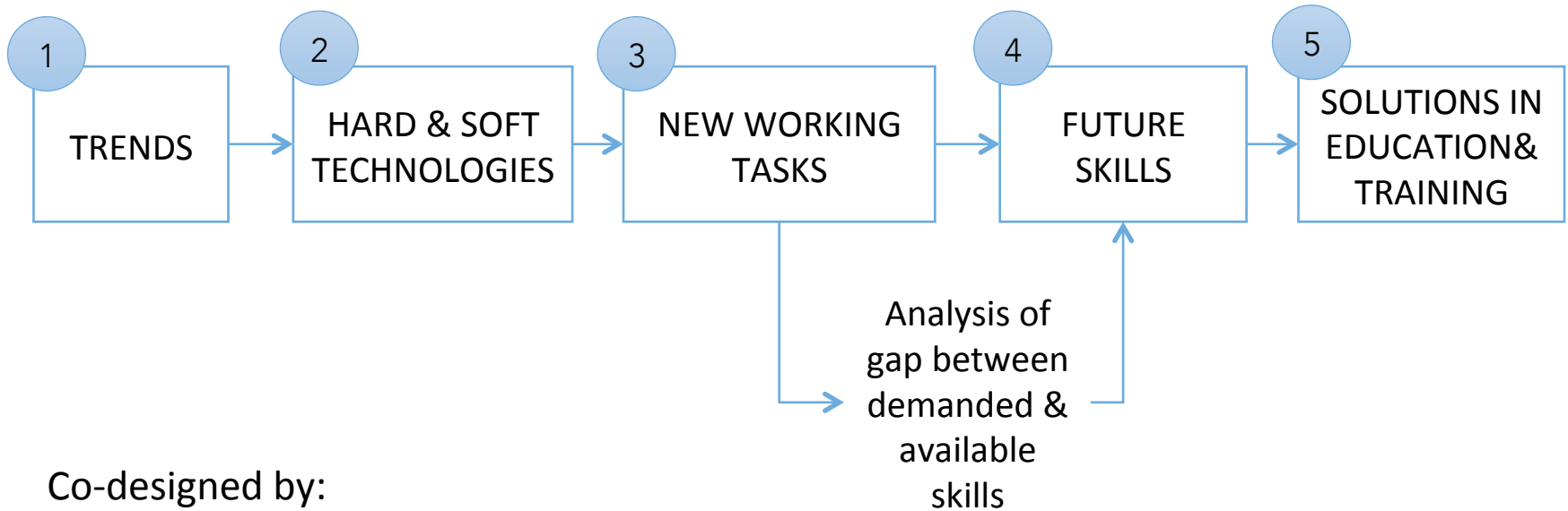
Presentation
of results

Group sharing

Group sharing &
final remarks



Main Process: Skills Technology Foresight



Co-designed by:





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