

Knowledge transfer and exploitation of stem cell research

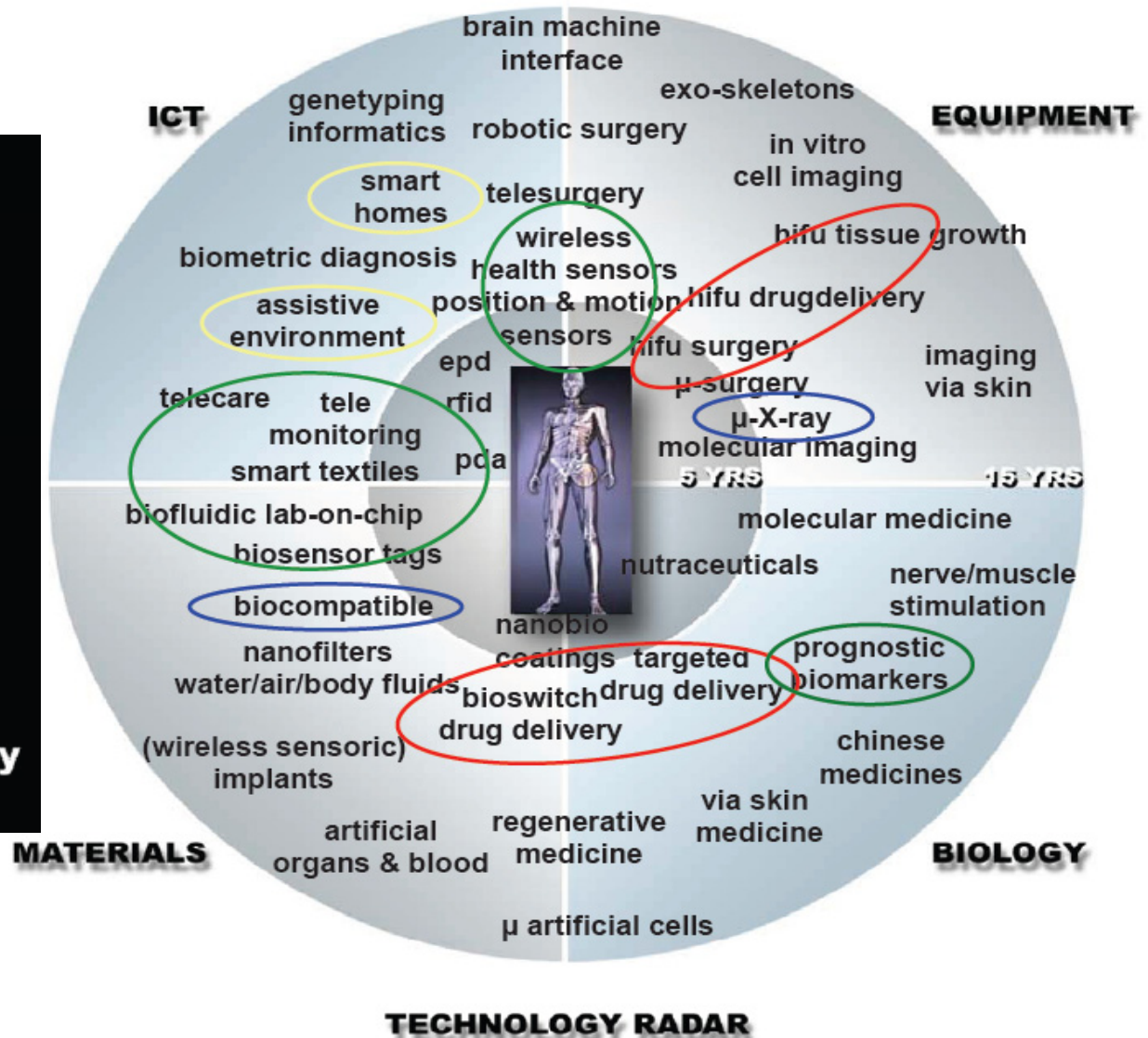


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Business opportunities

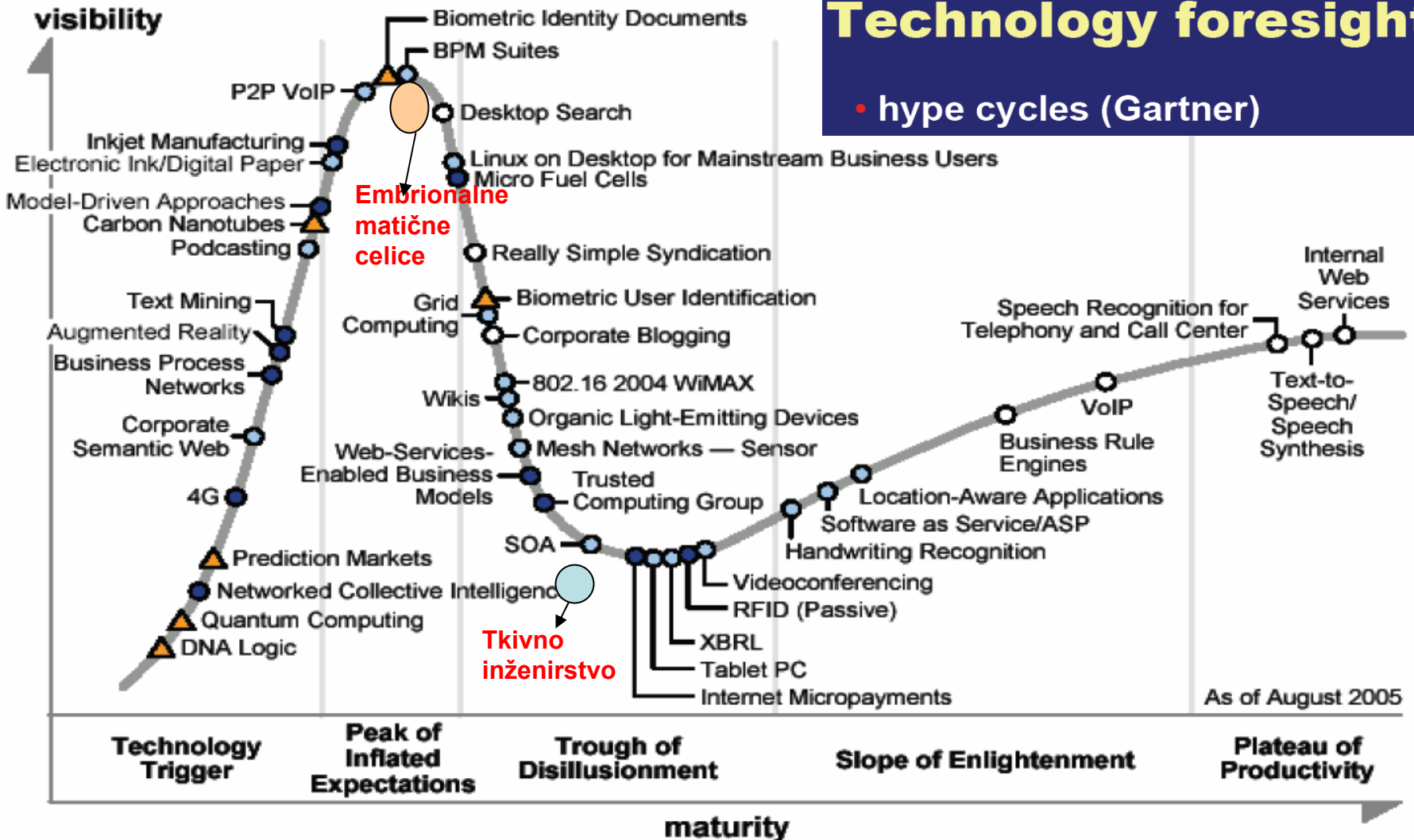
HEALTH CARE

- Less hospitalisation
- Homecare
- Elderly population
- Health IT
- Telemedicine
- Early diagnosis
- Drugs on target
- Minimal invasive
- Body repair & beauty
- Nanobio fusion



Technology foresight

• hype cycles (Gartner)



Plateau will be reached in:

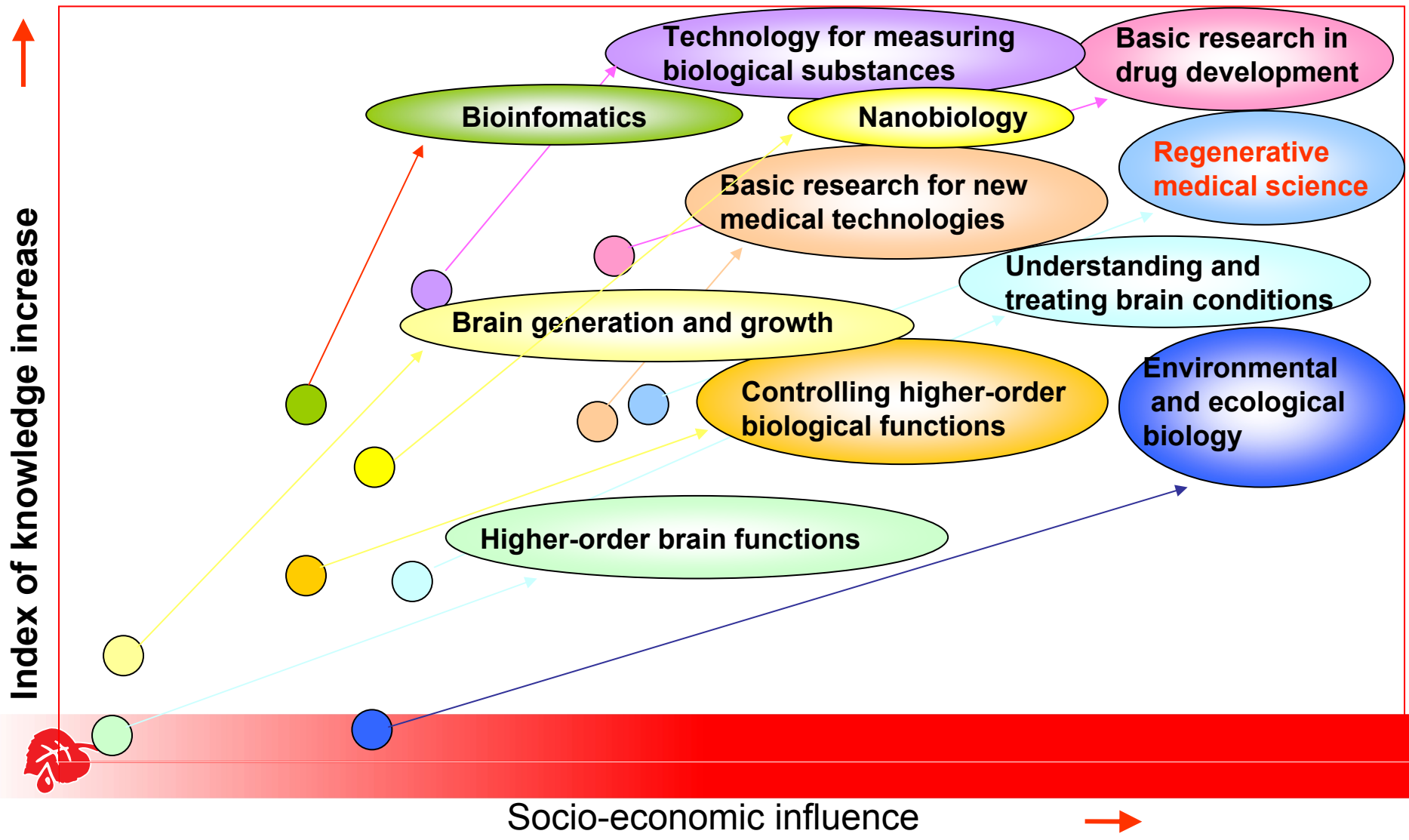
- less than 2 years
- ◐ 2 to 5 years
- 5 to 10 years
- ▲ more than 10 years
- ⊗ obsolete before plateau



Changing influence of Life science

before 2015

after 2015



Expected time to realisation – Life sciences



Time of technology realisation

Used in real life

2005 2010 2015 2020 2025 2030 2035

Bioinformatics

9.0 yrs.

Controlling higher-order biological functions

9.0 yrs.

Basic research in drug development

10.8 yrs.

Technology for measuring biological substances

10.6 yrs.

Environmental and ecological biology

11.4 yrs.

Nanobiology

10.8 yrs.

Regenerative medical science

11.3 yrs.

Understanding and treating brain conditions

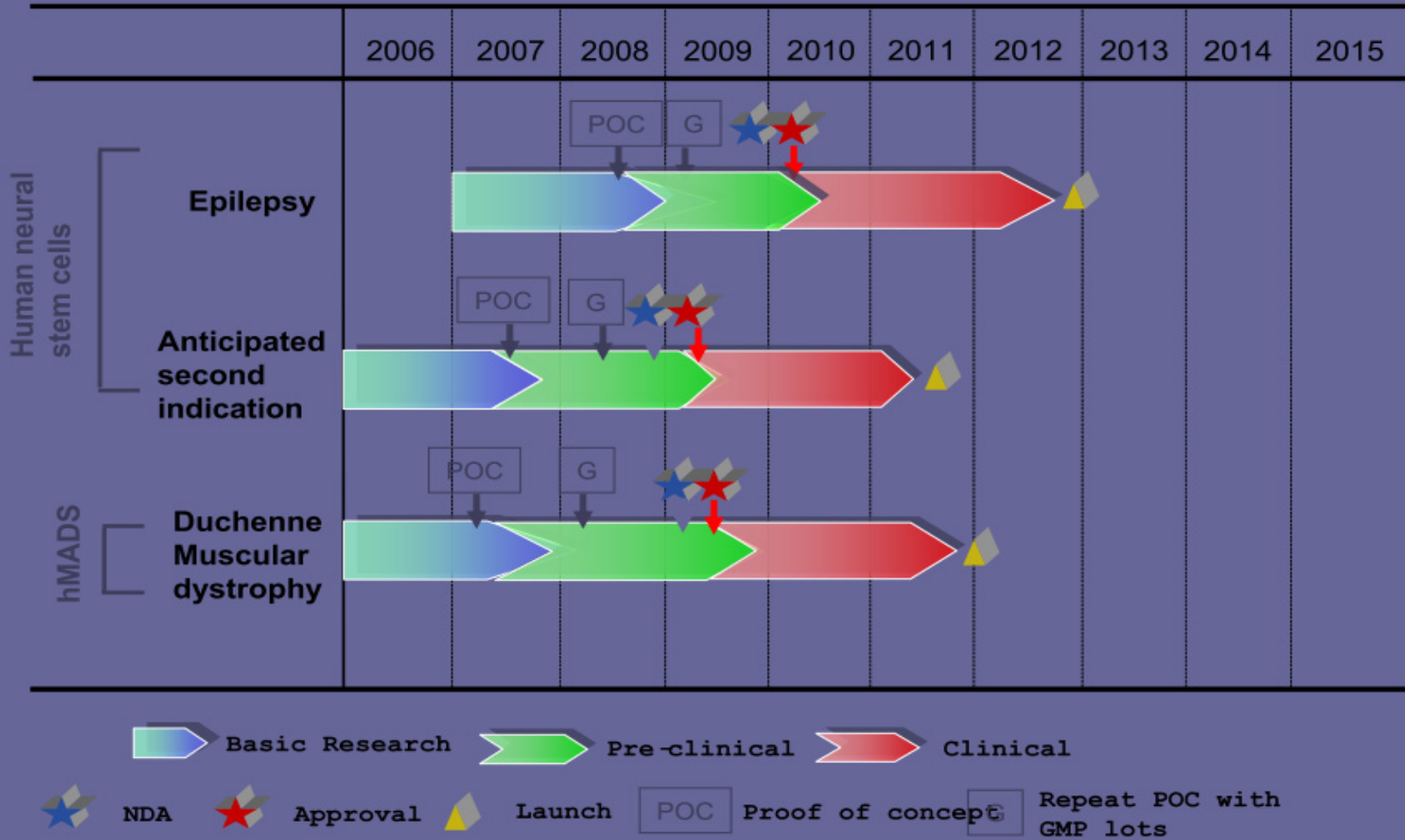
11.0 yrs.

Basic research for new medical technologies

10.6 yrs.



Stem Cell Therapy



Fundamental Ethical Principles at Stake.

(Opinion of the European Group on Ethics in Science and New Technologies to the European Commission, Nov. 2000)

“In the context of European pluralism, it is up to each Member State to forbid or authorise embryo research. In the latter case, respect for human dignity requires regulation of embryo research and the provision of guarantees against risks of arbitrary experimentation and instrumentalisation of human embryos.”



:

Legislation in individual countries incomplete, different.

The Oviedo Convention of the Council of Europe on human rights and biomedicine (1997)

Article 18: The creation of human embryos solely for research is prohibited.

About 30 states signed, 20 ratified

Protocol on prohibition of human cloning, 1998.

Second thoughts: have we overregulated?

Pressures of the science lobby, industry, patients..



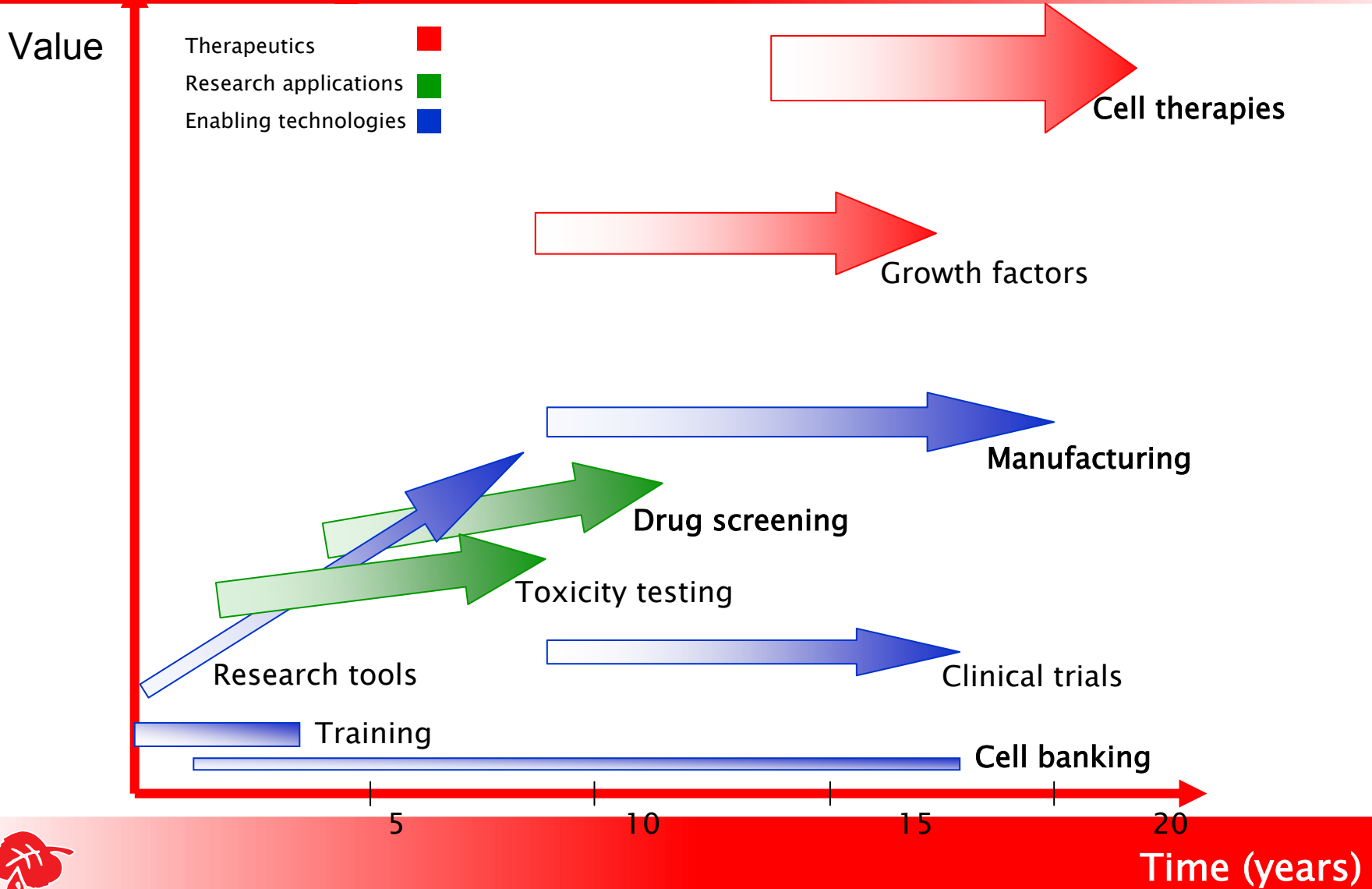
Regulation in EU member states re. embryonic stem cell (ESC) research (2003)

REGULATIONS IN EU MEMBER STATES REGARDING HUMAN EMBRYONIC STEM CELL RESEARCH

	AT	BE	DK	DE	ES	FI	FR	GR	IE	IT	LU	NL	PT	SE	UK
Allowing for the procurement of human embryonic stem cells from supernumerary embryos by law						X		X				X		X	X
Prohibition of the procurement of embryonic stem cells from human embryos but allowing by law for the importation of human embryonic stem cell lines	X		X	X											
Prohibition of the procurement of embryonic stem cells from human embryos					X		X		X						
No specific legislation regarding human embryo research		X								X	X		X		
Allowing for the creation of human embryos for stem cell procurement by law															X
Prohibition of the creation of human embryos for research purposes and for the procurement of stem cells by law or by ratification of the Convention of the Council of Europe on Human rights and Biomedicine signed in Oviedo on 4 April 1997	X		X	X	X	X	X	X	X			X	X	X	



Timescale for commercial opportunities

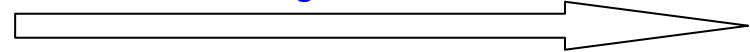


Translation of stem cell research into commercial products

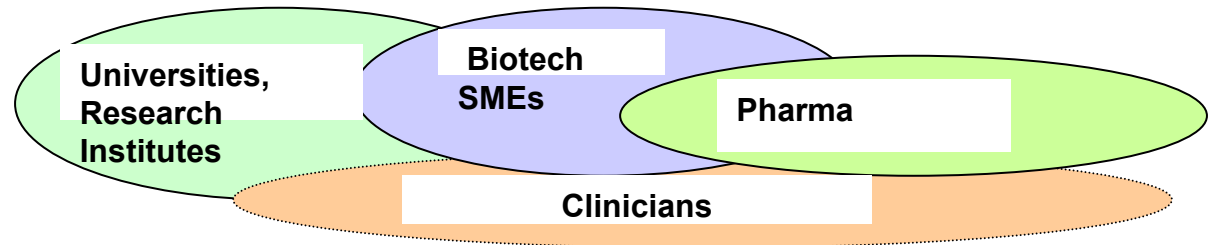
Stages:



Manufacturing



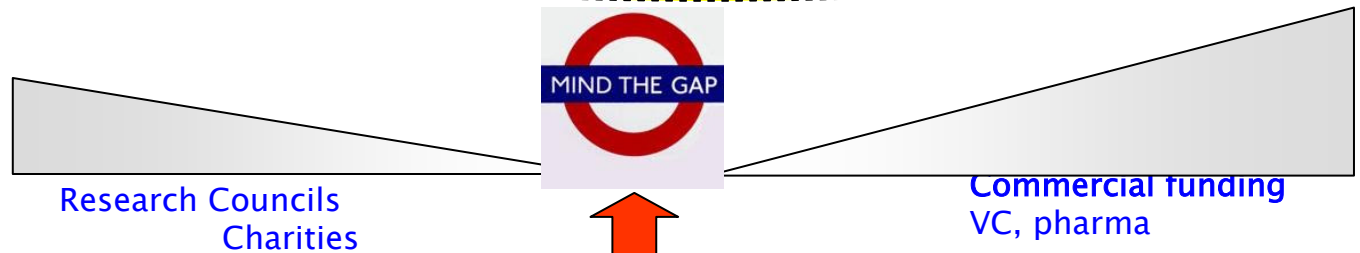
Infrastructure



Stakeholders:



Financing:



Funding Gap



Bench to bed side – work flow



- Isolate individual stem cell populations

- Ensure that cells retain their functionality and potential to differentiate

- Characterize & track stem cell populations

- Ensure that cells are “transplant” ready

- Culture stem cell lines in a stable, multi- or pluri-potent state, free from mutations & to sufficient quantity

- Enable Economical expansion to make cell-therapy a reality

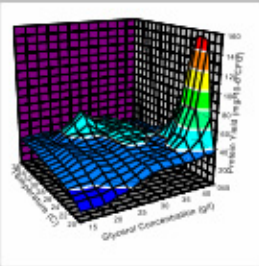
- Control & activate stem cell differentiation to desired lineages

- Functionally active differentiated cells



Enabling technologies for Stem cell therapies

Economic Production of Large Quantities of Cells

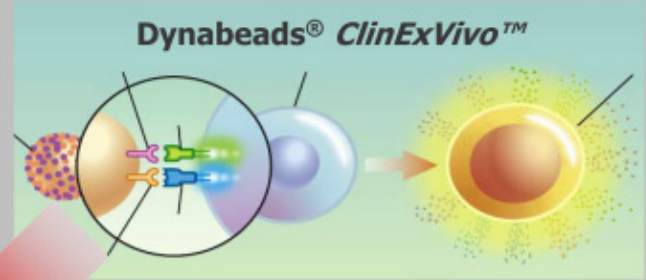


Optimized media

Process development

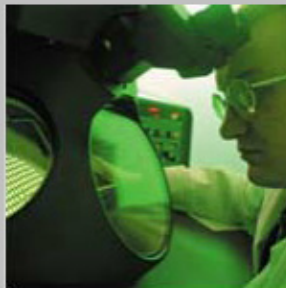


Isolation of Differentiated/Desired Cell Types



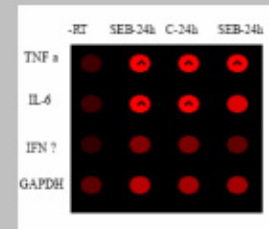
Research tools

Batch Release Testing

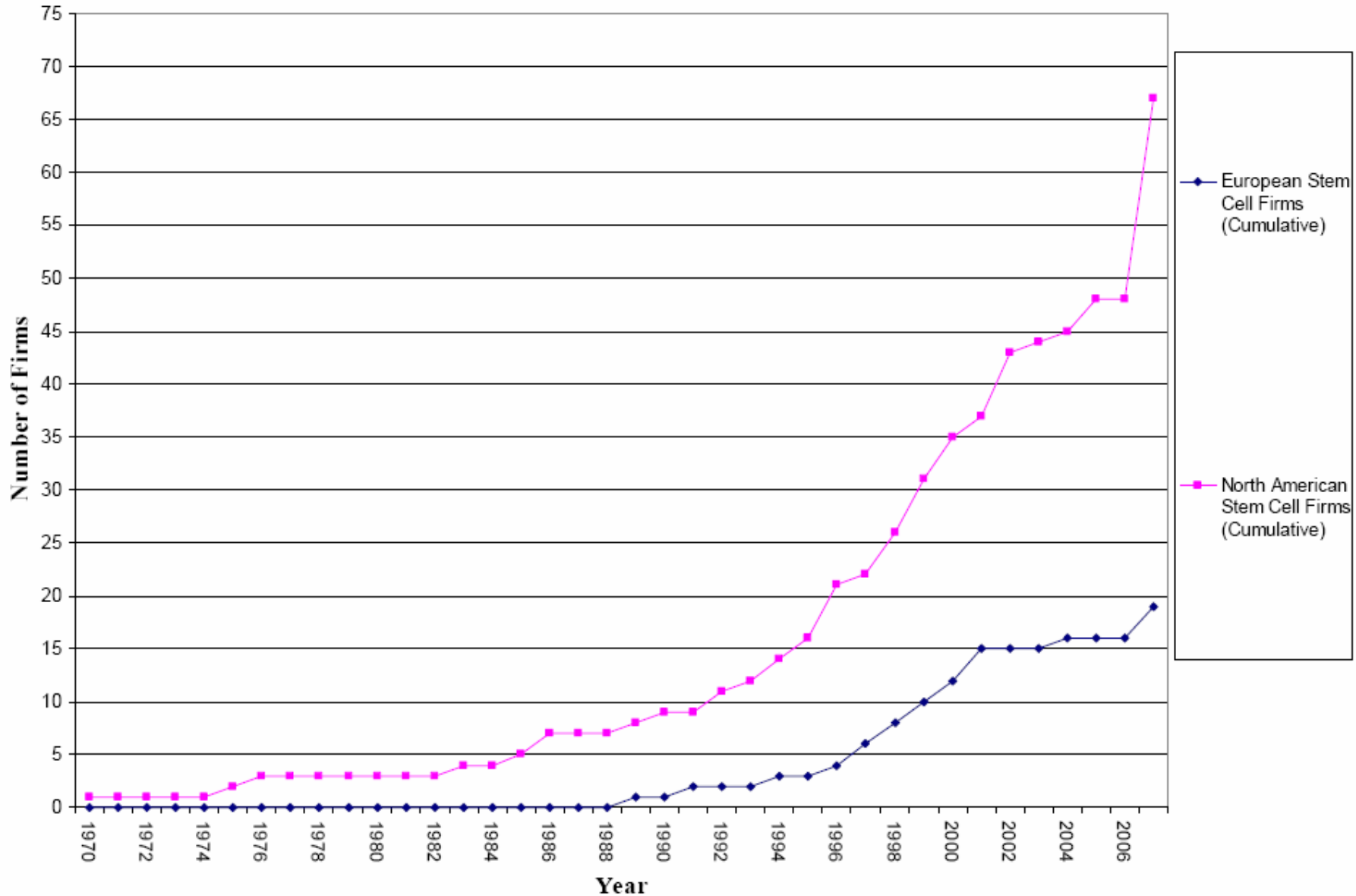


- Sterility/mycoplasma
- General safety
- Tumorigenicity
- Adventitious agents
- Novel cell-based test

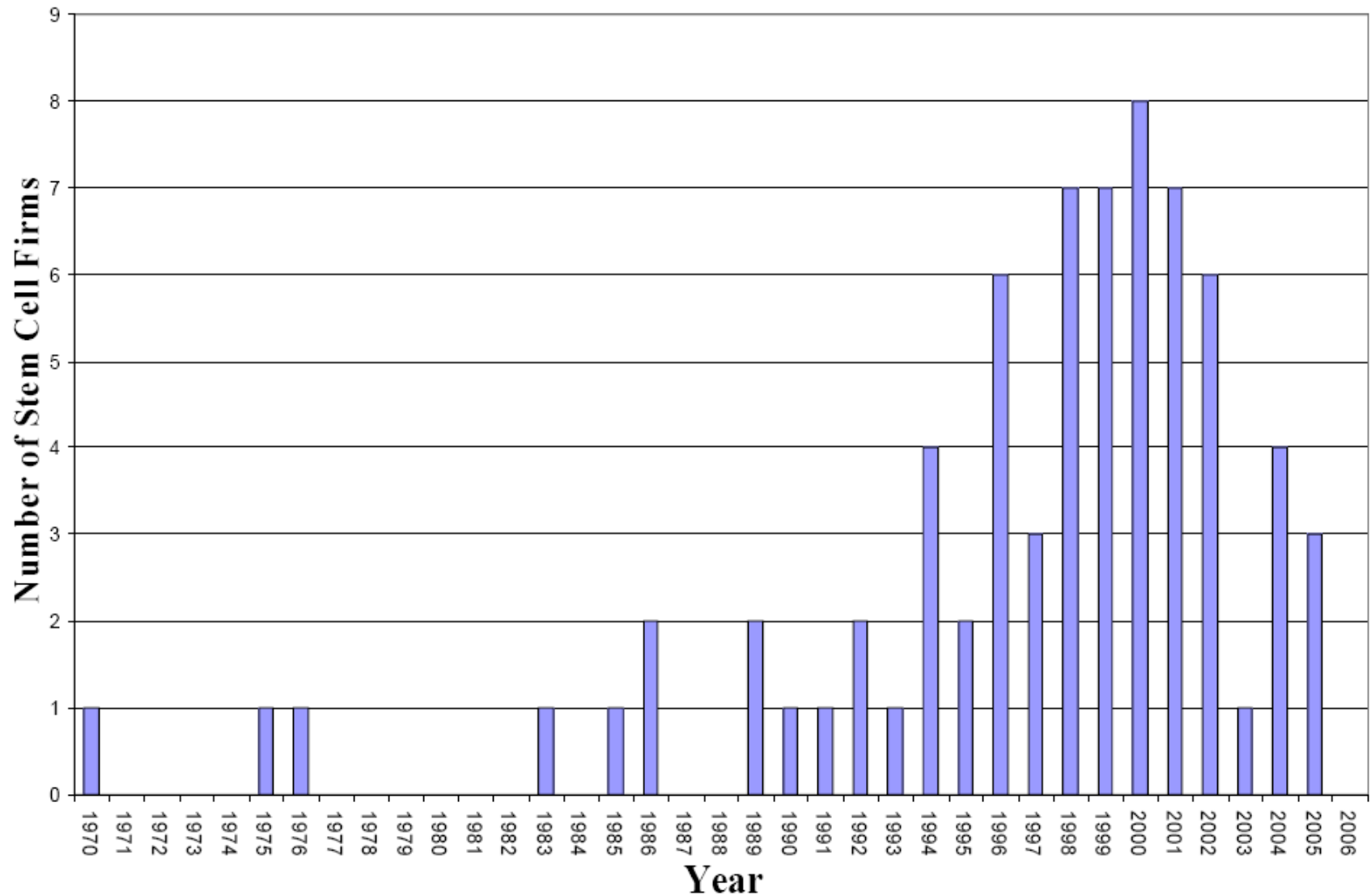
Cell Banking / Characterization



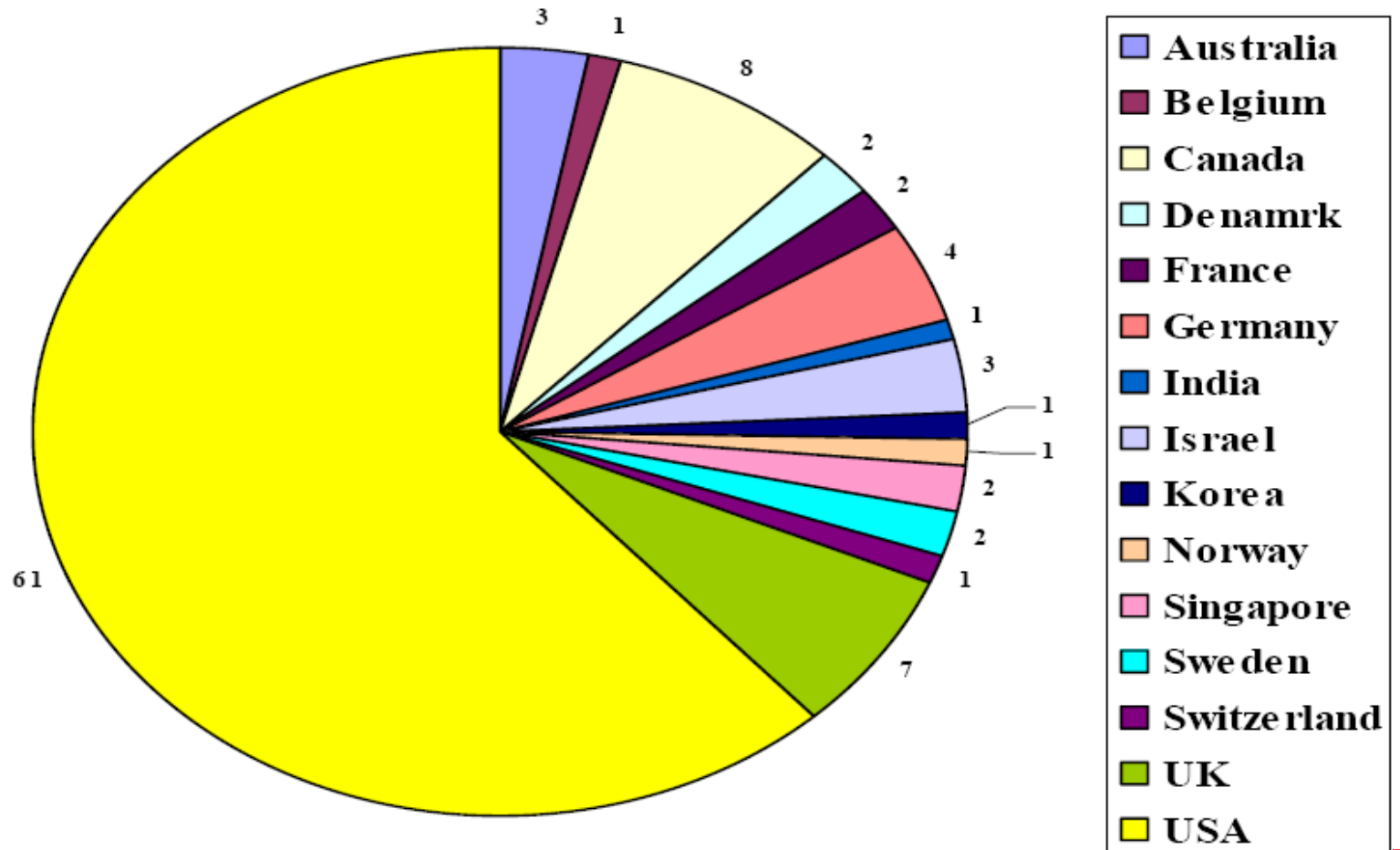
Growth of European & North American Stem Cell Firms



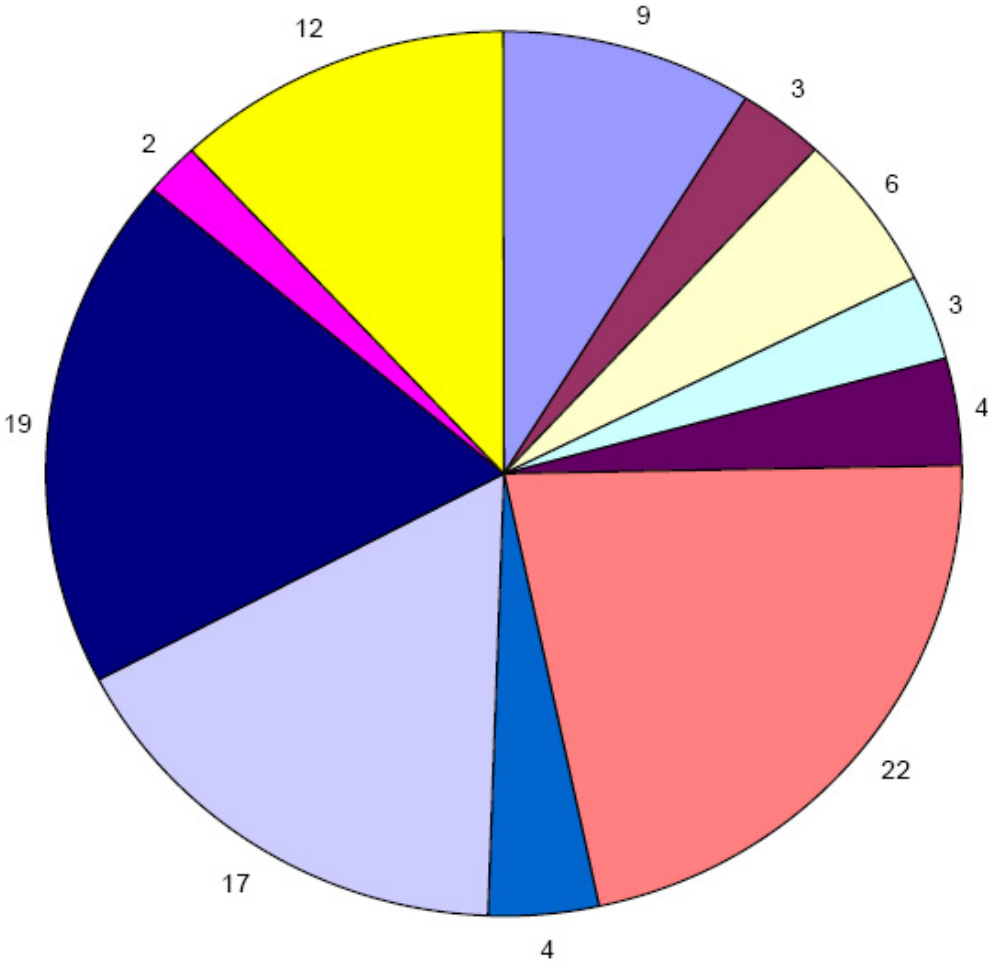
Number of Stem Cell Firms Founded 1970-2006



Distribution of Firms by Country



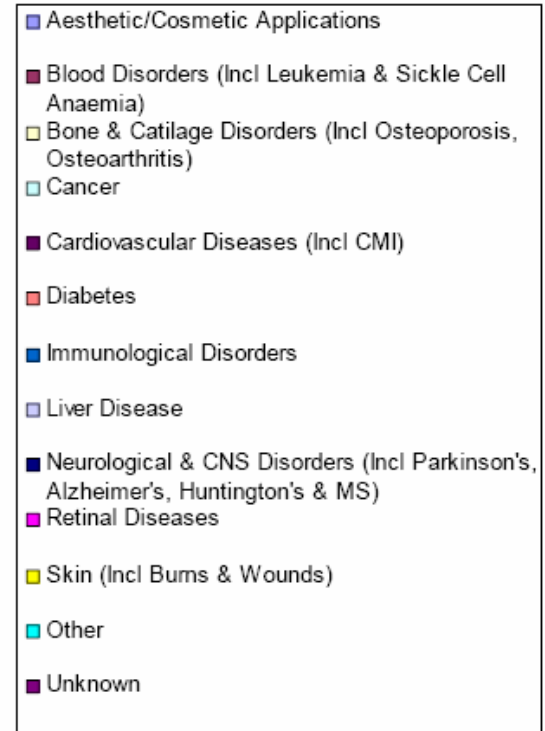
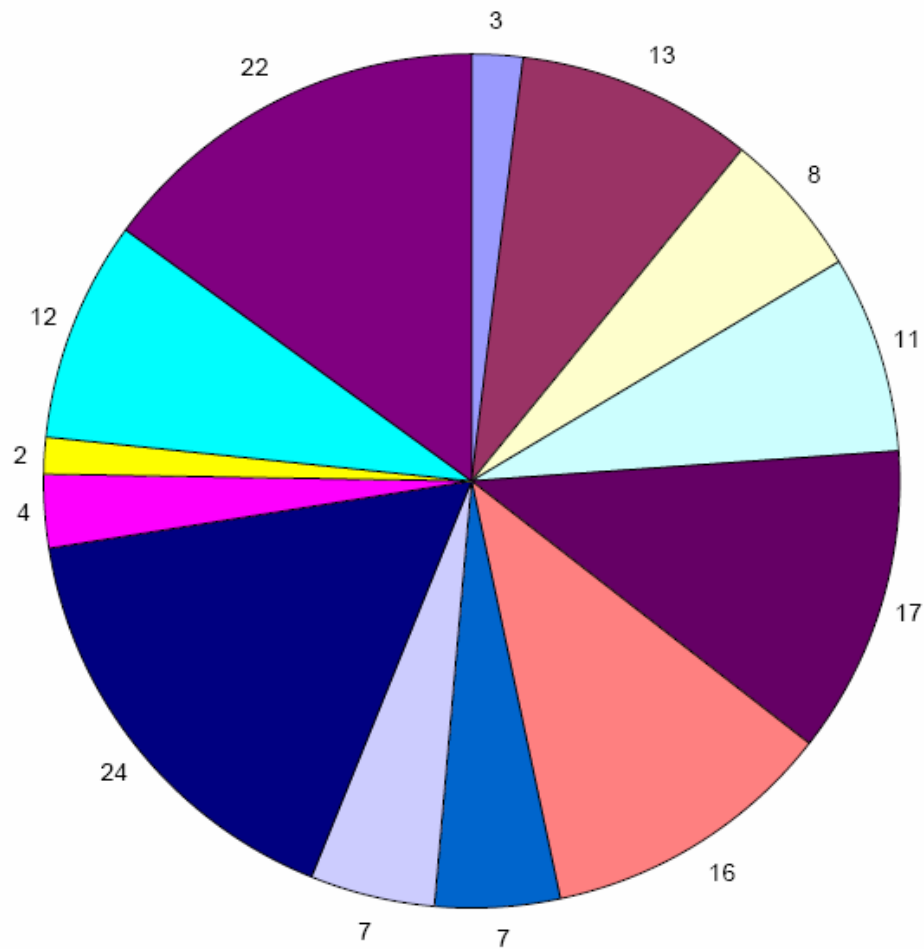
Stem Cell Types Being Developed by Firms



- Adult Bone Marrow SCs (Incl Haematopoetic)
- Adult Muscle SCs (Myoblasts)
- Adult Neural SCs
- Adult Pancreatic & Liver SCs
- Adult Progenitor SCs
- Adult SCs (Unspecified)
- Adult Skin & Adipose Derived SCs
- Cord Blood SCs (Incl Placenta)
- Human Embryonic SCs (Incl Mesenchymal & Foetal)
- Mouse Embryonic SCs
- Unknown



Disease Focus of Stem Cell Firms



Organisation types of stem cell legal entities

ORGANIZATION TYPE

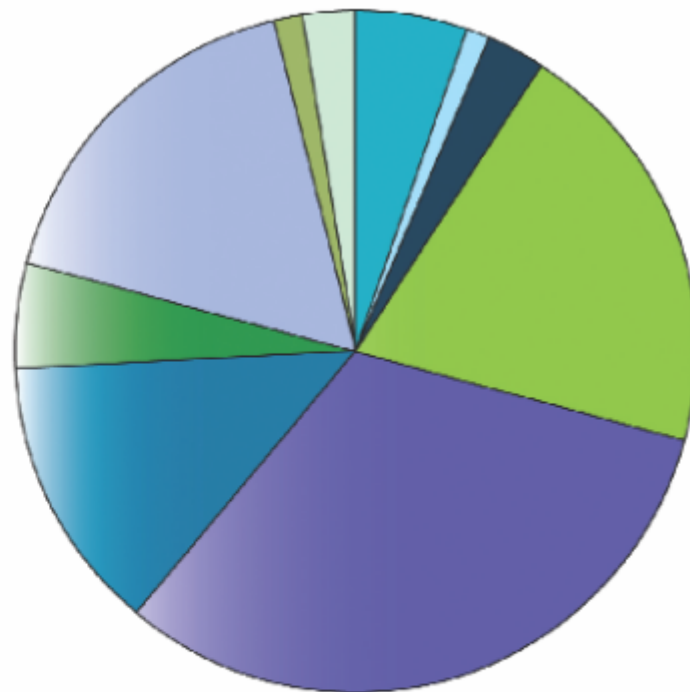


FIGURE 1

Top Ten Regenerative Medicine Products

Company	Product	Product Type	Therapeutic Area	Indication	Launch	2007 WW Revenue	'06-'07 Rev Growth
Medtronic	Infuse	Growth factor w/matrix	Bone	Spinal fractures, orofacial fractures, open tibial fractures	2002	~\$700ME	18%
LifeCell	Alloderm	Allogeneic acellular matrix	Skin	Skin replacement / hernia repair	1994	\$167.1M	40%
Genzyme	Carticel	Autologous cell based	Cartilage	Knee repair	1995	~\$88ME	~30%
Stryker	OP-1	Growth factor w/matrix	Bone	Humanitarian Device Exemption for spine fusion & long bone fractures	2005	~\$80ME	60%
RTI	Spinal Implants	Allogeneic Acellular matrix	Bone	Spinal fractures	1991	\$41.1M	17%
Organogenesis	Apligraf	Allogeneic Neonatal cells w/matrix	Skin	Diabetic skin ulcers	1998	~\$30ME	10%+
Advanced Biohealing	Dermagraft	Allogeneic Neonatal cells w/matrix	Skin	Diabetic skin ulcers	1997	~\$20ME	10%+
Integra Lifesciences	Various	Allogeneic acellular matrix	Skin	Skin repair / replacement	2001	~\$20ME each	25%
Osiris/ Nuvasive	Osteocell	Allogeneic cell based	Bone	Fracture repair	2005	\$15.2M	83%
Cytori	Celution	Autologous cell based	Soft Tissue (adipose)	Reconstructive Breast Surgery	2008 (ex-US)	~\$10-12M*	N/A

E=estimated from various sources

*=company projections for 208

Source: Company 10K Information, Frankel Group Analysis

FIGURE 2

Cell Based Business Models

Broad Product & Large Patient Base	<p>#1 Unachievable Model?</p> <ul style="list-style-type: none"> • Therapeutic benefit has to be extraordinary to compete with low cost therapies • Cost structure and manufacturing are not scalable • High risk of substitution & relatively low barriers to competitive entry 	<p>#3 Large Pharma Model</p> <ul style="list-style-type: none"> • Low COGS: Cost structure is scalable • Easily delivered to patients • Lower cost therapy could compete against biologics & possibly small molecules • High cost therapy that is "curative" • E.g., ESCs for diabetes
	<p>#2 Current State Model</p> <ul style="list-style-type: none"> • "Orphan" populations with no current efficacious therapy • Often "Salvage" therapies • Can be profitable but is not scalable • Creates strong relationships with caregivers and patients • E.g., Bone Marrow Transplant, Replicell, Carticel, Cytori 	<p>#4 Specialty Biotech Model</p> <ul style="list-style-type: none"> • Efficacious therapy that targets populations with high unmet needs • Moderate COGS for product (can include device component) • Cost structure can possibly be spread across multiple diseases (e.g., Osiris)
	Autologous	Allogeneic

Source: Frankel Group Analysis



FIGURE 3

Today's Autologous Business Models

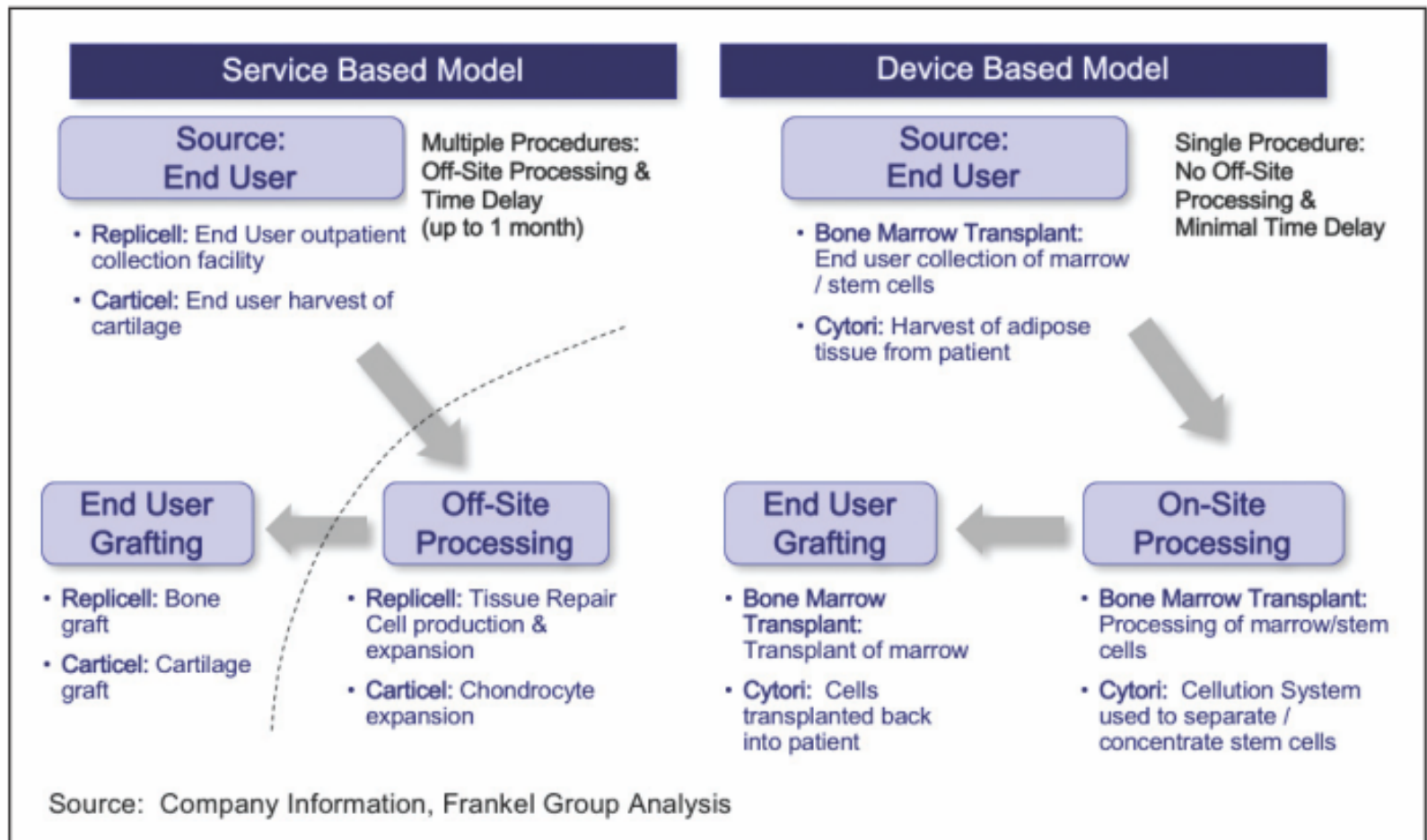
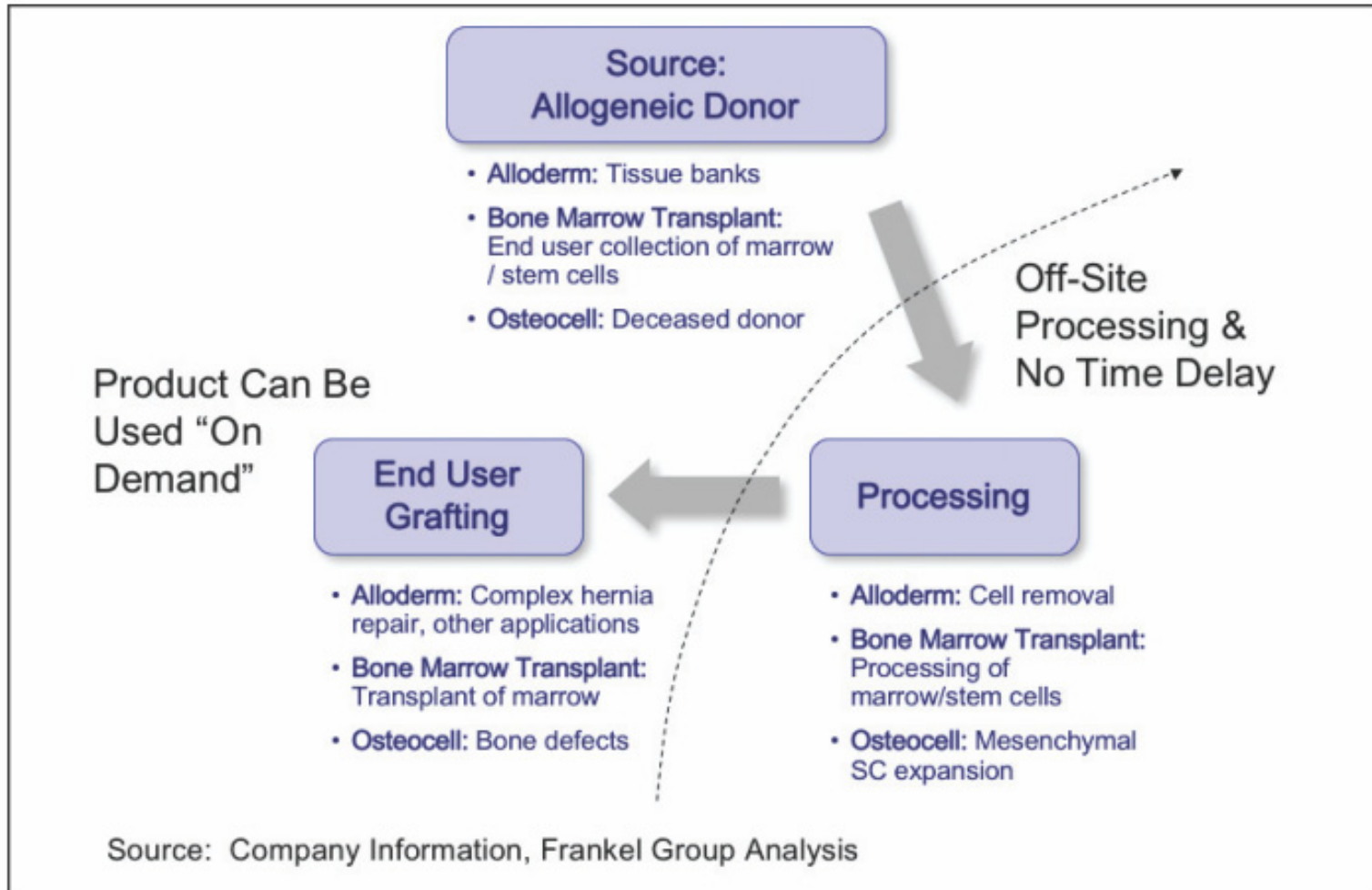


FIGURE 4

Today's Allogeneic Business Model – Speciality Pharma Model



Success is not final, failure is not fatal: it is the courage to continue that counts.

Winston Churchill

