The accuracy of general practitioner workforce projections

Backtesting the Dutch GP-supply model

Presented by Lud van der Velden

Based on Van Greuningen et al.
Human Resources for Health 2013, 11:31

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Main question

- How accurate is the Dutch model for predicting the supply of GPs?

Outline of the presentation

- The Dutch manpowerplanning model
- The Dutch supply model
  - headcount only
- Data analysis for the supply model
- Data requirement for the supply model
- Backtesting the supply model
- Results
- Conclusions

Available supply in year T

Development available supply until T+X

Available supply in year T+X

Present

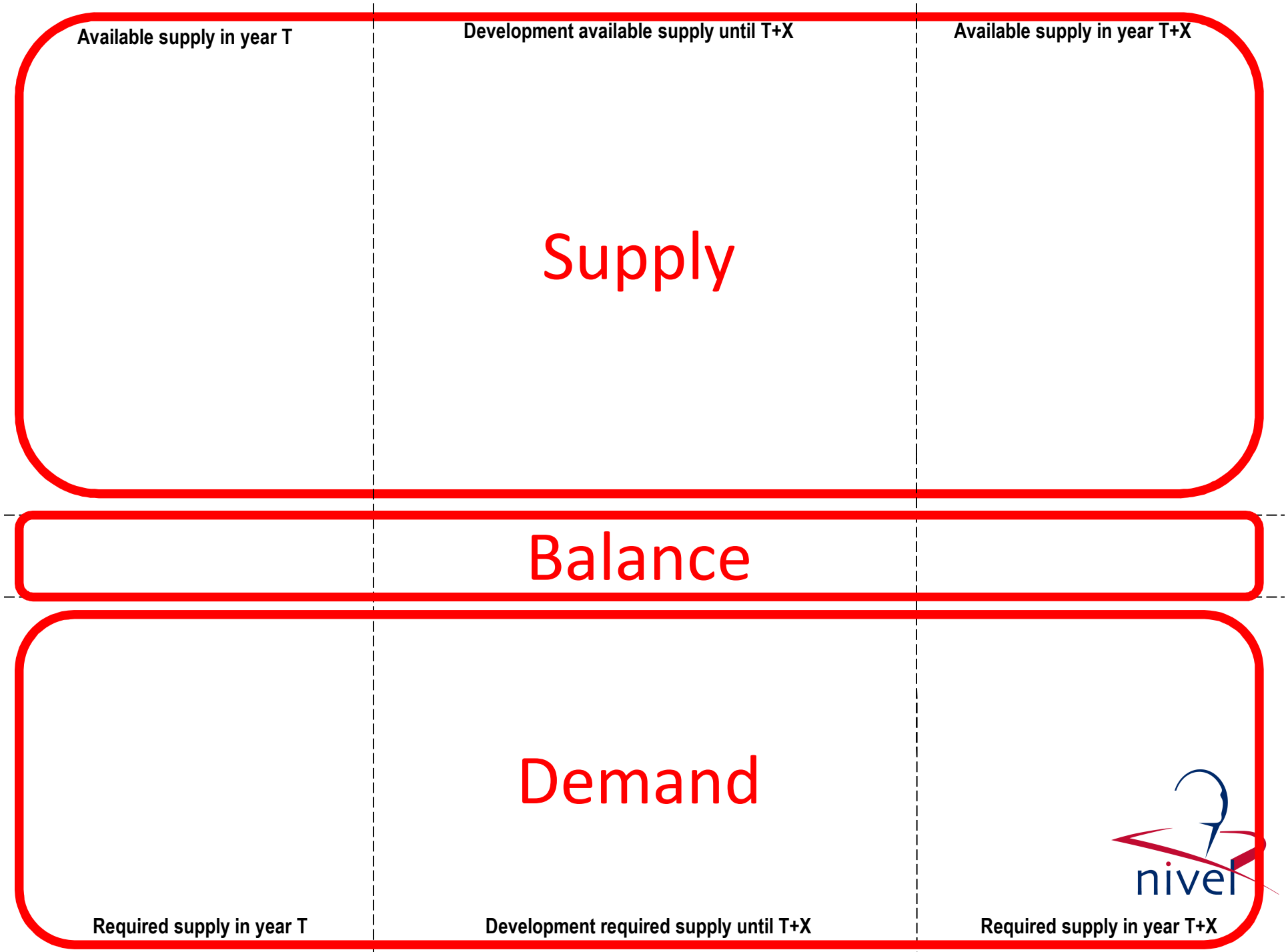
In between

Future

Required supply in year T

Development required supply until T+X

Required supply in year T+X


Available supply in year T
Development available supply until T+X
Available supply in year T+X
Supply
Balance
Demand
Required supply in year T
Development required supply until T+X
Required supply in year T+X
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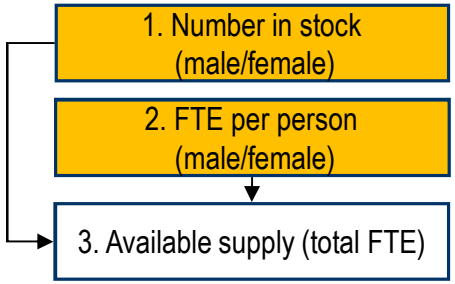
Available supply in year T	Development available supply until T+X	Available supply in year T+X
1. Number in stock (male/female)		
Required supply in year T	Development required supply until T+X	Required supply in year T+X

Available supply in year T	Development available supply until T+X	Available supply in year T+X
1. Number in stock (male/female) 2. FTE per person (male/female)		
Required supply in year T	Development required supply until T+X	Required supply in year T+X

Available supply in year T

Development available supply until T+X

Available supply in year T+X



Required supply in year T

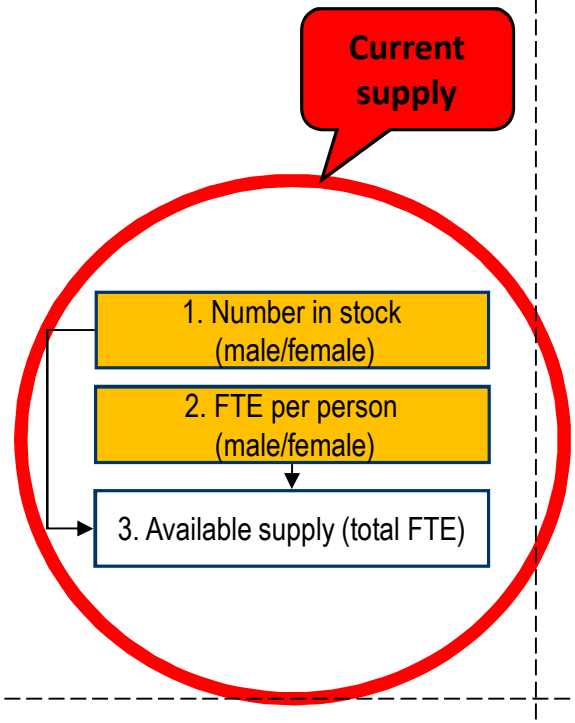
Development required supply until T+X

Required supply in year T+X

Available supply in year T

Development available supply until T+X

Available supply in year T+X



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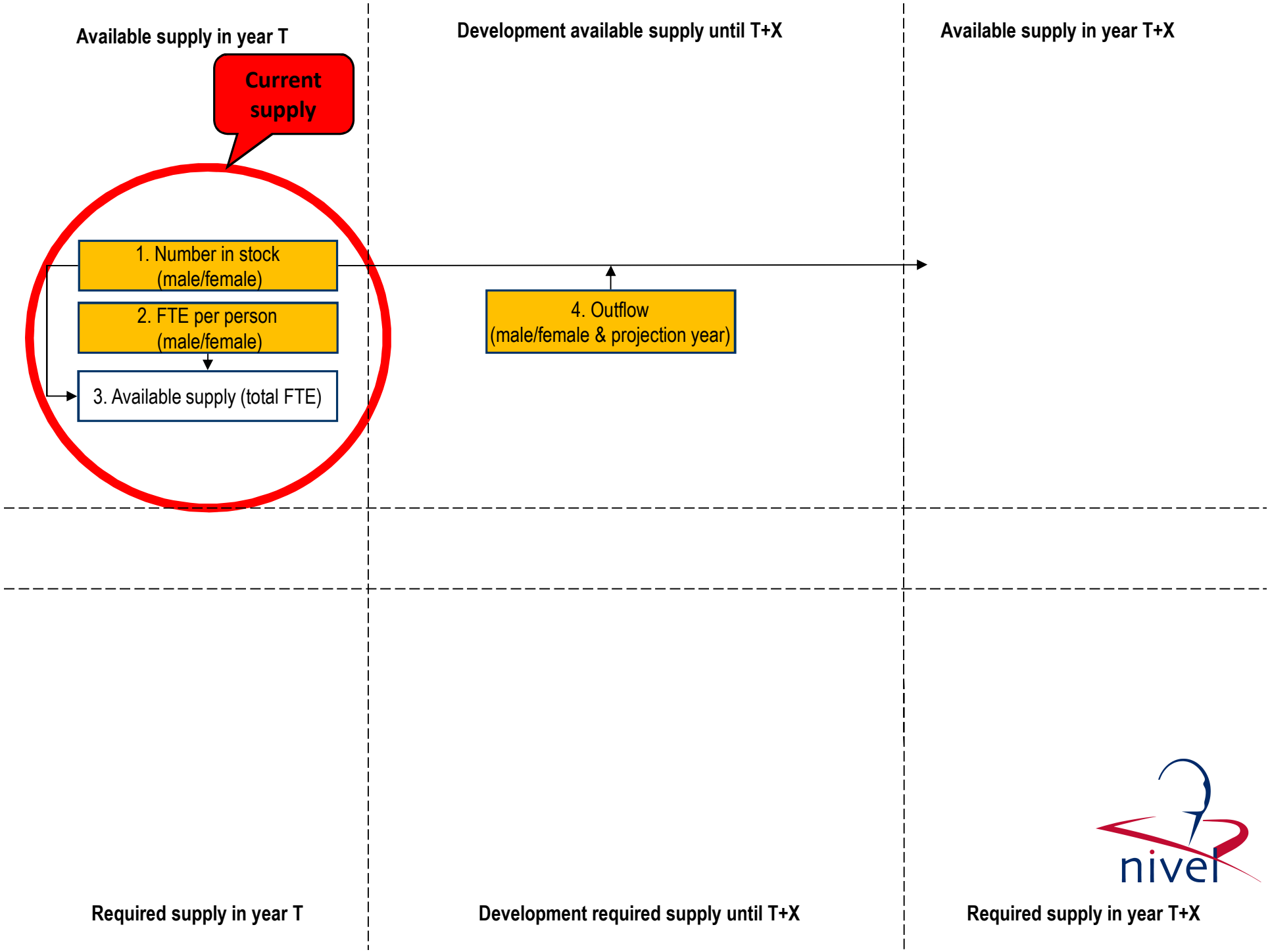
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4. Outflow (male/female & projection year)
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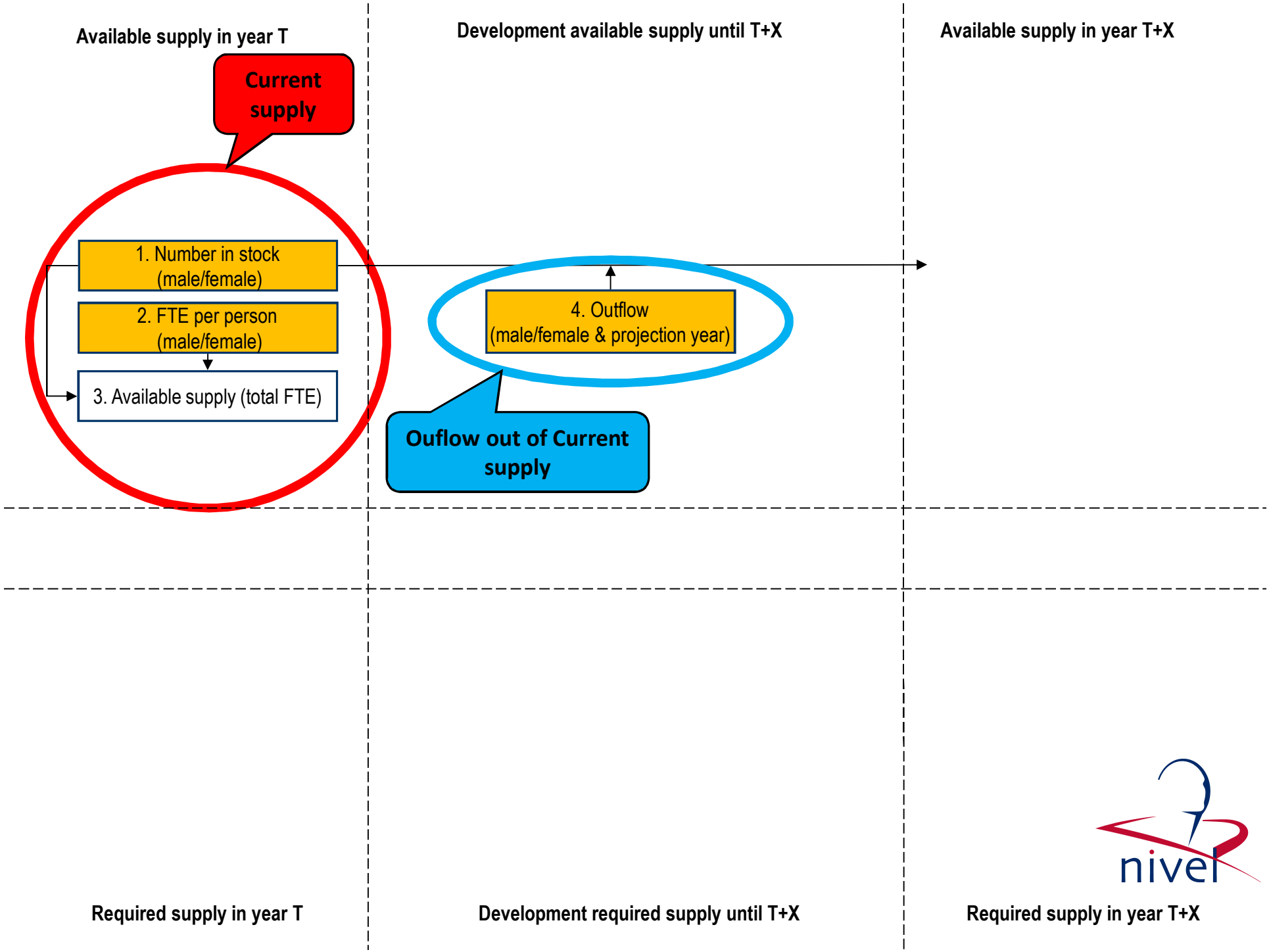
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Required supply in year T
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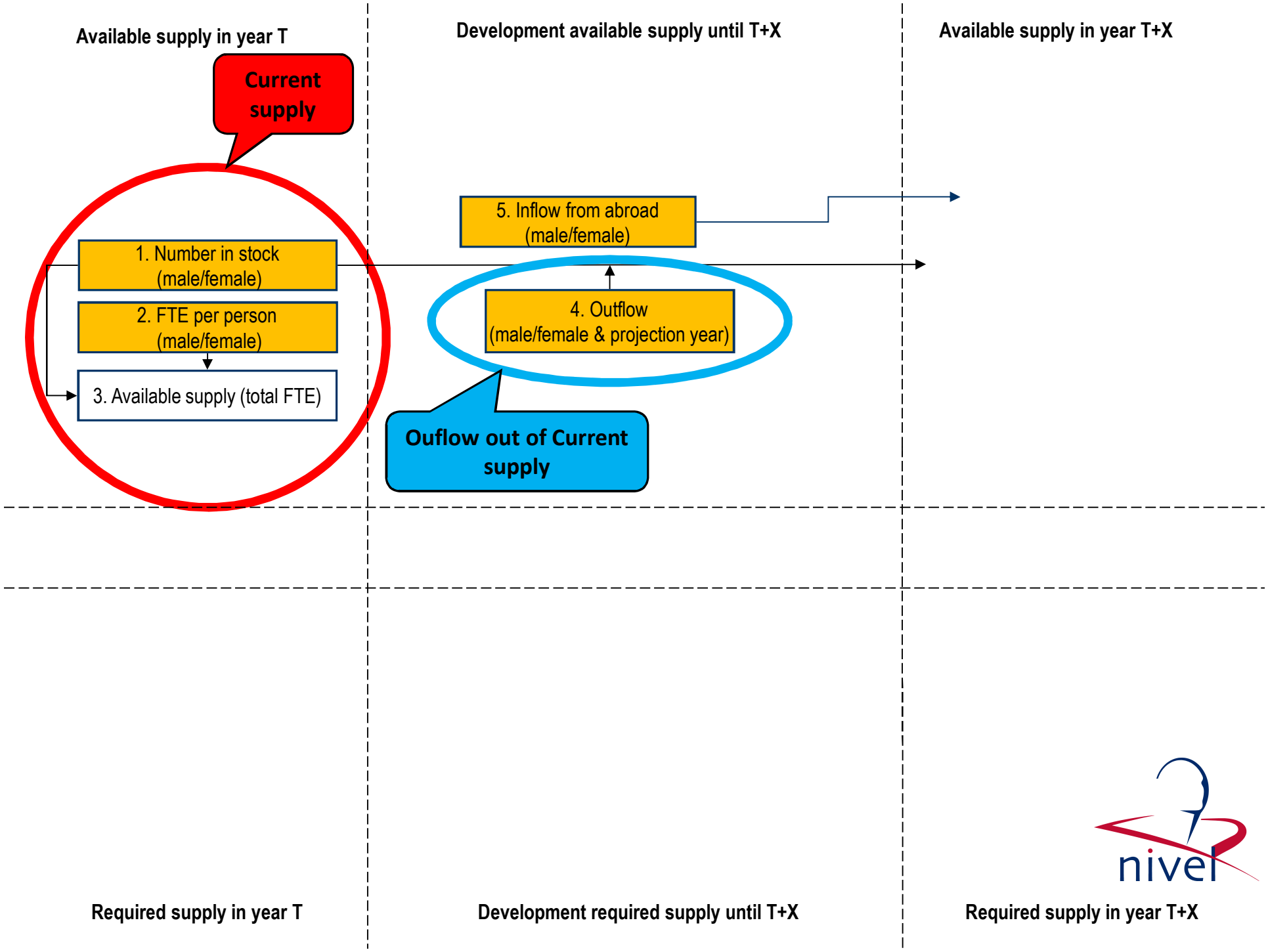
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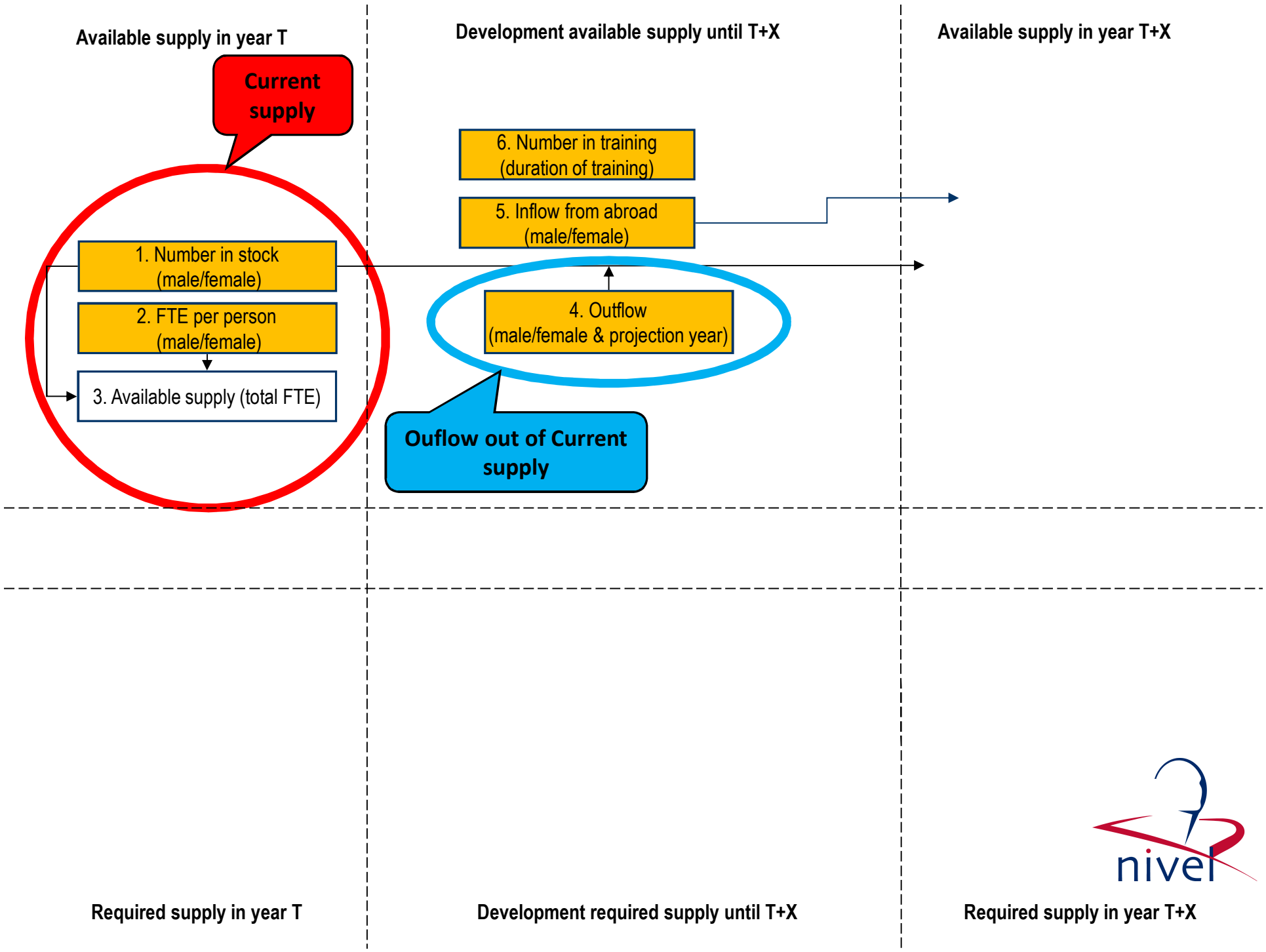
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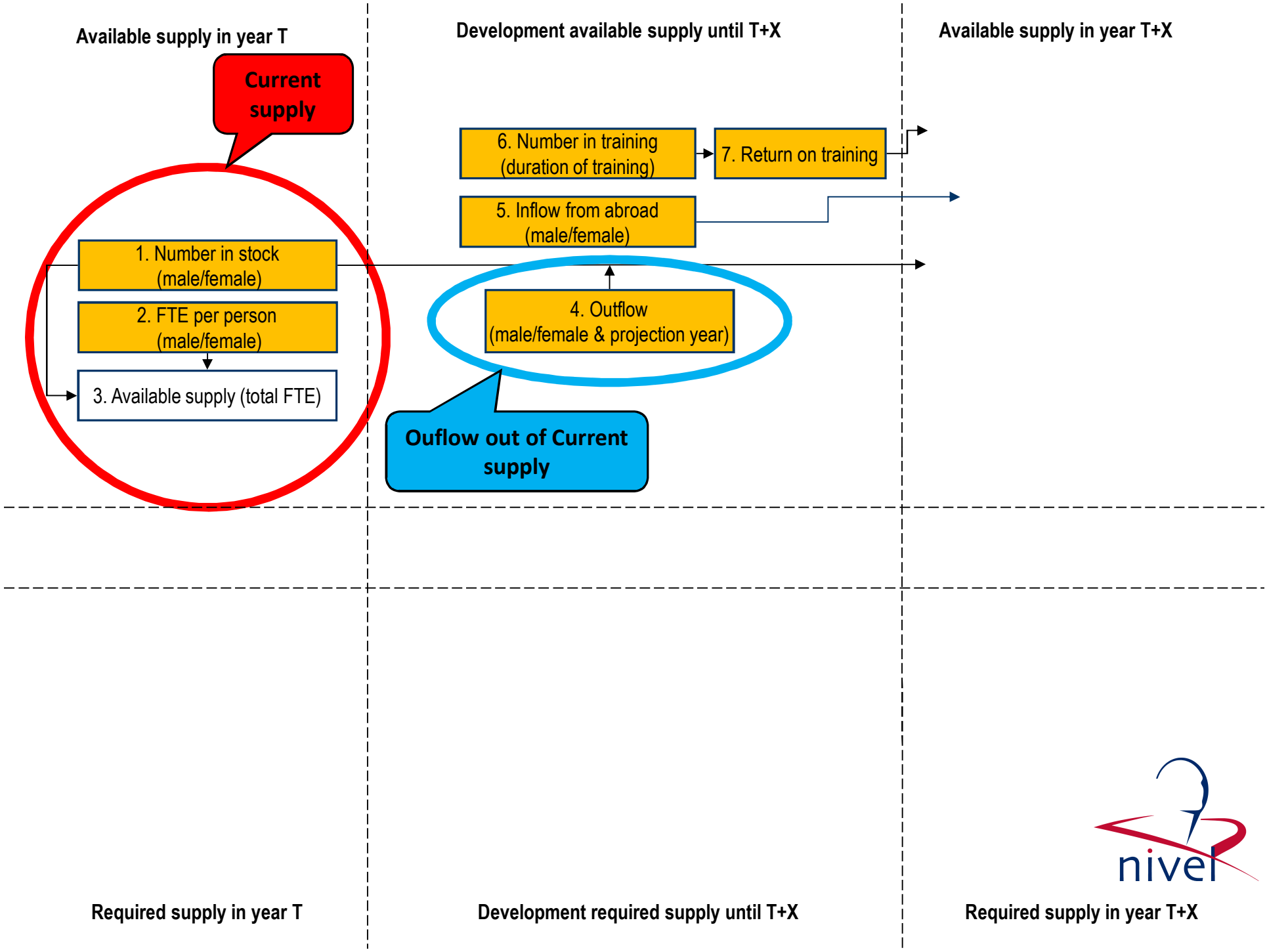
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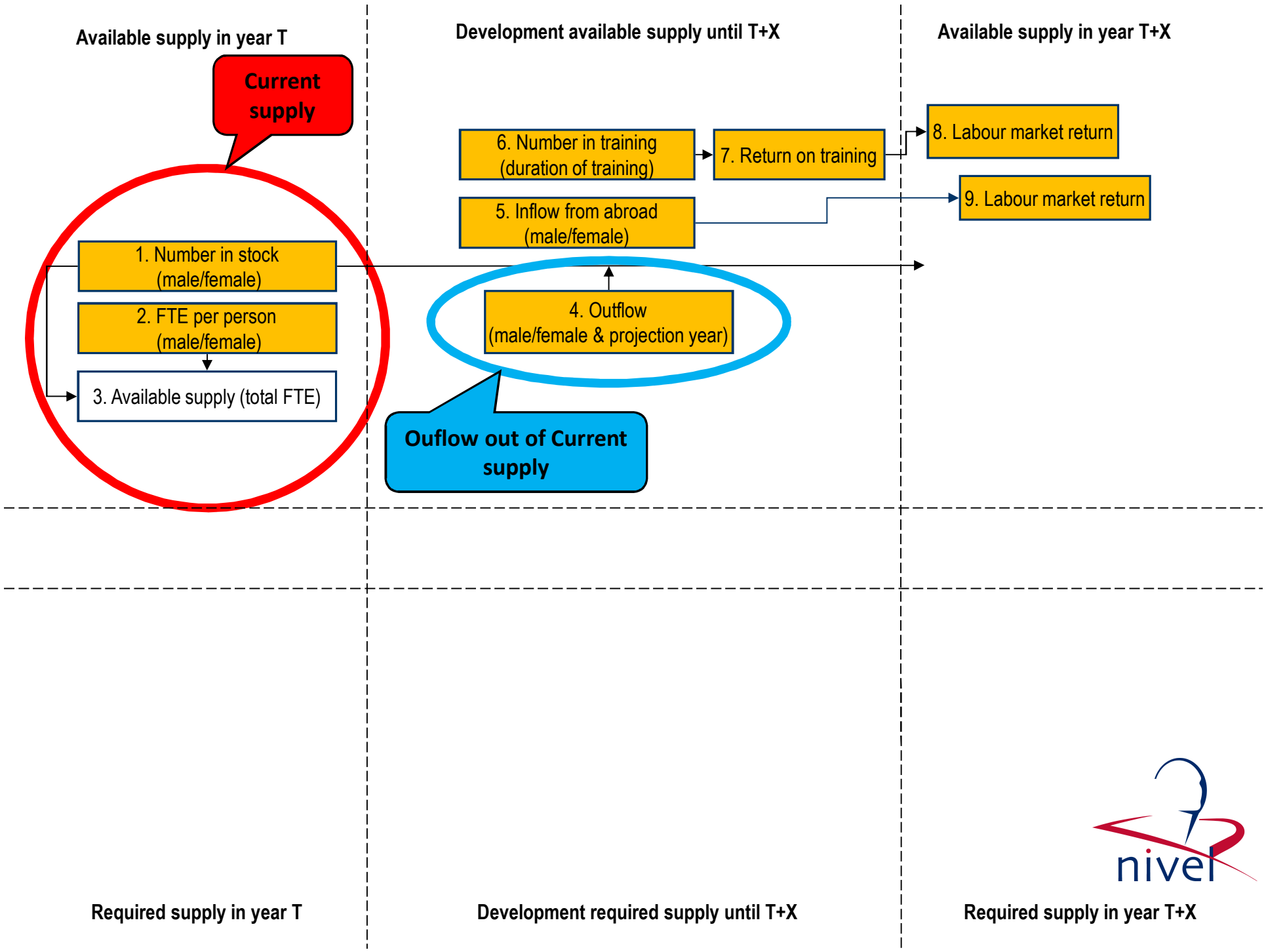
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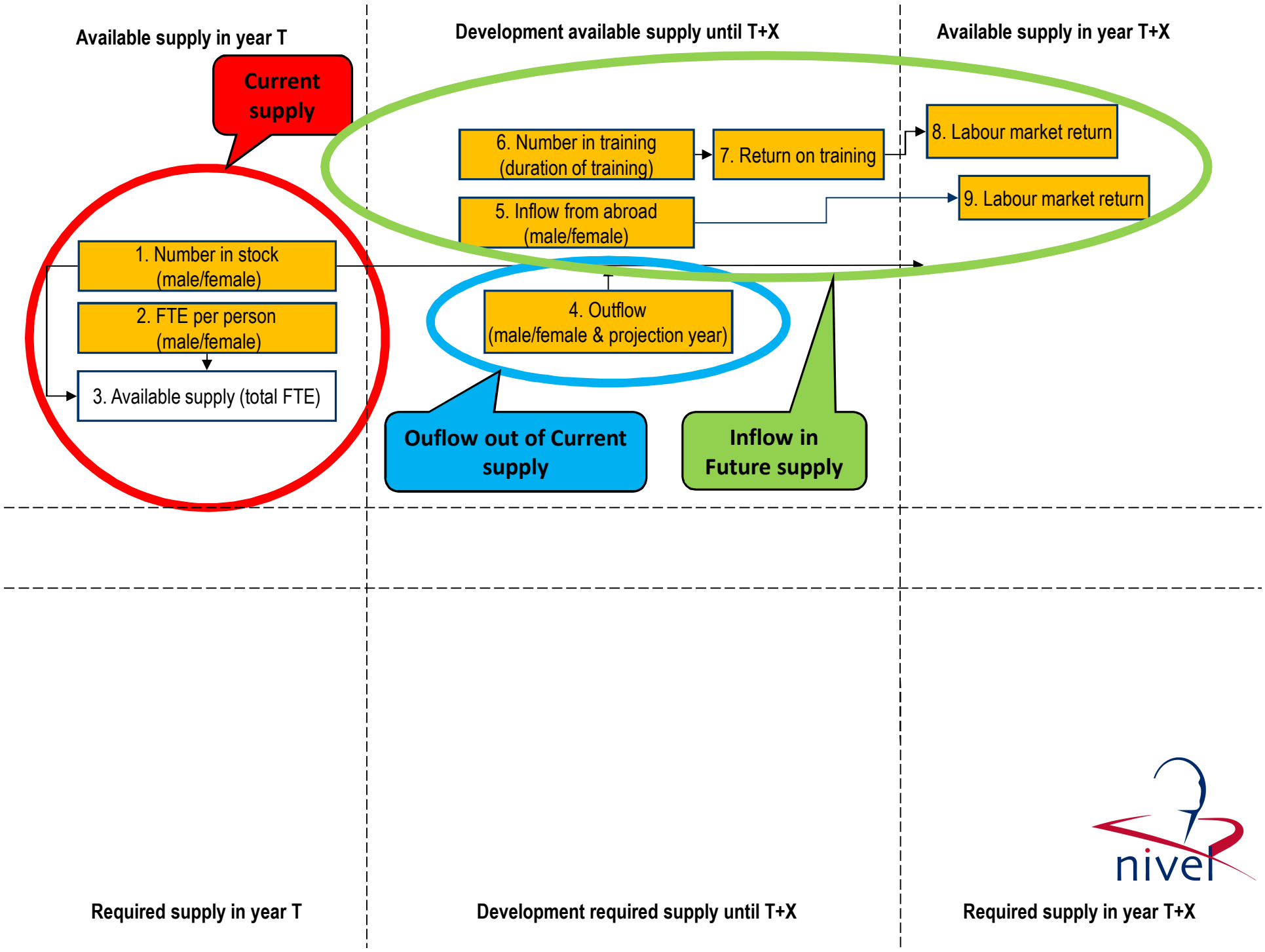
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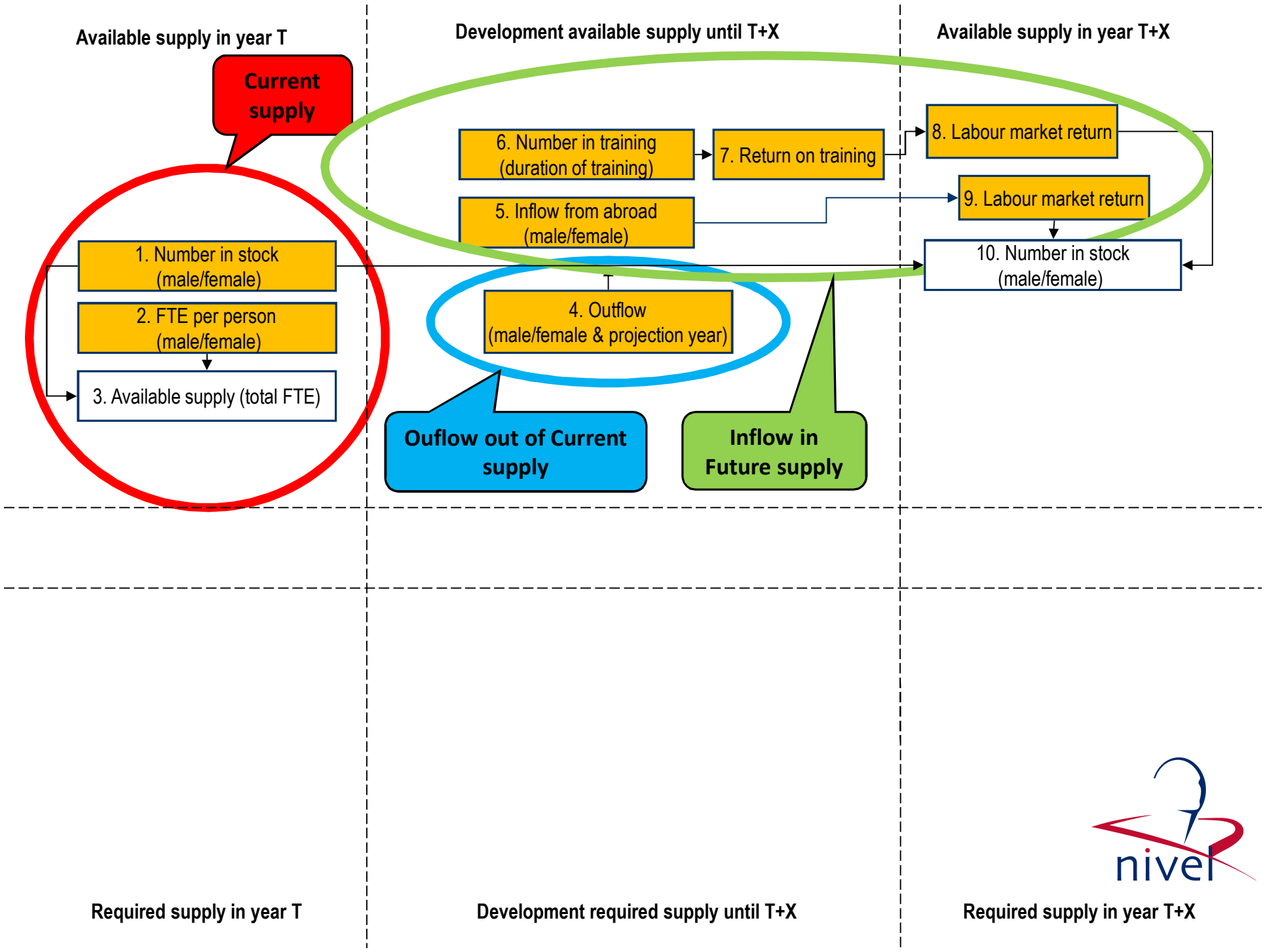
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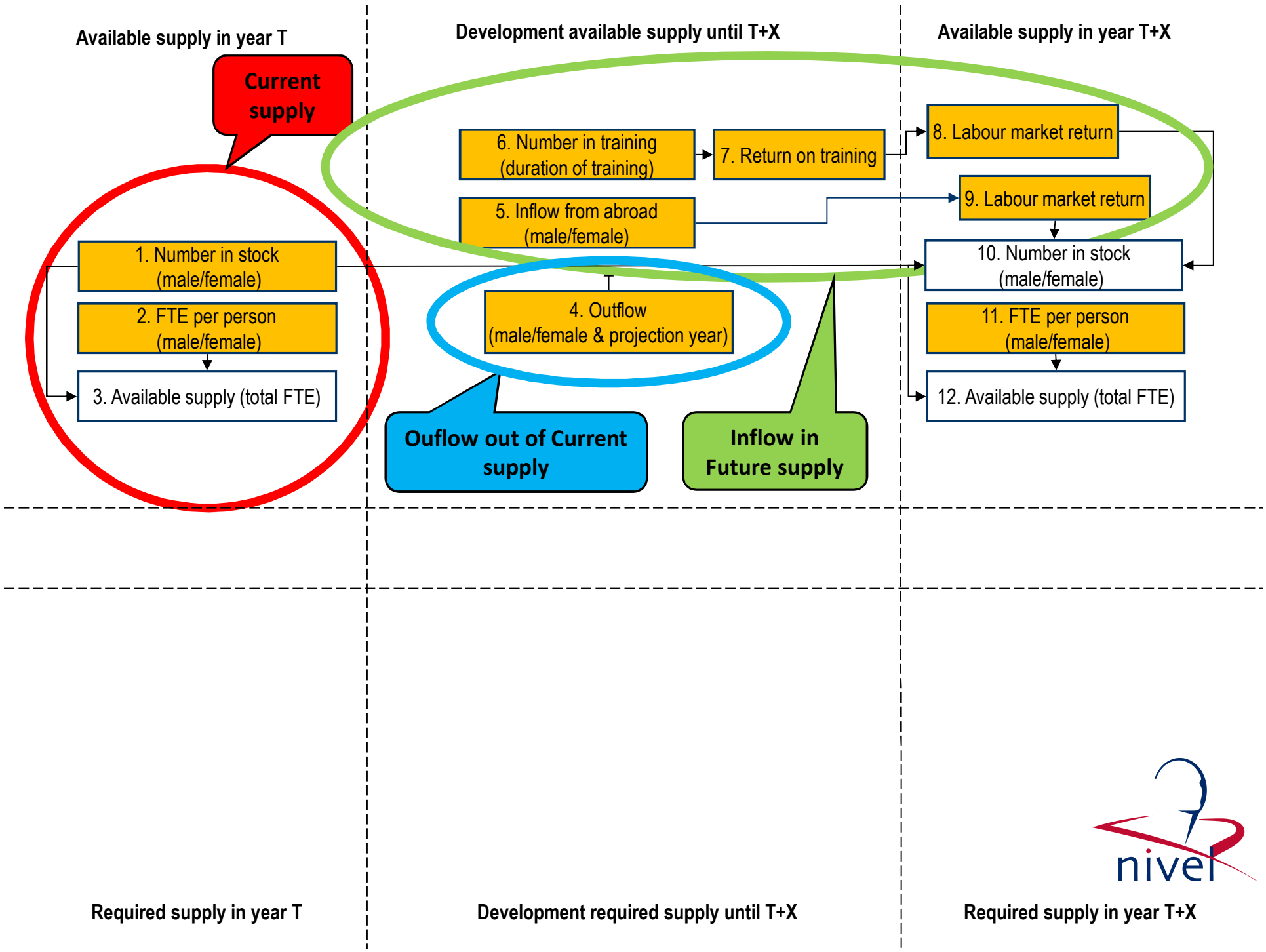
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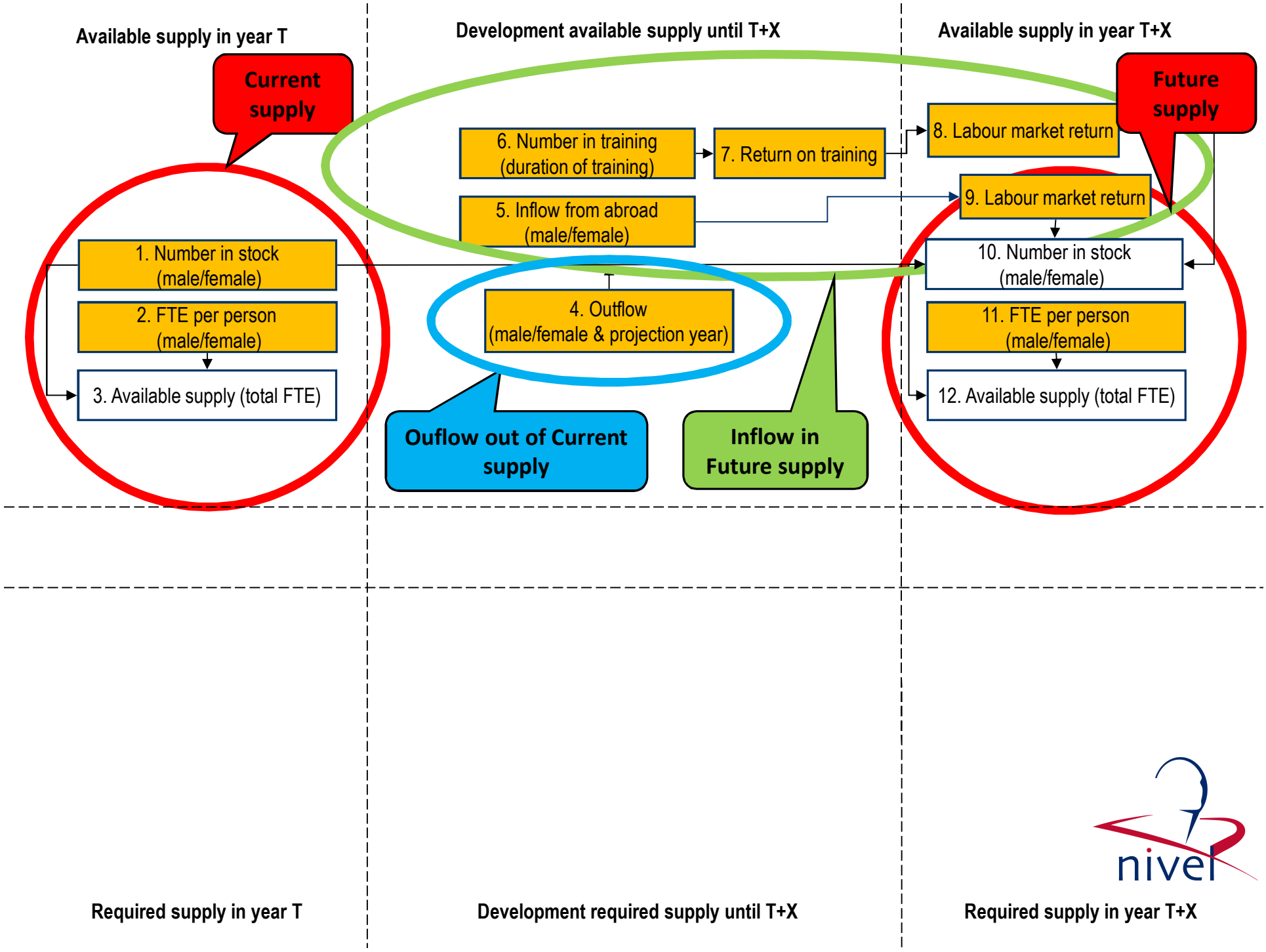
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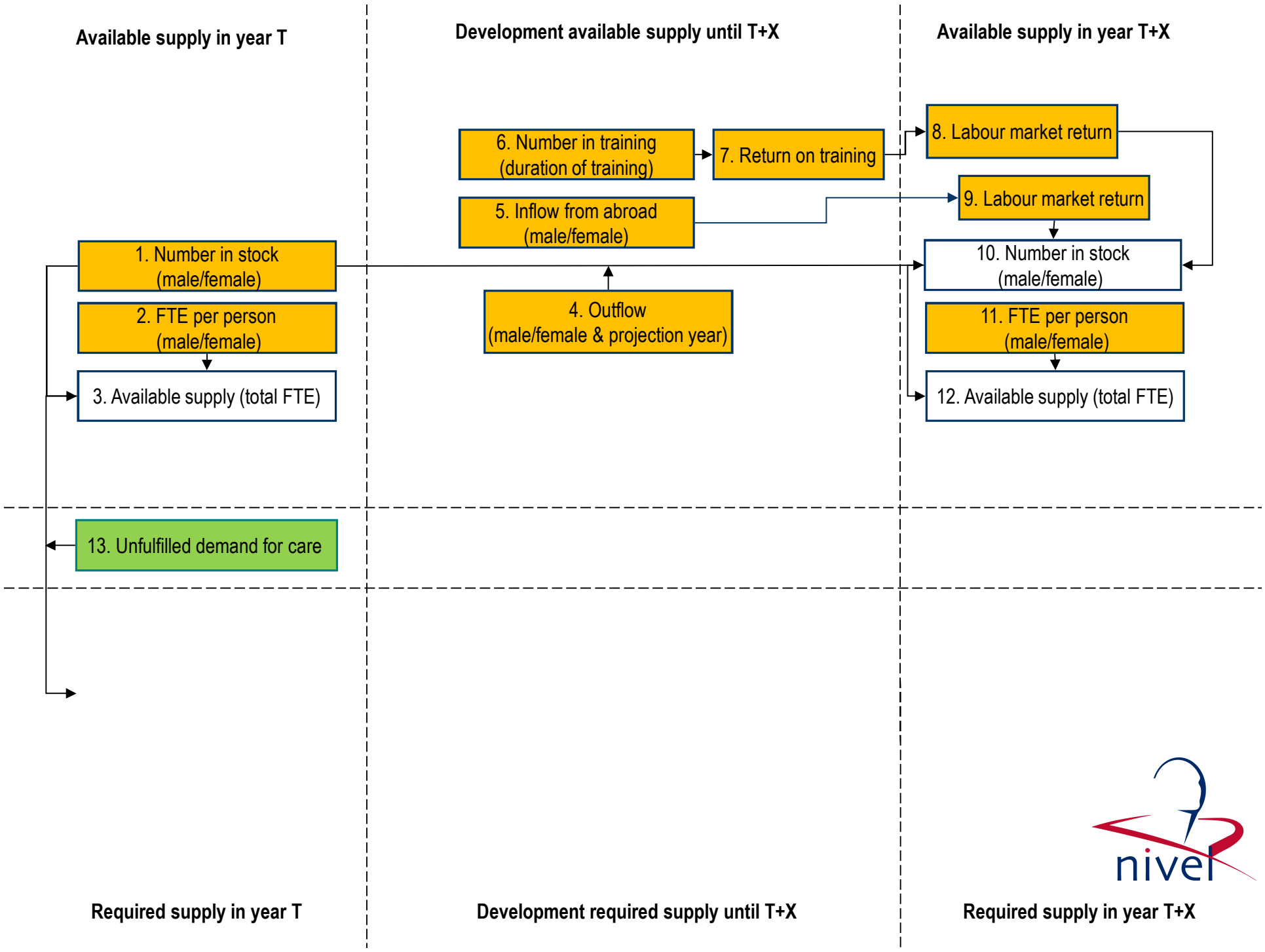
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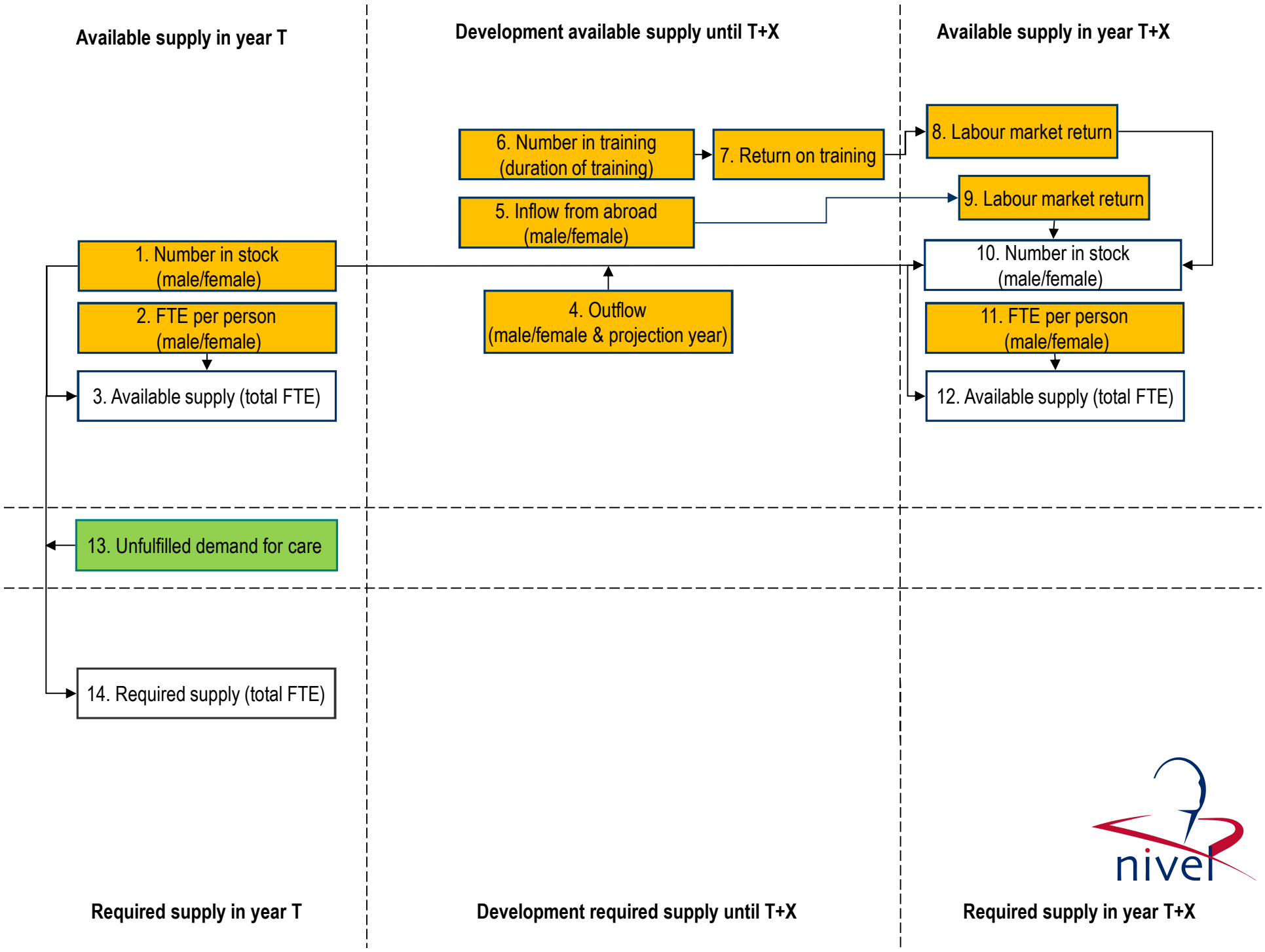
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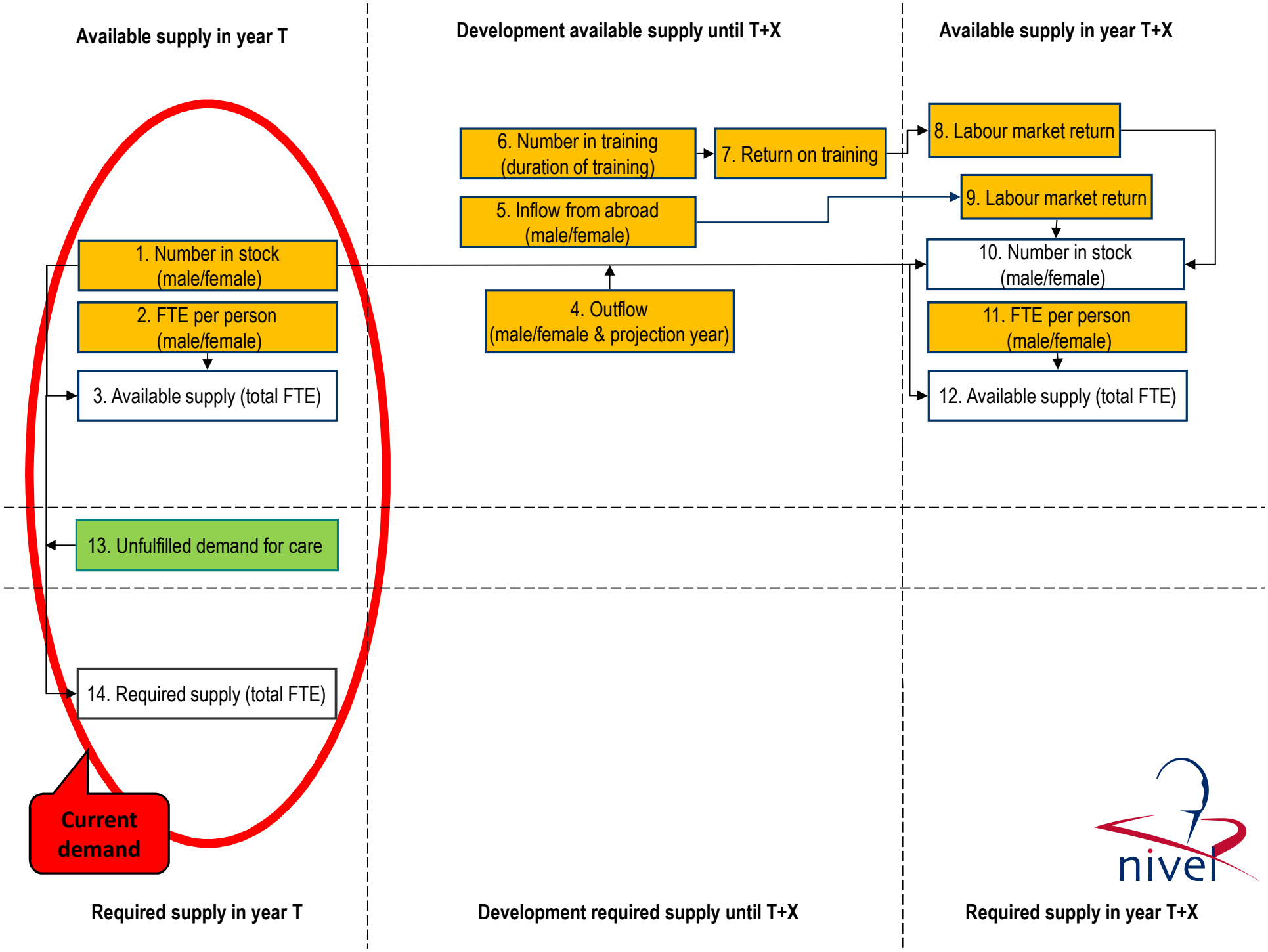
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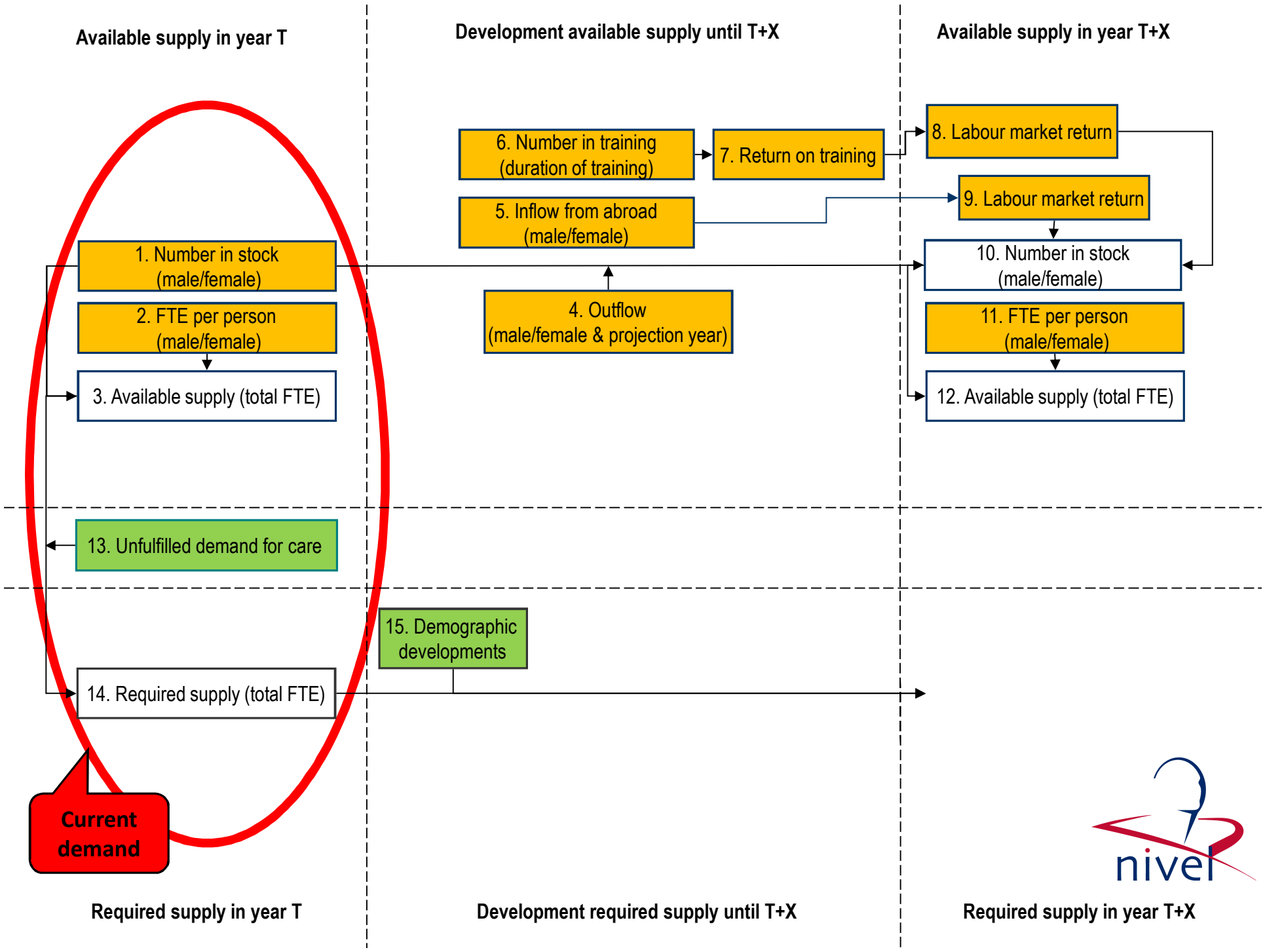
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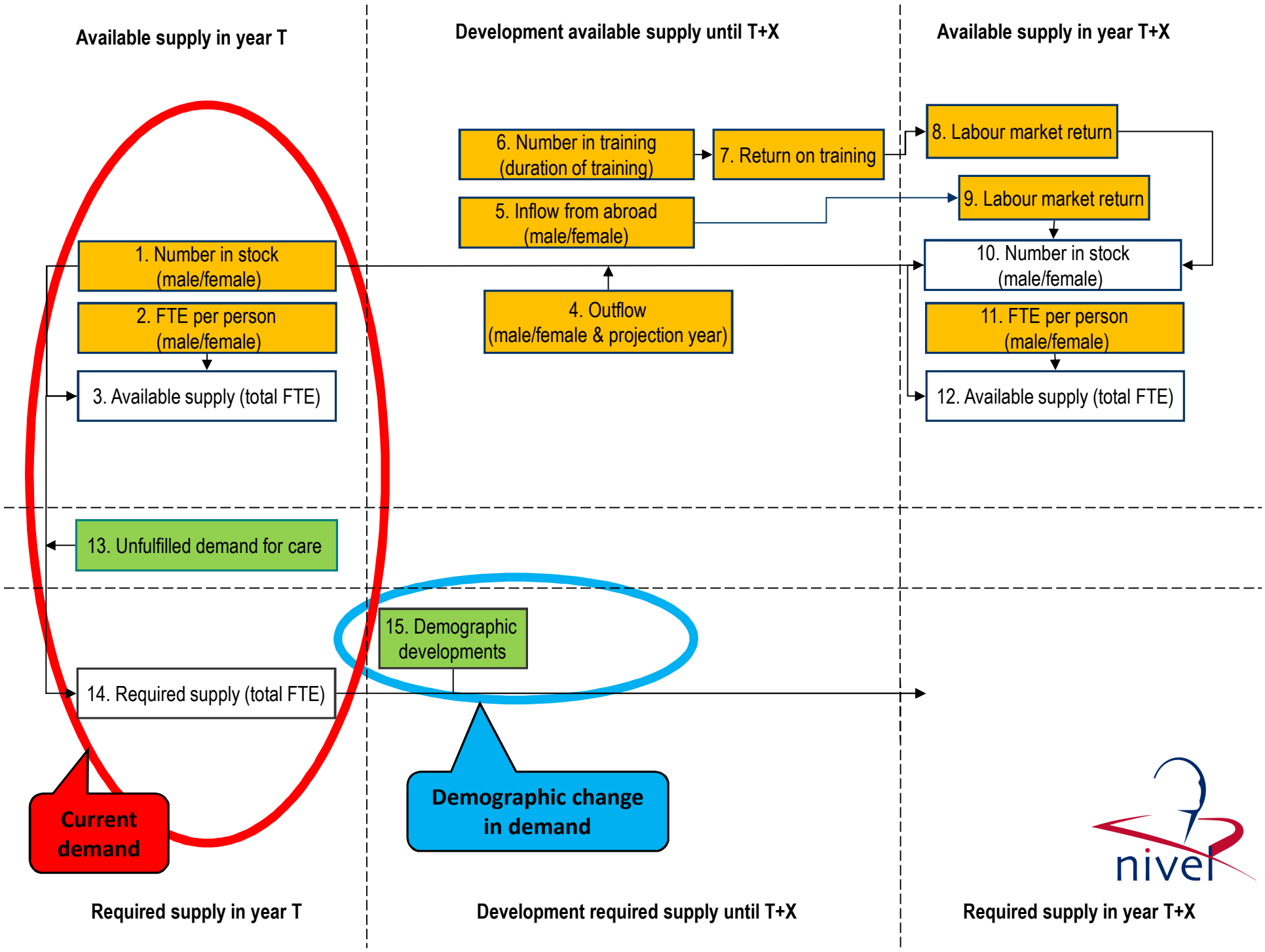
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Current demand
Demographic change in demand
Required supply in year T
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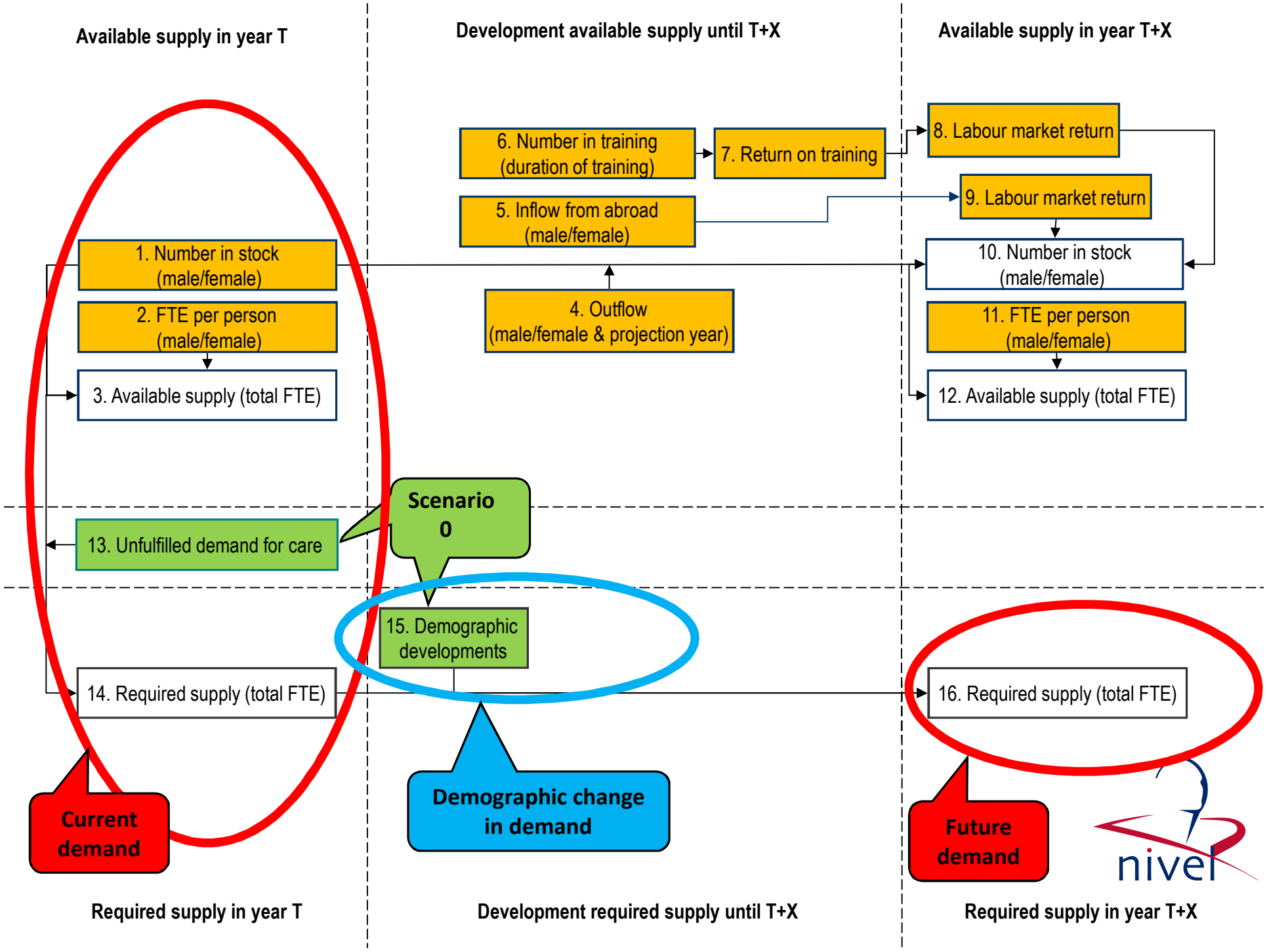
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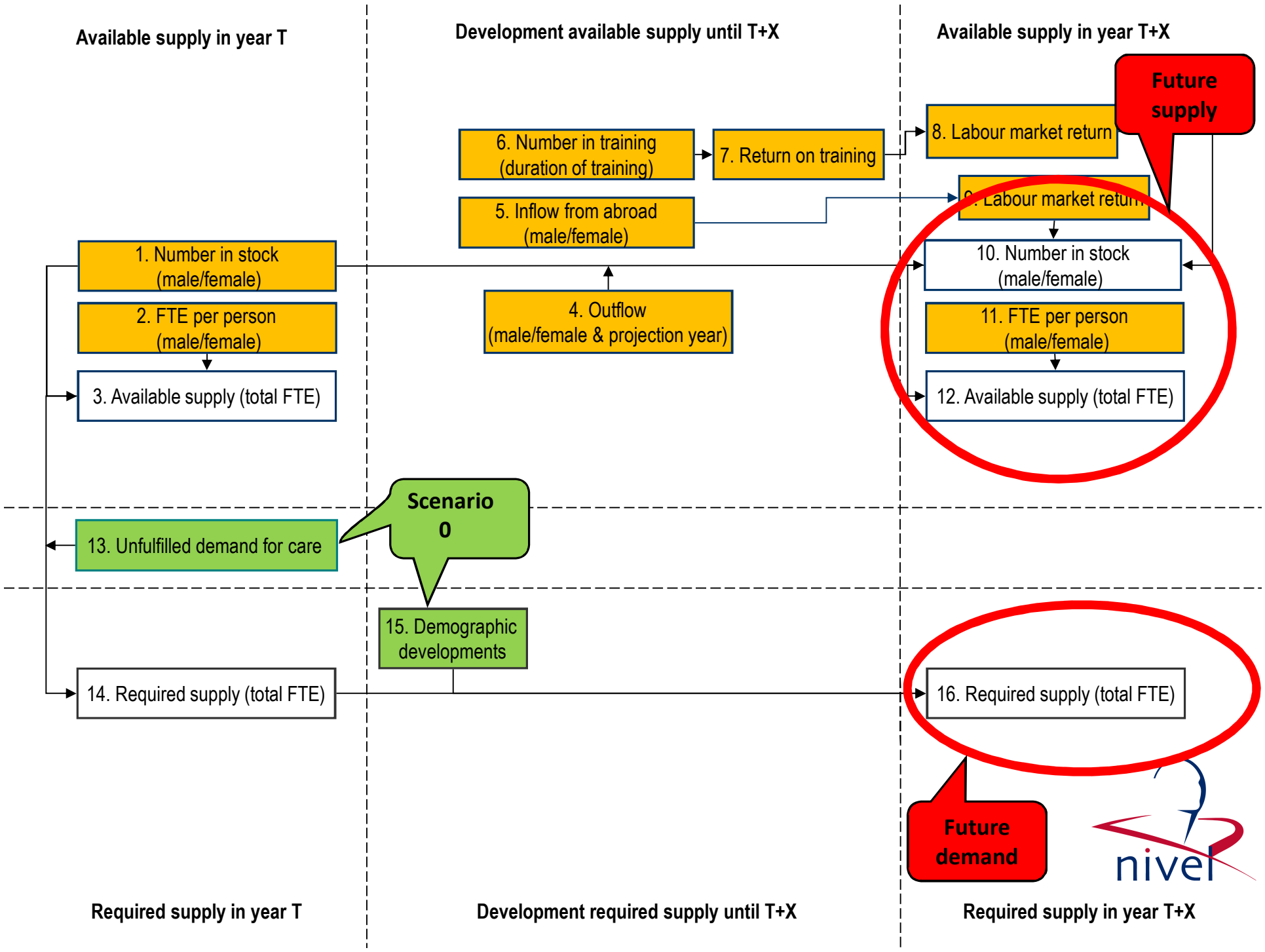
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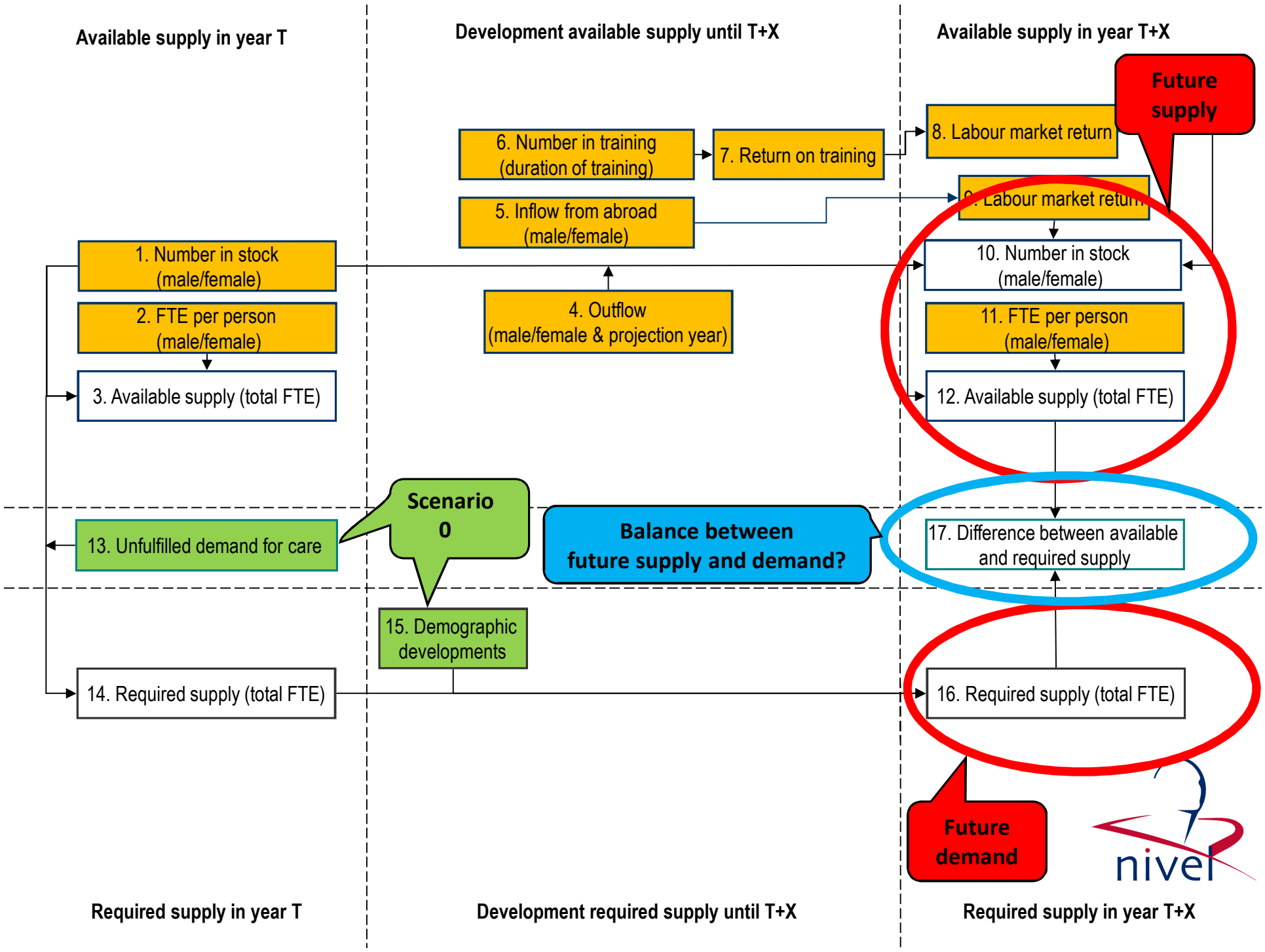
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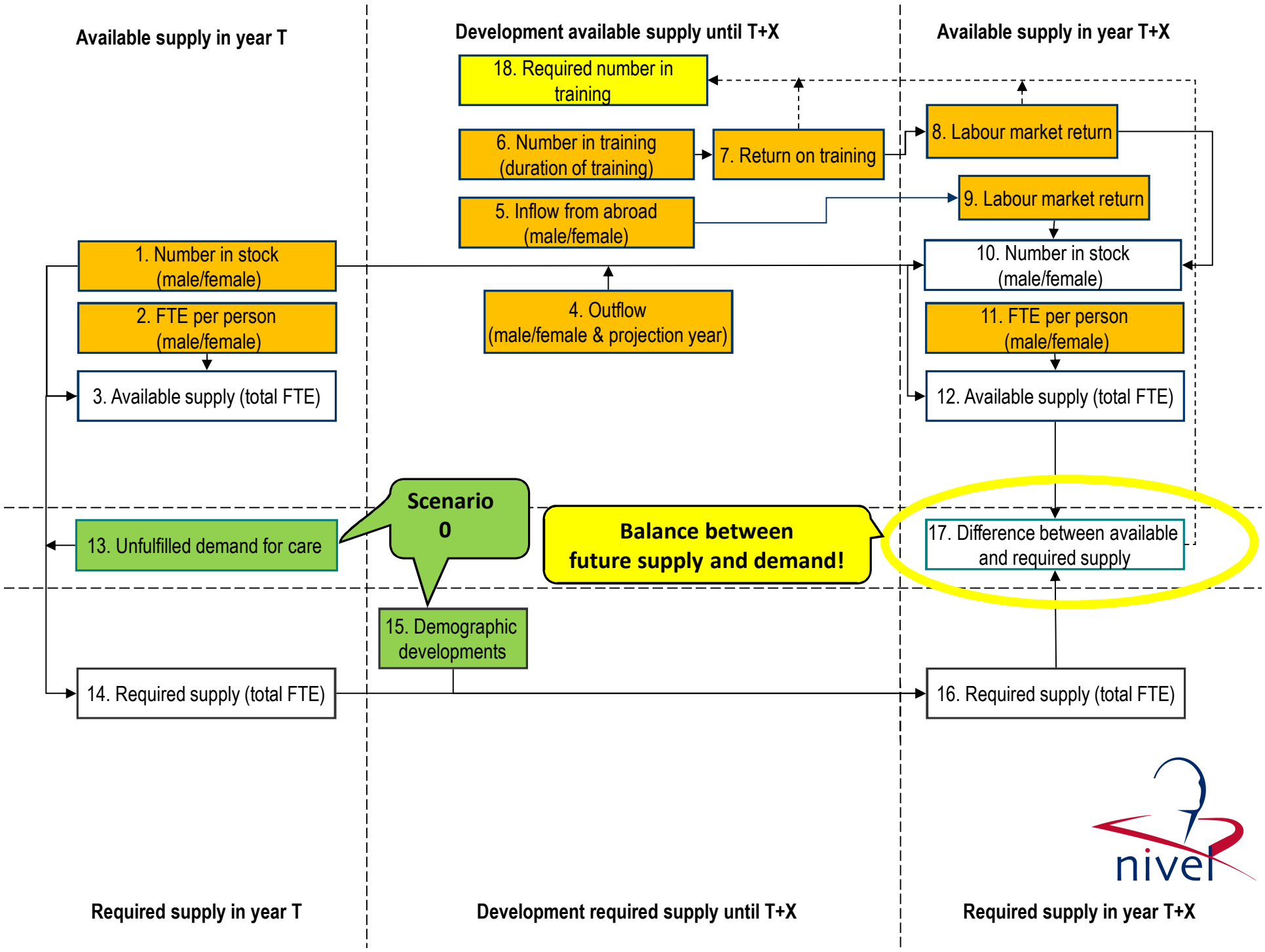
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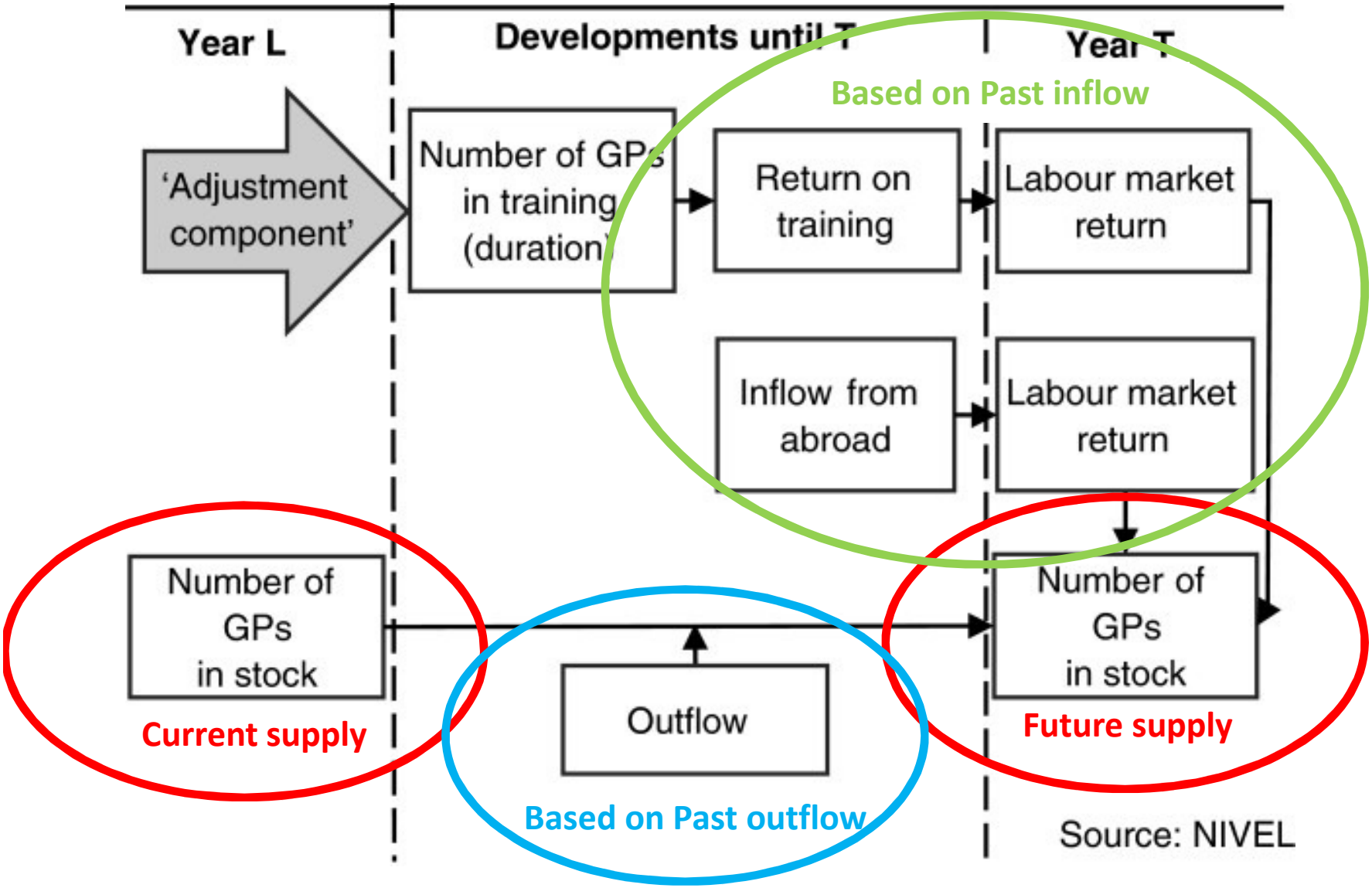
The Dutch supply model: Headcount



Methods for analysing in- and outflow

- “Simple” descriptive statistics
  - “Table” analysis with a minimum amount of data requirements
- “Complex” inferential statistics
  - Survival analysis
  - Event History analysis
  - Multilevel analysis
- The “Simple” method suits our needs far better than the “Complex” methods

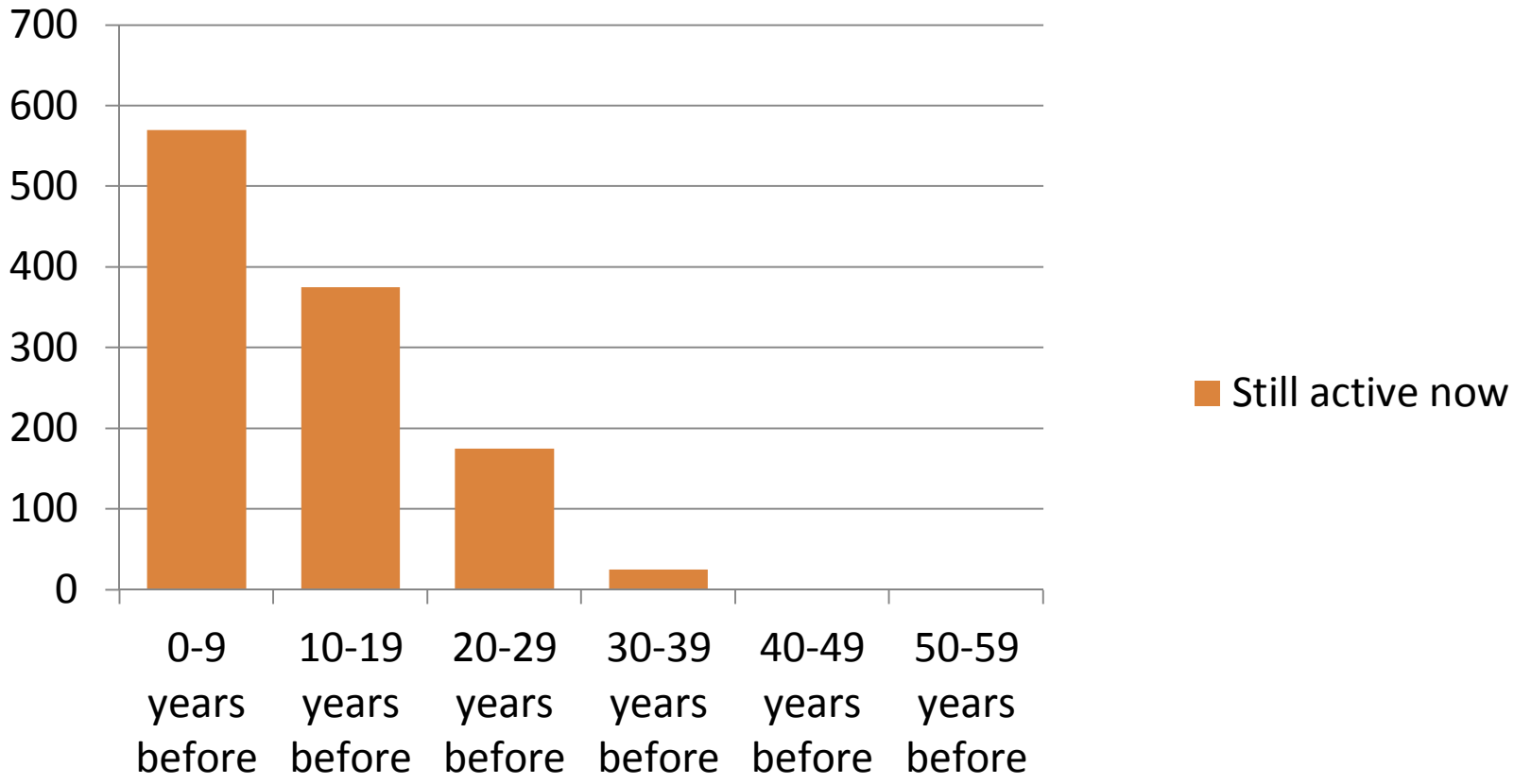
Data requirements for the “Simple” in- and outflow analysis

- “Current” number of professionally active professionals by gender and 5-year registration period

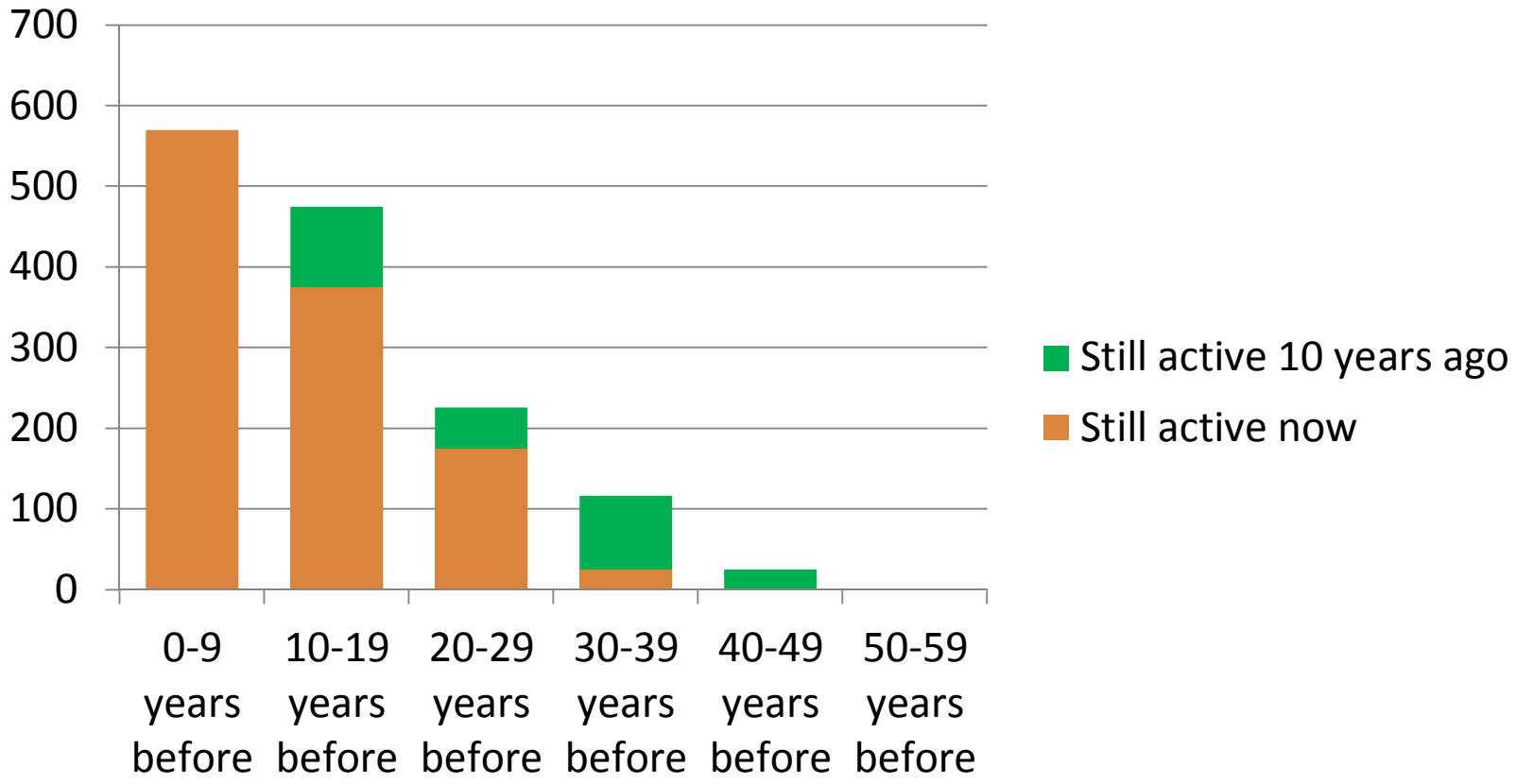
- “Historical” number of professionally active professionals by gender and 5-year registration period, 5, 10 and 15 years ago
  - For calculating the % still active after 5, 10 or 15 years

- For simplicity: a 10-year registration period is now shown
  - With fictional data

“Current” number of active professionals by registration period



“Current” and “Historical” number of active professionals by registration period



Professionaly active (number of active professionals, derived from current labour statistics)

Recognition period	"Now" Male	Female	Total	
0-9 years before	190	380	570	"current" number of active professinals who were recognised 0-9 years before "now"
10-19 years before	150	225	375	"current" number of active professinals who were recognised 10-19 years before "now"
20-29 years before	100	75	175	"current" number of active professinals who were recognised 20-29 years before "now"
30-39 years before	15	10	25	"current" number of active professinals who were recognised 30-39 years before "now"
40-49 years before	0	0	0	"current" number of active professinals who were recognised 40-49 years before "now"
Total	455	690	1.145	"current" number of active professinals who were recognised 0-49 years before "now"

Data for
Outflowmodel using current % still active after 10 years

Pr. Act. 10 y. before (number of ever recognised professionals, derived from historical labour statistics, including persons not recognised anymore)

Rec.per. 10 y. before	"10 years ago" Male	Female	Total	
not yet recognised	200	400	600	"historical" number of active professinals who were recognised 0-9 years before "now"
0-9 years before	190	285	475	"historical" number of active professinals who were recognised 10-19 years before "now"
10-19 years before	113	113	226	"historical" number of active professinals who were recognised 20-29 years before "now"
20-29 years before	67	50	117	"historical" number of active professinals who were recognised 30-39 years before "now"
30-39 years before	15	10	25	"historical" number of active professinals who were recognised 40-49 years before "now"
40-49 years before	0	0	0	"historical" number of active professinals who were recognised 50-59 years before "now"
Total	385	458	843	"historical" number of active professinals who were recognised 10-59 years before "now"

Professionaly active (number of active professionals, derived from current labour statistics)

"Now"

Recognition period	Male	Female	Total
0-9 years before	190	380	570
10-19 years before	150	225	375
20-29 years before	100	75	175
30-39 years before	15	10	25
40-49 years before	0	0	0
Total	455	690	1.145

% Still act. after 10 y. (% still active per year, derived from current and historical labour statistics)

"Now versus 10 year ago"

Rec.per. 10 y. before	Male	Female	Total	
not yet recognised	95,0%	95,0%	95,0%	chance of being active "now" for professinals who were recognised 0-9 years before "now" ("labour market return after 10 years")
0-9 years before	78,9%	78,9%	78,9%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 10-19 years before "now"
10-19 years before	88,5%	66,4%	77,4%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 20-29 years before "now"
20-29 years before	22,4%	20,0%	21,4%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 30-39 years before "now"
30-39 years before	0,0%	0,0%	0,0%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 40-49 years before "now"
40-49 years before	0,0%	0,0%	0,0%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 50-59 years before "now"
Total	68,8%	67,7%	68,2%	

Pr. Act. 10 y. before (number of ever recognised professionals, derived from historical labour statistics, including persons not recognised anymore)

"10 years ago"

Rec.per. 10 y. before	Male	Female	Total
not yet recognised	200	400	600
0-9 years before	190	285	475
10-19 years before	113	113	226
20-29 years before	67	50	117
30-39 years before	15	10	25
40-49 years before	0	0	0
Total	385	458	843

Data and calculations of chances of being still active for Outflowmodel using current % still active after 10 years

Professionaly active (number of active professionals per year, derived from current labour statistics and assuming constant future % activity per age/sex group)

"Now"

Recognition period	Male	Female	Total
0-9 years before	190	380	570
10-19 years before	150	225	375
20-29 years before	100	75	175
30-39 years before	15	10	25
40-49 years before	0	0	0
Total	455	690	1.145

"In 10 years"

Then	Male	Female	Total	Outflow
10-19	150	300	450	-21,1%
20-29	133	149	282	-24,8%
30-39	22	15	37	-78,6%
40-49	0	0	0	-100,0%
50-59	0	0	0	x
	305	464	769	-32,8%
	-32,9%	-32,7%		

"In 20 years"

Then	Male	Female	Total	Outflow
20-29	133	199	332	-41,8%
30-39	30	30	60	-84,1%
40-49	0	0	0	-100,0%
50-59	0	0	0	-100,0%
60-69	0	0	0	x
	162	229	391	-65,8%
	-64,3%	-66,8%		

% Still act. after 10 y. (% still active per year, derived from current labour statistics and assuming constant future % activity per age/sex group)

"Now versus 10 year ago"

Rec.per. 10 y. before	Male	Female	Total	
not yet recognised	95,0%	95,0%	95,0%	chance of being active "now" for professinals who were recognised 0-9 years before "now" ("labour market return after 10 years")
0-9 years before	78,9%	78,9%	78,9%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 10-19 years before "now"
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30-39 years before	0,0%	0,0%	0,0%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 40-49 years before "now"
40-49 years before	0,0%	0,0%	0,0%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 50-59 years before "now"
Total	68,8%	67,7%	68,2%	

Pr. Act. 10 y. before (number of ever recognised professionals per year, derived from labour statistics, including persons not recognised anymore)

"10 years ago"

Rec.per. 10 y. before	Male	Female	Total
not yet recognised	200	400	600
0-9 years before	190	285	475
10-19 years before	113	113	226
20-29 years before	67	50	117
30-39 years before	15	10	25
40-49 years before	0	0	0
Total	385	458	843

Outflowmodel using current % still active after 10 years

Professionaly active (number of active professionals per year, derived from current labour statistics and assuming constant future % activity per age/sex group)

Recognition period	"Now" Male	Female	Total		"In 10 years" Then	Male	Female	Total	Outflow		"In 20 years" Then	Male	Female	Total	Outflow
0-9 years before	190	380	570		10-19	150	300	450	-21,1%		20-29	133	199	332	-41,8%
10-19 years before	150	225	375		20-29	133	149	282	-24,8%		30-39	30	30	60	-84,1%
20-29 years before	100	75	175		30-39	22	15	37	-78,6%		40-49	0	0	0	-100,0%
30-39 years before	15	10	25		40-49	0	0	0	-100,0%		50-59	0	0	0	-100,0%
40-49 years before	0	0	0		50-59	0	0	0	x		60-69	0	0	0	x
Total	455	690	1.145			305	464	769	-32,8%			162	229	391	-65,8%
						-32,9%	-32,7%					-64,3%	-66,8%		

% Still act. after 10 y. (% still active per year, derived from current labour statistics and assuming constant future % activity per age/sex group)

Rec.per. 10 y. before	"Now versus 10 years ago" Male	Female	Total	
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40-49 years before	0,0%	0,0%	0,0%	chance of being active "now" for professinals who were active 10 years before "now" and were recognised 50-59 years before "now"
Total	68,8%	67,7%	68,2%	

Pr. Act. 10 y. before (number of ever recognised professionals per year, derived from labour statistics, including persons not recognised any more)

Rec.per. 10 y. before	"10 years ago" Male	Female	Total
not yet recognised	200	400	600
0-9 years before	190	285	475
10-19 years before	113	113	226
20-29 years before	67	50	117
30-39 years before	15	10	25
40-49 years before	0	0	0
Total	385	458	843

Outflowmodel using current % still active after 10 years

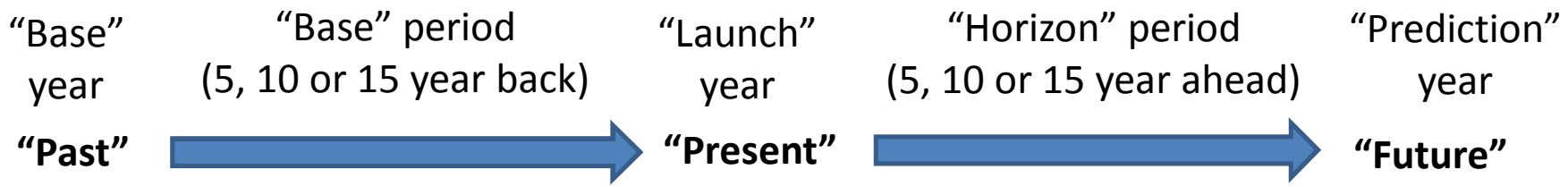
Backtesting the supply model

- Ex-post predictions of the supply in 1998-2011
- Starting from 5, 10 or 15 years before
- Based on 5, 10 or 15 year old data
- Comparison of the predictions with the actual supply
- Testing the models with the “Percentage Error” (PE) and “Mean Absolute Percentage Error” (MAPE)

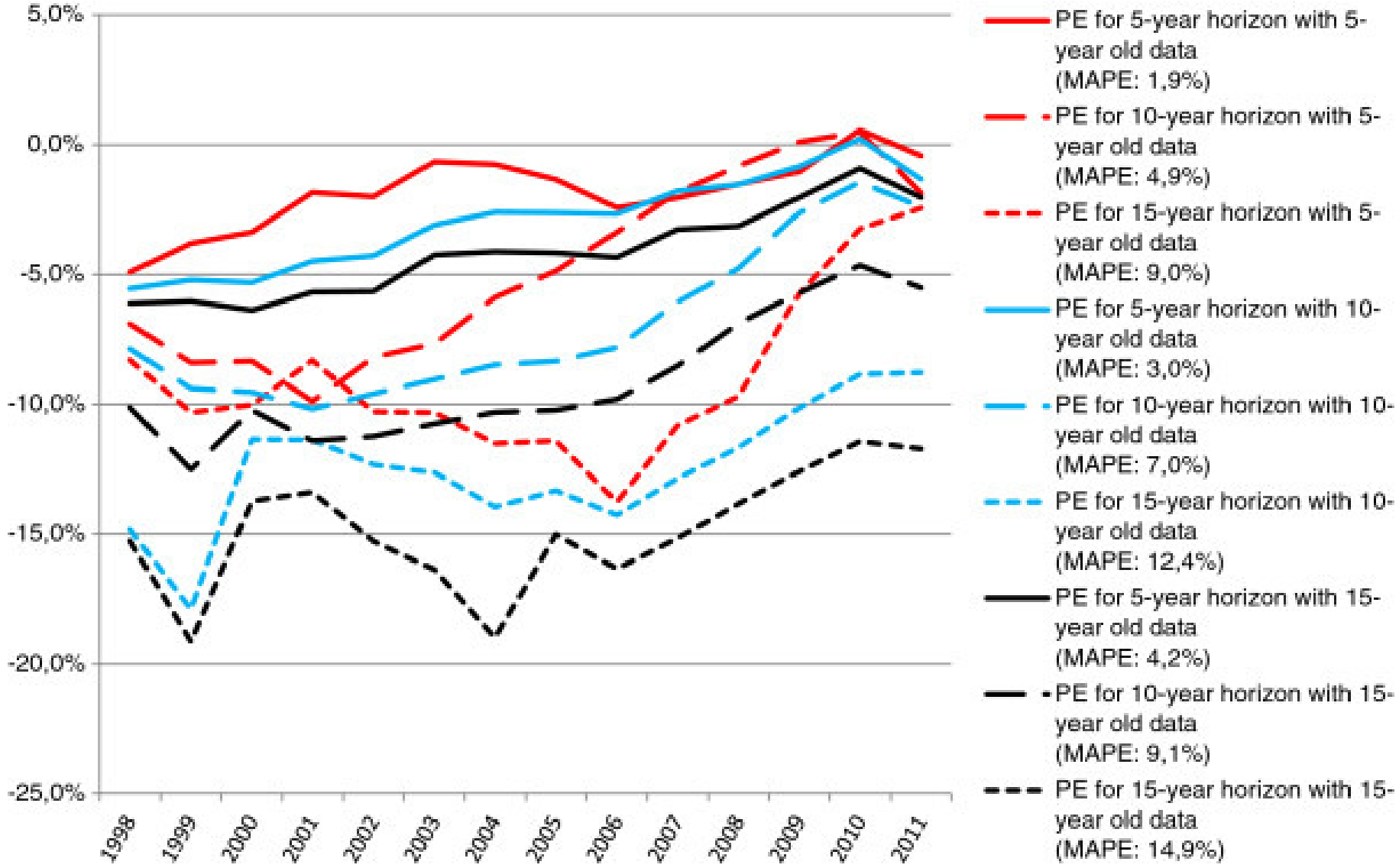
“Horizon” and “Base”

- The horizon is about how far away we have to predict: 5, 10 or 15 years into the future

- The base is about how far back we look for our predictors: 5, 10 or 15 years into the past



All results


5,0%
0,0%
-5,0%
-10,0%
-15,0%
-20,0%
-25,0%
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
PE for 5-year horizon with 5-year old data (MAPE: 1,9%)
PE for 10-year horizon with 5-year old data (MAPE: 4,9%)
PE for 15-year horizon with 5-year old data (MAPE: 9,0%)
PE for 5-year horizon with 10-year old data (MAPE: 3,0%)
PE for 10-year horizon with 10-year old data (MAPE: 7,0%)
PE for 15-year horizon with 10-year old data (MAPE: 12,4%)
PE for 5-year horizon with 15-year old data (MAPE: 4,2%)
PE for 10-year horizon with 15-year old data (MAPE: 9,1%)
PE for 15-year horizon with 15-year old data (MAPE: 14,9%)

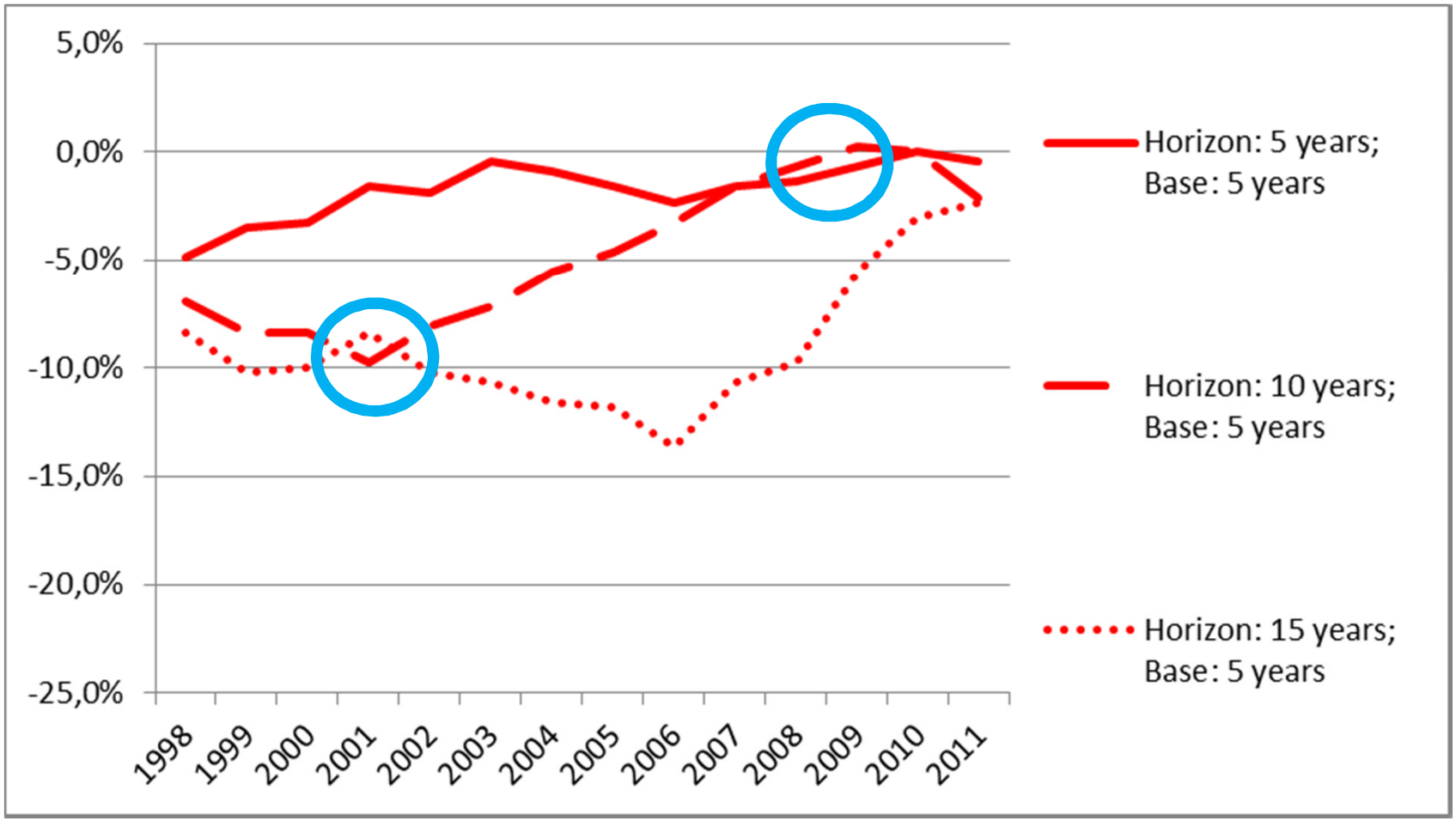
Main hypotheses

- The shorter the horizon period, the more accurate the prediction

- The longer the base period, the more accurate the prediction

The shorter the horizon, the better the prediction?

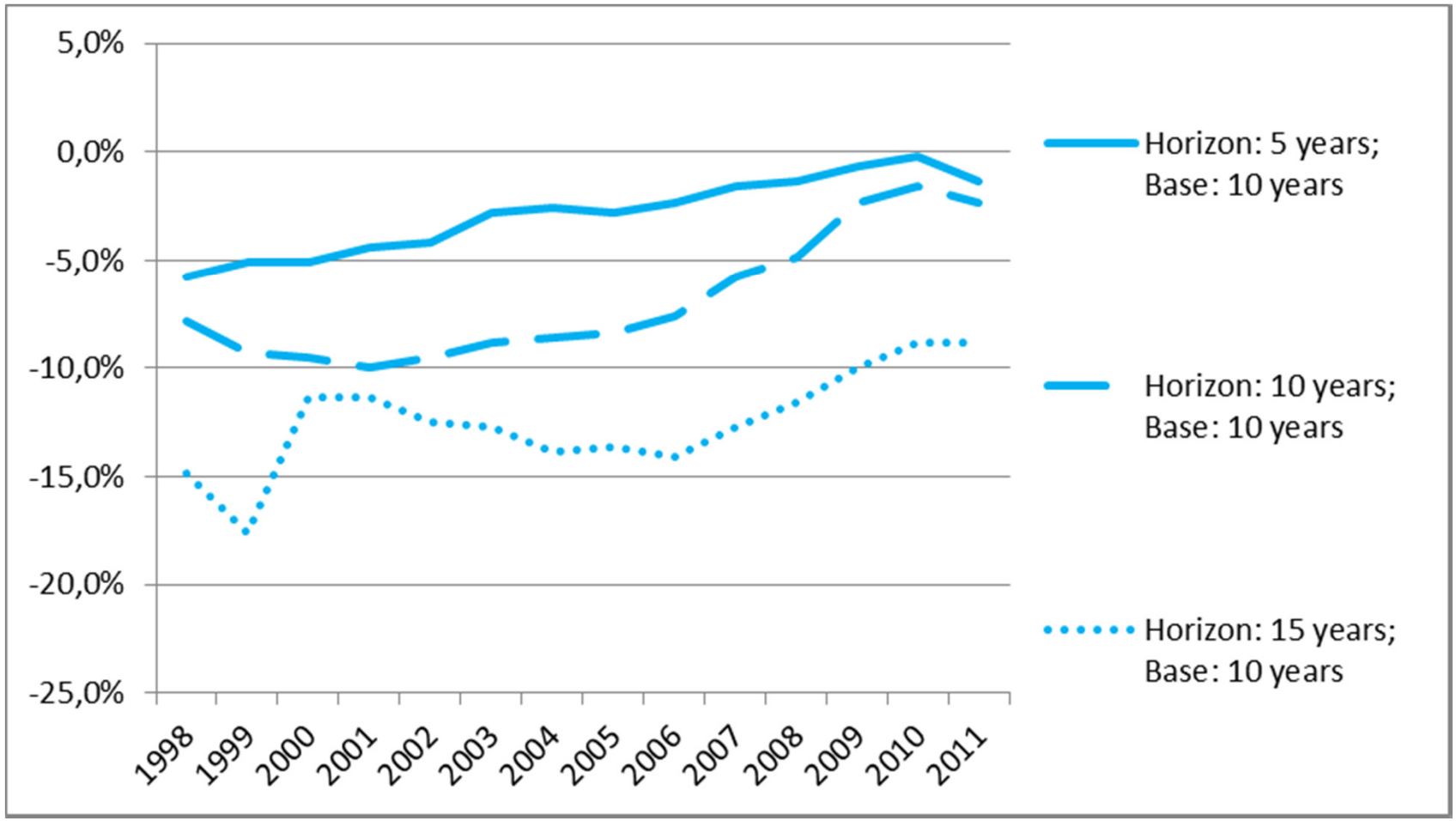
True for most 5-year-base-period projections



The shorter the horizon, the better the prediction?

True for most 5-year-base-period projections

True for all 10-year-base-period projections

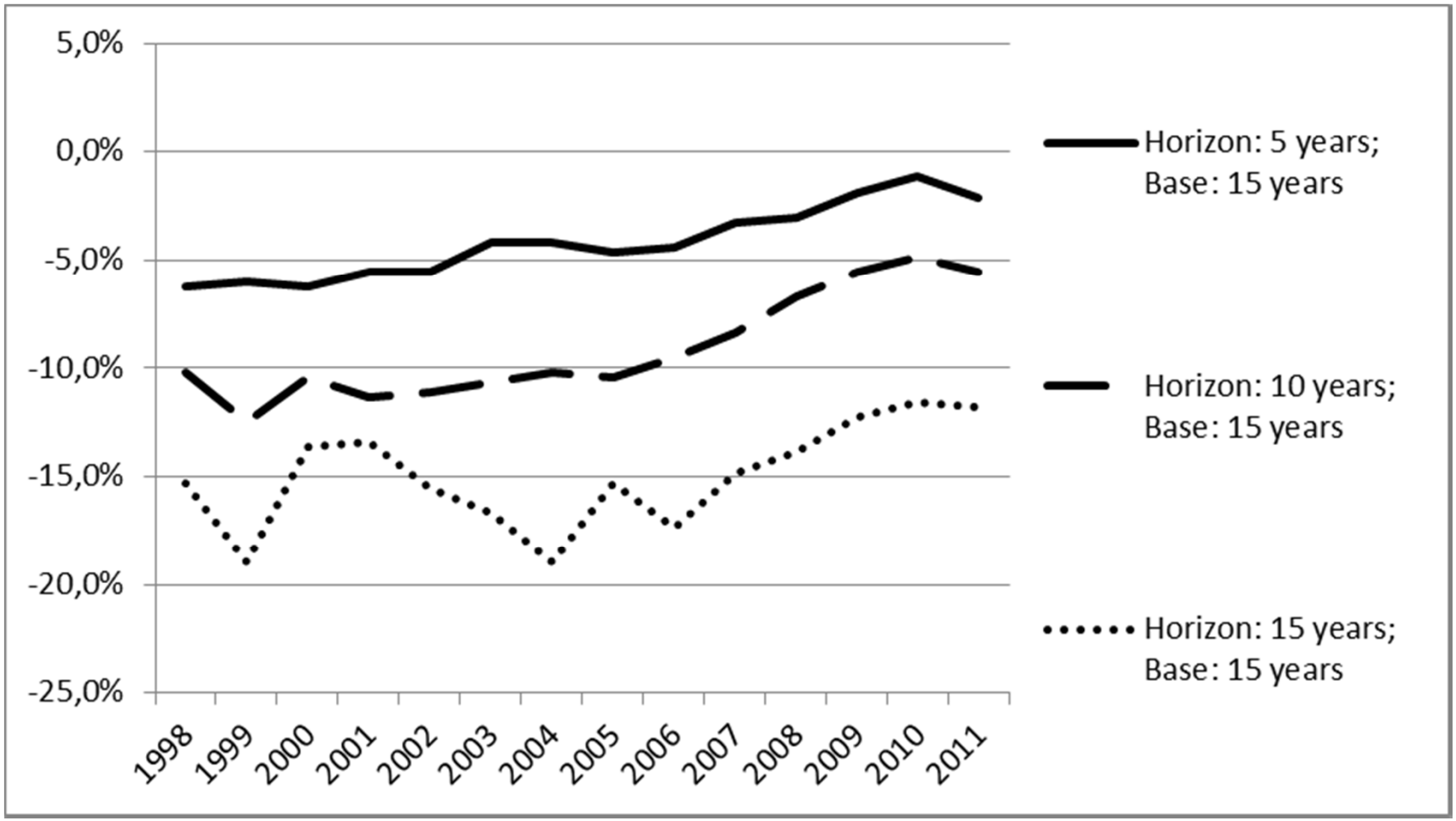


The shorter the horizon, the better the prediction?

True for most 5-year-base-period projections

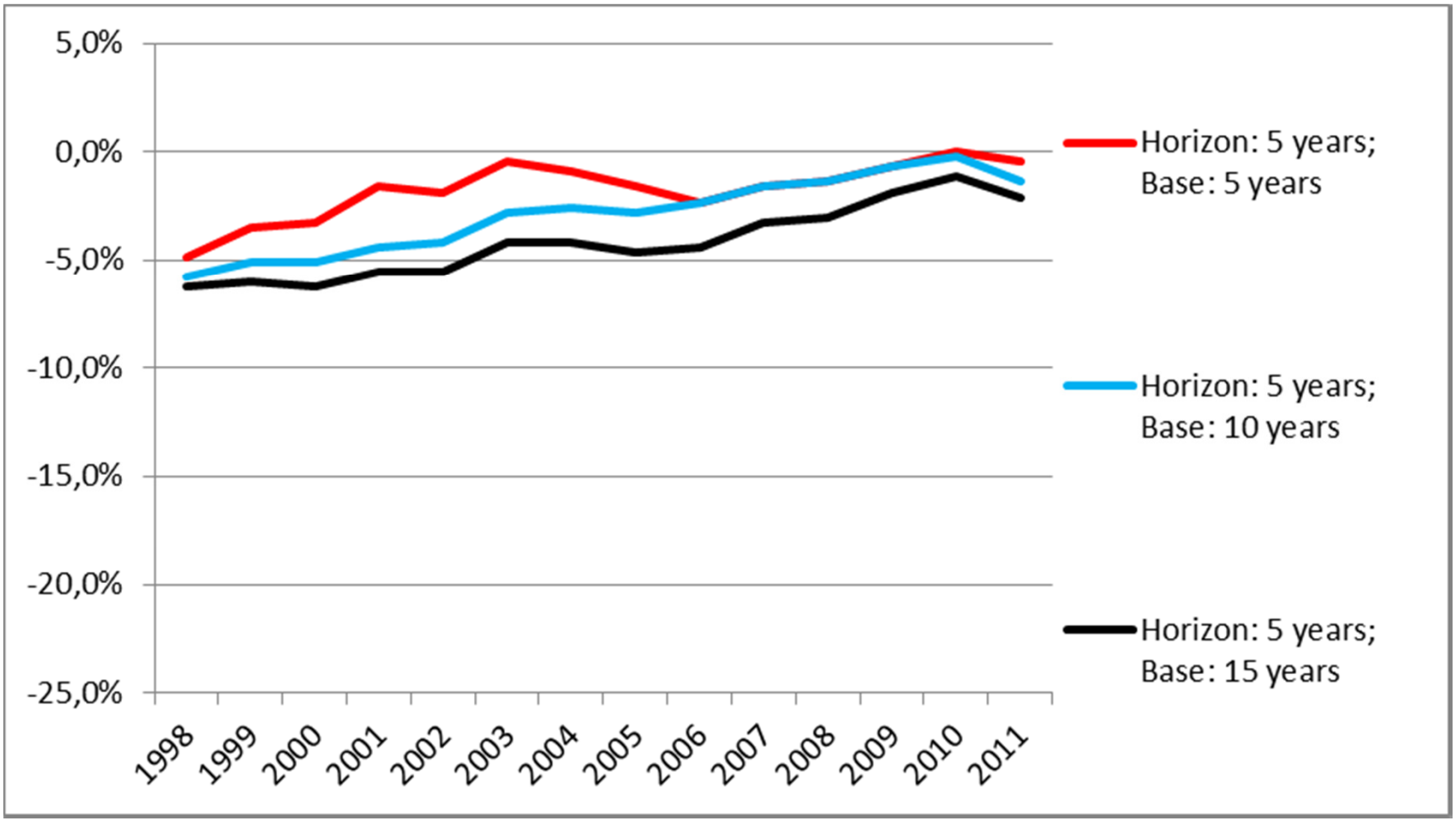
True for all 10-year-base-period projections

True for all 15-year-base-period projections



The longer the base, the better the prediction?

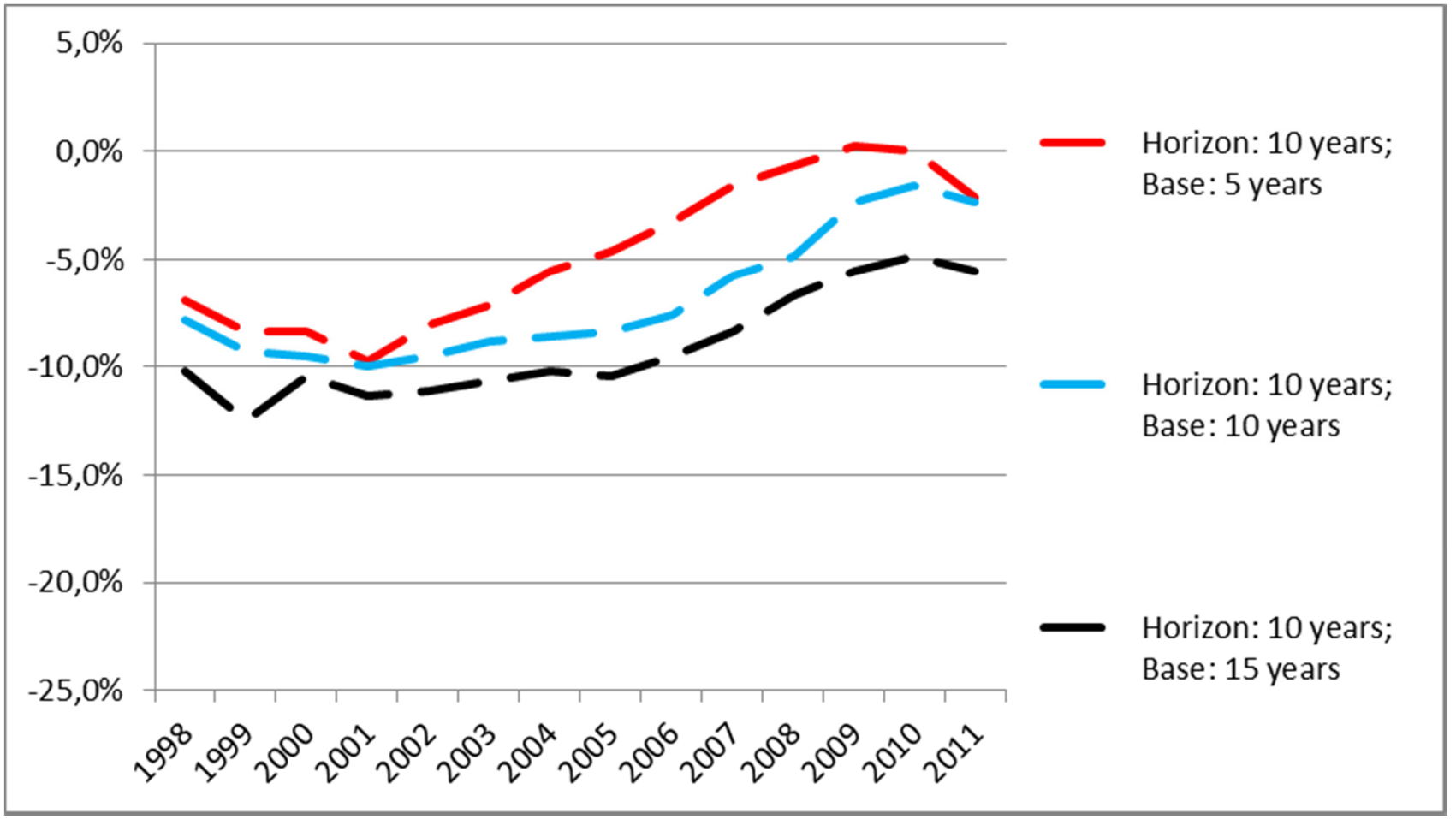
False for all 5-year-horizon projections



The longer the base, the better the prediction?

False for all 5-year-horizon projections

False for all 10-year-horizon projections

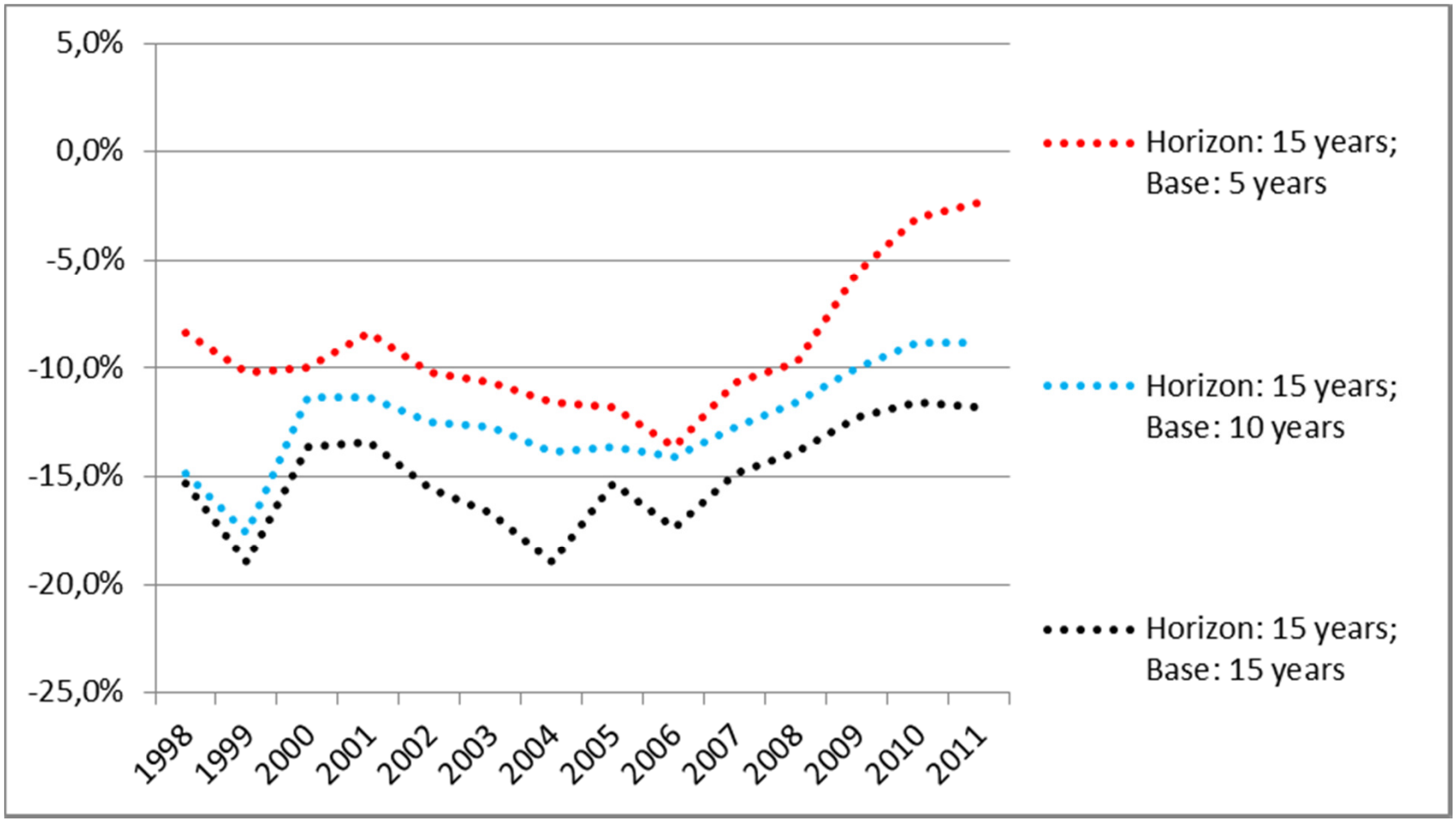


The longer the base, the better the prediction?

False for all 5-year-horizon projections

False for all 10-year-horizon projections

False for all 15-year-horizon projections



Main question and answers

- How accurate is the Dutch model for predicting the supply of GPs?

- Reasonably well !
  - Considering that an underestimation is less harmful than an overestimation
  - Better for the latest years
  - Better for the short term
  - Better with a short base

Main conclusions

- “More complex models” do not always lead to better predictions
  - So, countries can start with simple “Table”-analysis and Excel-models
- “More data” does not always lead to better predictions
  - So, countries with a short historical database can do predictions