

## 1 The Status Quo

There are many applications requiring breath-by-breath analysis of the oxygen and the carbon dioxide concentration simultaneously. The integration of the different sensor components needed are challenging in many respects:

- Regard of different dependencies on pressure, temperature and humidity
- Regular exchange of exhausted sensor elements (e.g. electrochemical cell for oxygen measuring)
- Different calibration requirements (specific calibration gases)
- Synchronisation of differing response times
- Rate and constancy of volume flow
- Array of sensor components and layout of tubing

High costs are the consequence out of it - not only to develop and re-engineer the system from time to time (e.g. if a supplier of sensors has to be replaced) but also for materials logistics, the manufacturing and the quality management. In addition the user of the medical device has to take high running costs into account as consumptive sensors and calibration gas cylinders have to be replaced periodically.

## 2 Make or buy ACE-DXmed from ACEOS?

modules per year	100	
modules per life cycle	1.000	
economies of scale	0%	
<b>costs/item</b>	<b>make</b>	<b>buy</b>
material costs	1.615	1.280
development costs	146	8
maintenance costs	47	1
manufacturing costs	164	49
<b>total costs/item</b>	<b>1.972</b>	<b>1.338</b>
Advantage ACEOS	32%	

The economical advantage of ACE-DXmed is (100 items per year and 1000 items per life cycle of the medical device):

- **cost savings: 32%**
- **time savings development: 8 months**
- **time savings re-engineering: 3 monts**
- **savings of operation costs: 4.670,-€**

### 3 Calculation

#### 3.1 Material costs

<u>Parts/module (per item)</u>	<u>make EUR</u>	<u>buy EUR</u>
O2-Sensor	700	0
CO2-Sensor	300	0
additonal electronics	70	0
ambient sensors	45	0
pump	40	0
tubes, connectors, valves	40	0
small parts	20	0
calibration system	400	0
ACE-DXmed (100 p.a.)	0	1200
<b>material Costs</b>	<b>1.615</b>	<b>1.200</b>

#### 3.2 Production costs

<u>Production (per item)</u>	<u>make EUR</u>	<u>buy EUR</u>
procurement	18	4,4
assembly	75	0
tests	21	21
documentation	13	13
<b>production costs direct</b>	<b>126</b>	<b>38</b>
indirect costs	38	11
<b>Manufacturing costs</b>	<b>164</b>	<b>49</b>

#### 3.3 Development costs and time needed

<u>Development</u>	<u>make EUR</u>	<u>buy EUR</u>
design, prototype	67.200	0
evaluation	11.200	5600
firmware	50.400	0
documentation	11.200	1120
processes	6.400	1280
<b>development costs</b>	<b>146.400</b>	<b>8.000</b>
<b>development months (net)</b>	<b>9</b>	<b>1</b>

#### 3.4 Re-Engineering costs and time needed (device life cycle 10 years)

<u>Maintenance</u>	<u>make EUR</u>	<u>buy EUR</u>
redesign (3 / lifecycle)	16.800	0
evaluation	16.800	0
firmware	8.400	0
documentation	3.360	336
processes	1.920	192
<b>maintenance costs</b>	<b>47.280</b>	<b>528</b>
<b>Maintenance months (net)</b>	<b>2,9</b>	<b>0,1</b>

#### 3.5 Costs of Operation

<u>Operation (device life-time: 7 Y)</u>	<u>qty</u>	<u>make EUR</u>	<u>buy EUR</u>
galvanic O2-cell replacements	7	1.050	0
calibration gas replacements	10	3.000	0
procurement		340	0
service manufacturer		280	0
<b>operation costs medical device</b>		<b>4.670</b>	<b>0</b>

4 Chart

