Façade Leasing | Developing a business-to-client product-service system (PSS) for resource-efficient facades

Tutors | Dr.-Ing. Tillmann Klein | building technologies / facade research group
        | Dr.ir. Alexandra den Heijer | real estate & housing

Juan F Azcarate Aguerre | P5.Graduation Studio_Façade Leasing
1. Market strategy
2. Schematic service scenarios
3. Case-study and financial model
4. Value-Engineered renovation strategies
5. Evaluation and conclusions
Would a Product-Service System approach lead to broader industry collaboration and more resource-efficient facades?

Where could we find space for improvement in terms of resource and energy use?

How would construction methods adapt and evolve to new strategies of system management?
1. Market strategy
Façade Leasing  | Assessing Façade Leasing according to performance

Productivity
Optimize m² usage
Generate a stimulating environment

Group identity
Generate sense of belonging through inclusive, quality facilities

Sustainable energy
Improve m² performance
Reduce grid dependency

Green marketing
Promote organization’s values and cutting-edge technological know-how
Façade Leasing | Facade Catalogue

Industrial facilities function dictates

Storage block function / commercial activ.

Disneyland high maintenance / high profit

NY by Gehry Real estate enhanced by branding

East-block facade renovations energy cost reduction

ZiggoDome Branding for urban presence

Solar Fabrik sustainability as branding

Igloo local availability, max. performance
Façade Leasing  |  Are universities the ideal clients for new business scenarios?

University campus

- High 4 value demand
- Investor, manager and end-user are (generally) the same
- Buildings can be used for centuries
- Branding in terms of philosophy and technology
- Building portfolio from the 60’s and 70’s (almost 50%)
- Low rate of use per m²
- Constant changes in strategic planning

TU Delft BK City
Renovation project impulsed by availability and time restrictions in special circumstances

Harvard GSD Building
Optimal building functionality, promotion of a specific academic environment

SCI-Arc Building
Branding through the use of an uncommon structure
## Façade Leasing

### Financial models & What types of projects have been funded in the last decade?

<table>
<thead>
<tr>
<th>Physical Value</th>
<th>Users</th>
<th>Investment</th>
<th>Façade investment potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>GFA</td>
<td>UFA</td>
</tr>
<tr>
<td>GFA 100</td>
<td>62%</td>
<td>5</td>
<td>172</td>
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<tr>
<td>GFA 600</td>
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<tr>
<td>GFA 1,200</td>
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<td>GFA 2,400</td>
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<tr>
<td>GFA 3,600</td>
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<tr>
<td>GFA 4,800</td>
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</table>

### Construction costs / m²

<table>
<thead>
<tr>
<th>Construction cost / m²</th>
<th>Cons : Oper Ratio</th>
<th>= GFA x 40% Average ratio for low-rise, non-ionic buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg = € 2,000 / m²</td>
<td>Avg = 3%</td>
<td>GFA x 40% x 1.33 (100% for facades) x 90% for non-ionic buildings</td>
</tr>
<tr>
<td>Max = € 4,100 / m²</td>
<td>Max = 20%</td>
<td>GFA x 40% x 1.33 (100% for facades) x 90% for non-ionic buildings</td>
</tr>
<tr>
<td>Min = € 0.400 / m²</td>
<td>Min = 1%</td>
<td>GFA x 40% x 1.33 (100% for facades) x 90% for non-ionic buildings</td>
</tr>
</tbody>
</table>

### Façade area

<table>
<thead>
<tr>
<th>Façade area</th>
<th>Facade cost / m²</th>
<th>= InvCost x 20% Average ratio of façade costs against overall investment costs</th>
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</thead>
<tbody>
<tr>
<td>Avg = 5,000 m²</td>
<td>Max = € 2,000 / m²</td>
<td>InvCost x 20% x 1.33 (100% for facades) x 90% for non-ionic buildings</td>
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<tr>
<td>Max = 28,000 m²</td>
<td>Min = € 0.400 / m²</td>
<td>InvCost x 20% x 1.33 (100% for facades) x 90% for non-ionic buildings</td>
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<tr>
<td>Total = 240,000 m²</td>
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### Façade cost per m²

<table>
<thead>
<tr>
<th>Façade cost per m²</th>
<th>Investment</th>
<th>= InvCost x 20% Average ratio of façade costs against overall investment costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg = € 1,000 / m²</td>
<td>Avg = € 2,000 / m²</td>
<td>InvCost x 20% x 1.33 (100% for facades) x 90% for non-ionic buildings</td>
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<tr>
<td>Max = € 15,000 / m²</td>
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### Source

### General Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Project</th>
<th>Campus</th>
<th>Project Type</th>
<th>Year</th>
<th>Location</th>
<th>Plan &amp; Effici.</th>
<th>M2 $/ student</th>
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<th>Student</th>
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<td>2006</td>
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<td>7.6</td>
<td>31.33</td>
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<tr>
<td>BA-3</td>
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### Functional Value

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<td>1,000</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

### Strategic value of projects

- **Representative**: 35%
- **Meeting Place**: 40%
- **Plain & Efficient**: 25%

### Operation costs breakdown for a commercial building

- **Fixed**: Administrative, Security, Grounds, Cleaning
- **Variable**: Cleaning, Security, Administrative, Fixed

### Standard costs

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost $/sq ft</th>
<th>%</th>
<th>Potential PSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning</td>
<td>1.50</td>
<td>13%</td>
<td>3%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1.75</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>Utilities</td>
<td>2.25</td>
<td>19%</td>
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</tr>
<tr>
<td>Grounds</td>
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<tr>
<td>Security</td>
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<tr>
<td>Administrative</td>
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<td>11%</td>
<td>3%</td>
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<tr>
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<td></td>
<td>11.75</td>
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<td>27%</td>
</tr>
</tbody>
</table>

*Source: 2; BOMA, 2010. Practical Industry Intelligence for Commercial Real Estate*
### Façade Leasing | Financial models | How much could a client invest in such a system?

#### Physical Value

<table>
<thead>
<tr>
<th>GFA</th>
<th>UFA</th>
<th>UFA/GFA Floors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>500</td>
<td>62% 5</td>
</tr>
<tr>
<td>1500</td>
<td>500</td>
<td>72% 5</td>
</tr>
<tr>
<td>2000</td>
<td>500</td>
<td>72% 5</td>
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<tr>
<td>3000</td>
<td>1500</td>
<td>62% 5</td>
</tr>
<tr>
<td>6100</td>
<td>1500</td>
<td>62% 10</td>
</tr>
<tr>
<td>16000</td>
<td>3500</td>
<td>65% 7</td>
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<tr>
<td>12000</td>
<td>5000</td>
<td>52% 7</td>
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<td>18000</td>
<td>3500</td>
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</tr>
<tr>
<td>34000</td>
<td>5000</td>
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<td>24200</td>
<td>4200</td>
<td>66% 10</td>
</tr>
<tr>
<td>30000</td>
<td>4200</td>
<td>71% 10</td>
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#### Users

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<th>M2 per User</th>
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<td>1188</td>
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<tr>
<td>1500</td>
<td>1166</td>
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<tr>
<td>24200</td>
<td>4000</td>
</tr>
<tr>
<td>30000</td>
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</table>

#### Investment

<table>
<thead>
<tr>
<th>Cost per m2</th>
<th>Cost per m2 Façade</th>
<th>Investment per User</th>
<th>Investment per Façade</th>
</tr>
</thead>
<tbody>
<tr>
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<td>UFA</td>
<td>User Const</td>
<td>User Inv</td>
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<td>429 700</td>
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<tr>
<td>2000</td>
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<td>16000</td>
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<td>350 600</td>
<td>375 600</td>
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#### Façade-related costs

- Facade construction 20% of construction costs
- Mechanical installations 10% of construction costs
- Related operation costs 30% of operation costs

#### PSS financing / m² / year

<table>
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<tr>
<th>Avg</th>
<th>Max</th>
<th>Min</th>
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<tbody>
<tr>
<td>€65</td>
<td>€115</td>
<td>€30</td>
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Notes: 4 Cost model: Office design
2004 issue 49 | By Davis Langdon & Everest
Façade Leasing | F.I.B.C.S.P. | Facade-Integrated Building-Climate-Services Provider

Traditional purchase or leasing
Financing and managing of technological products to obtain a range of final results

Building climate technologies
Facade
Heating
Heat exchange
Ventilation
Automated control

Financial

Client

Management
Maintenance

End result

22°C 40% R.H.
What would a PSS-modeled facade provider do?

Building climate technologies
- Facade
- Heating
- Heat exchange
- Ventilation
- Automated control

Central control
- Financial, management and maintenance services
- Technological hardware and software
- Material ownership and recycling

Service delivery
- End result is fixed
- Client avoids responsibility and risk management

Product-Service System
Bundled products and services based on final result
### Façade Leasing

**Product / Service models**

What types of business-to-client relations exist in other industries?

<table>
<thead>
<tr>
<th>Façade Leasing</th>
<th>British Car Hire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xerox model</td>
<td>UK Car Hire</td>
</tr>
<tr>
<td>Technological leasing</td>
<td>Telecommunications</td>
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<tr>
<td>Pandora bracelet</td>
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</table>

#### AT&T Phone + Plan

<table>
<thead>
<tr>
<th></th>
<th>AT&amp;T Phone + plan (Purchase)</th>
<th>AT&amp;T 2 year (Leasing)</th>
<th>AT&amp;T Next (PSS)</th>
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</thead>
<tbody>
<tr>
<td><strong>Initial cost</strong></td>
<td>$649.00</td>
<td>$199.00</td>
<td>$-</td>
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<tr>
<td><strong>Monthly financial cost</strong></td>
<td>$-</td>
<td>$-</td>
<td>$25.00</td>
</tr>
<tr>
<td><strong>Plan costs</strong></td>
<td>$20.00</td>
<td>$60.00</td>
<td>$45.00</td>
</tr>
<tr>
<td><strong>Total (24 month term)</strong></td>
<td>$1,129.00</td>
<td>$1,639.00</td>
<td>$1,680.00</td>
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</table>

* iPhone 5c 16gb
Unlimited call + text
300mb data
www.att.com, 2014
Façade Leasing | Product / Service models | What are the potential (dis)advantages of each model?

**Disadvantages of purchasing**

- **Locks**
  Cash and credit resources

- **End-of-life**
  Is no-one’s responsibility

- **Functional Cycle**
  Is tied to investment return

**Advantages of a PSS**

- **Capital investment**
  Significantly reduced

- **Building portfolio**
  Asset swapping, extends material cycles

- **Renovation / Upgrade**
  Is in the service provider’s best interest

- **Branding**
  Is based not on form but on customization, personalization and flexibility
2. Schematic service scenarios
Façade Leasing | Case Study - Applying PSS to an existing structure

TU Delft
3mE Building
4 main volumes and connecting bridges
**Facade Leasing** | Design Requirements | Integrated / User-defined service layers

**Structural**
Support layer

**Mechanical**
Installations and systems

**Performative**
Watertightness and appearance

**Solar Shading**
Fixed or adaptable

**Energy**
Generation / Storage

**Media**
Sponsorship / Informative

---

**Base Systems**
Required initial investment
Longer term contract

**Unit catalogue**
Would expand through time as new technologies become available, older units become cheaper and stocks of second-hand panels vary.

**Add-on’s**
Shorter term upgrades for strategic flexibility
Modular interchangeability throughout building portfolio
Façade Leasing | Advantages and Potentials | Provides user flexibility and personalization

Basic Configuration

→ Image-based upgrade

→ User-based upgrade

→ Space-based upgrade
Façade Leasing | Applied scenarios_ Client-based upgrades

<table>
<thead>
<tr>
<th>Now</th>
<th>Administrative building</th>
<th>Educational building</th>
<th>Student Housing building</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Years</td>
<td>15 Years</td>
<td>10 Years</td>
<td></td>
</tr>
</tbody>
</table>

- **Structural substrate**
  - 7.5 Years
  - Standard aluminum frame 2.80 x 1.40m
- **Basic Window or Panel**
  - 7.5 Years
  - Full-size double glazing panels
  - 20% Bay window module
  - 40% Closed / Insulated Panels
  - 40% Operable Window panels
  - Replacement of seals + gaskets
- **Watertight layer**
  - 7.5 Years
  - Commercial standard electrical and ICT
  - Technical upgrade and update
  - Downgrade to residential and update
  - Addition of water/gas installations
  - Commercial building standards
- **Frame-integrated installations**
  - 7.5 Years
  - Downgrade to domestic standards
  - 100% Vertical louvers
  - 60% PV Panels 30% efficiency
  - 40% Vertical louvers
- **Ventilation and heating units (interpanel)**
  - 15 Years
  - 40% PV Panels 50% efficiency
  - 20% Operable shading on bay windows
  - 40% Operable vertical shading
- **Functional layers**
  - 5 Years
  - Decentralized heating and ventilation control
  - Occupancy sensors and regulators
  - Domestic unoccupied unit lock-down
- **Automation**
  - 10 Years
  - System renovation / update
  - System replacement / strategic change
  - Technical End-of-life
  - Unit continuation

- **System renovation / update**
- **System replacement / strategic change**
- **Technical End-of-life**
- **Unit continuation**
**Façade Leasing** | Advantages and Potentials | Absorbs emerging technologies

**Centralized management**
A service-based business-to-client relation would promote innovation and integration of latest technologies towards a more energy and cost efficient delivery.

**New Technologies**
Would normally displace existing ones as they become obsolete or no longer cost-effective.

**Modular Integration**
Allows new technologies and emerging systems to be absorbed into the catalogue and immediately available to the client-base.
### Façade Leasing | Applied scenarios_ Service-provider based

<table>
<thead>
<tr>
<th>Now</th>
<th>Sun-shading integration</th>
<th>Solar-energy production</th>
<th>Solar-energy update</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Years</td>
<td>12 Years</td>
<td>10 Years</td>
<td></td>
</tr>
</tbody>
</table>

#### Educational building

<table>
<thead>
<tr>
<th>30 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5 Years</td>
</tr>
</tbody>
</table>

- **Structural substrate**
  - Standard aluminum frame 2.80 x 1.40m

- **Basic Window or Panel**
  - Full-size double glazing panels
  - 60% Double glazed w/argon-filled cavity
  - 40% Insulated closed panels

- **Watertight layer**
  - 100% Double-glazed with vacuum cavity
  - Replacement of seals + gaskets

- **Frame-integrated installations**
  - Commercial standard electrical and ICT
  - Technical upgrade and update
  - Technical upgrade and update
  - Replacement with fiber optics and wireless

- **Ventilation and heating units**
  - Commercial standard units
  - Downgrade thanks to insulation improvement
  - Technical update (new heatpumps and radiators)
  - Downgrade thanks to insulation improvement

- **Functional layers**
  - 100% Vertical louvers
  - 30% Glass-integrated PV-cells 15% efficiency
  - 30% Algae-based bio-reactive facades
  - 40% PV Panels 50% efficiency
  - 50% Algae-based bio-reactive facades
  - 50% Smart transparent window coating

- **Replacement of seals + gaskets**
- **Full-size double glazing panels**
- **Technical upgrade and update**
- **Technical update (new heatpumps and radiators)**
- **Replacement with fiber optics and wireless**
- **Commercial standard units**
- **Downgrade thanks to insulation improvement**
- **System renovation / update**
- **System replacement / strategic change**
- **Technical End-of-life**
- **Unit continuation**

---

**Juan F Azcarate Aguerre | P5.Graduation Studio_Façade Leasing**
Façade Leasing | Advantages and Potentials | Sponsor- and subsidy-friendly

**CO2 Point Acquisition**
- Building energy neutrality.
- Installing cost-effective add-on’s through grants.
- Energy point exchange between properties.

**Marketing or information**
- Third parties or tenants can sponsor media or showcase add-on’s by paying only for the installation fees and month to month (additional) expense.
- Reducing initial sponsor capital investment.

60% energy demand

40% missing

+ 15%

+ 25%

+ 20%

120% total energy sponsored
Façade Leasing | Applied scenarios_ Sponsor-based scenario

<table>
<thead>
<tr>
<th>Now</th>
<th>Energy grant for PV panels</th>
<th>Algae private sponsorship</th>
<th>Private media / energy grant</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 Years</td>
<td>6 Years</td>
<td>12 Years</td>
<td></td>
</tr>
</tbody>
</table>

Educational building

30 Years

Grant subsidized
Structural substrate
Basic Window or Panel
Watertight layer
Frame-integrated installations
Ventilation and heating units (interpanel)

CO₂ point sponsoring
Functional layers

Media sponsoring
Functional layers

System renovation / update
System replacement / strategic change
Technical End-of-life
Unit continuation

10Years
10 Years
10 Years

10 Years
10 Years
10 Years

Standard aluminum frame 2.80 x 1.40m
50% Full-sized double-glazed panels
50% Full-sized closed insulated panels
Replacement of seals + gaskets
Commercial standard electrical and ICT
Commercial standard units

50% PV Panels 30% efficiency
50% Horizontal canopy louvers
100% Algae-based bio-reactive facades
50% Glass-integrated PV-cells 15% efficiency
50% LED media facade

30 Years

Educational building
3. Case-study and financial model
Façade Leasing | Case-study - Basic surfaces

\[ gfa = (500 \times 6 \times 4) + (900 \times 6) = 17,400 \text{ m}^2 \]

\[ \text{concrete area} = (280 \times 8) + (500 \times 3) + (225 \times 6) + 130 = 5,780 \text{ m}^2 \]

\[ \text{glass area} = (350 \times 6) + (440 \times 2) + (150 \times 4) + 1370 = 4,950 \text{ m}^2 \]
## 3ME Building Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Sq Meters of Construction</td>
<td>17,400</td>
</tr>
<tr>
<td>Sq Meters of Façade</td>
<td>10,730</td>
</tr>
<tr>
<td>Floor:Façade Area Ratio</td>
<td>62%</td>
</tr>
<tr>
<td>Current Energy Use (kWh/sqm-year)</td>
<td>200</td>
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<tr>
<td>Cost of Energy (kWh)</td>
<td>€ 0.214</td>
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<tr>
<td>Current Energy Expense (per year)</td>
<td>€ 744,720</td>
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<tr>
<td>Rate of Interest (30 Year Loan)</td>
<td>6%</td>
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<tr>
<td>Rate of Inflation</td>
<td>2%</td>
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<tr>
<td>Rate of Inflation (for energy prices)</td>
<td>7%</td>
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<tr>
<td>Yield of Alternative Investment</td>
<td>8%</td>
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<tr>
<td>PSS Production and Maintenance Costs (Economy of scale)</td>
<td>90%</td>
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<tr>
<td>Down Payment (20%)</td>
<td>€ 1,277,276</td>
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<tr>
<td>PSS Return On Investment</td>
<td>10%</td>
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<tr>
<td>Maintenance Costs (% of overall costs)</td>
<td>3%</td>
</tr>
<tr>
<td>Façade Maintenance Costs (% of maintenance costs)</td>
<td>16.50%</td>
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### Façade Leasing | Financial model - Construction costs

#### Façade Construction (Purchase system)

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<thead>
<tr>
<th>Year</th>
<th>Project</th>
<th>M² Transparent</th>
<th>M² Solid</th>
<th>M² Total</th>
<th>€ / m² Transparent</th>
<th>€ / m² Solid</th>
<th>Facade Initial Cost (with 8% inflation)</th>
<th>Upgrade / Renovation Costs (with 8% inflation)</th>
<th>Total Construction Costs</th>
<th>Years</th>
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<tbody>
<tr>
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<td>5,800</td>
<td>10,730</td>
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<td>£ 484</td>
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<td>€ 5,192,000</td>
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<td>2024</td>
<td>Mayor Maintenance</td>
<td>6,930</td>
<td>5,800</td>
<td>10,730</td>
<td>£ 183</td>
<td>€ 1,100</td>
<td>€ 7,850,000</td>
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<td>2025</td>
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<td>€ 7,941,000</td>
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<tr>
<td>2029</td>
<td>Energy Renovation</td>
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<td>5,800</td>
<td>10,730</td>
<td>£ 404</td>
<td>€ 2,404</td>
<td>€ 6,566,000</td>
<td>€ 0</td>
<td>€ 13,923,000</td>
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<tr>
<td>2030</td>
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<td></td>
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<td>€ 6,670,000</td>
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<td>€ 7,004,000</td>
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<td>€ 7,065,000</td>
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<td>2036</td>
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<td>£ 77</td>
<td>€ 477</td>
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<td>€ 8,292,000</td>
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<td>2042</td>
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<td>€ 8,407,000</td>
<td>€ 0</td>
<td>€ 18,945,000</td>
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<tr>
<td>2043</td>
<td>Demolition</td>
<td>6,930</td>
<td>5,800</td>
<td>10,730</td>
<td>£ 109</td>
<td>€ 1,226</td>
<td>€ 11,342,000</td>
<td>€ 0</td>
<td>€ 20,490,000</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Subtotal in terms of NPV

#### 30 Year Total

---

Juan F Azcarate Aguerre | P5.Graduation Studio_Façade Leasing
Façade Leasing  |  Financial model - “No Renovation” Model

Construction costs = 0
Energy Costs = 7% increase per year
Façade Leasing | Financial model - Loan Model

High initial payment and interest costs

High demolition costs which match the construction of the next facade

Energy gradually reduced through renovations

- Principal costs
- Interest costs
- Energy costs
- Maintenance costs
- Total yearly costs

- Total Loan Costs:
  - Capital, Interest, Energy, Maintenance

- Total No Renovation

- PSS Service Cost Adjusted to Inflation
  - € 1,000,000
  - € 2,000,000
  - € 3,000,000
  - € 4,000,000
  - € 5,000,000
  - € 6,000,000
Façade Leasing | Financial model - PSS model

1. It requires no initial effort or mayor investment
2. Offers a stable, predictable expense scheme

Total No Renovation

Total Loan Costs:
Capital, Interest, Energy, Maintenance

PSS Service Cost Adjusted to Inflation
### Façade Leasing | Financial model - Financial conclusions

<table>
<thead>
<tr>
<th></th>
<th>Construction</th>
<th>Maintenance</th>
<th>Energy</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loan</strong></td>
<td>€ 20,734,000.00</td>
<td>€ 6,413,000.00</td>
<td>€ 5,694,000.00</td>
<td>€ 32,839,000.00</td>
<td>39%</td>
</tr>
<tr>
<td><strong>Without Renovation</strong></td>
<td>-</td>
<td>€ 13,645,000.00</td>
<td>€ 70,347,000.00</td>
<td>€ 83,992,000.00</td>
<td>100%</td>
</tr>
<tr>
<td><strong>PSS</strong></td>
<td>€</td>
<td>-</td>
<td>-</td>
<td>€ 39,936,000.00</td>
<td>48%</td>
</tr>
<tr>
<td><strong>Alternative Investment</strong></td>
<td>€ 78,984,000.00</td>
<td>€ 13,645,000.00</td>
<td>€ 5,694,000.00</td>
<td>€ 98,322,000.00</td>
<td>117%</td>
</tr>
</tbody>
</table>

3. Optimizes returns on primary business activities.

4. Cost against traditional model is within an acceptable 22% range.
4. Value-Engineered renovation strategies
Façade Leasing  |  Renovation strategies - Building fragment
Façade Leasing | Renovation strategies - Production strategy

Material strategies

Reusable

Disposable

Applications / Users

Manufacturer / Service Provider
Façade Leasing  | Renovation strategies - Grading methodology

10 Years

30 Years

3 x 10 Years

Terms
## Façade Leasing | Renovation strategies - Planning and comparison

<table>
<thead>
<tr>
<th>Production</th>
<th>Value strengths</th>
<th>Financial Strengths</th>
<th>Functional Strengths</th>
<th>System Keynote(s)</th>
<th>Risks for Provider</th>
<th>Benefits for Provider</th>
<th>Benefits for Client</th>
<th>Main difference against current model</th>
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<tbody>
<tr>
<td><strong>Project Term</strong></td>
<td><strong>Production Strategy</strong></td>
<td><strong>Financial Strategy</strong></td>
<td><strong>Fabrication Strategy</strong></td>
<td><strong>Sustainable Strengths</strong></td>
<td><strong>Strategic Strength</strong></td>
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<td><strong>Benefits for Client</strong></td>
<td><strong>Main difference against current model</strong></td>
</tr>
</tbody>
</table>
| **10 Year** | **Rehabil** | **Long Term** | **Long-term cost savings** | **Low investment with long use potential with intermod-
| &nbsp; | **ative adjustment experience** | **Reduced material selection would lead to fewer reworkable materials that could save many building users a single service life.** | **Low investment with quick return and consistent material reuse** | **Cost of time and materials for rework is lower and thus the financial return is faster.** | **Flexible, durable materials** | **Flexible installation and cost savings** | **Limited risk and without further interventions. Project risks attached to large contracts are reduced as investments and service lives become smaller.** | **Replacement after 10 years is an option (allowing innovation and re-styling), but not financially feasible with current costs.** | **Assembly** |
| &nbsp; | **Cheap reprocessing** | **Low cost fabrication** | **Cost-effective and easy to assemble.** | **Cheap reprocessing** | **Low cost manufacturing and assembly** | **Technical difficulties of building a project in is set for 10 years. 30% of the service life should be delivered by 30% at the cost.** | **Cost savings and quick fabrication / installation for clients without long term vision possibilities.** | **Finishing** | **Commercial / public institutions** |
| **High End** | **Medium Term** | **High-cost contracts** | **Medium-term cost savings** | **Higher investment with less guaranteed outcomes** | **Higher investment with less guaranteed outcomes** | **High and flexible appearance with limited potential for customization due to case by case design and production.** | **Large first-time return due to limited initial investment. Performance of facade and financial estimations more likely to be accurate as operations, maintenance, and reprocessing energy.** | **Maintaining** | **Limited resource organizations** |
| **30 Year** | **Low Term** | **High-cost contracts** | **Long-term cost savings** | **Low investment with long service life with high intervention potential.** | **Long-term cost savings** | **Higher investment with less guaranteed outcomes** | **Higher investment with less guaranteed outcomes** | **Large first-time return due to limited initial investment. Performance of facade and financial estimations more likely to be accurate as operations, maintenance, and reprocessing energy.** | **Maintaining** | **Limited resource organizations** |
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| **Standardized** | **Long Term** | **Expensive planning and logistics** | **Large-scale planning and logistics** | **Large investment with high intervention potential.** | **Large investment with high intervention potential.** | **Large investment with high intervention potential.** | **Large investment with high intervention potential.** | **Large first-time return due to limited initial investment. Performance of facade and financial estimations more likely to be accurate as operations, maintenance, and reprocessing energy.** | **Maintaining** | **Limited resource organizations** |
| **Shelltrad** | **Combined Term** | **Cheap planning and logistics** | **Low-cost planning and logistics** | **Low investment with quick return and consistent material reuse** | **Low investment with quick return and consistent material reuse** | **Cost of time and materials for rework is lower and thus the financial return is faster.** | **Flexible, durable materials** | **Flexible installation and cost savings** | **Limited risk and without further interventions. Project risks attached to large contracts are reduced as investments and service lives become smaller.** | **Replacement after 10 years is an option (allowing innovation and re-styling), but not financially feasible with current costs.** |

### Juan F Azcarate Aguerre
P5. Graduation Studio_Façade Leasing
### Fabrication Strategy

- **Trimmable, adjustable components.**
- **Durable materials and techniques.**
- **Universal connections.**
- **Mass production, fast (dis)assembly.**

---

### Façade Leasing | Renovation strategies - Planning and comparison

<table>
<thead>
<tr>
<th>Project Term</th>
<th>Production Strategy</th>
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</tr>
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<tbody>
<tr>
<td>10 Year</td>
<td>Long term</td>
<td>Economic</td>
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<tr>
<td>Disposable</td>
<td>Short term</td>
<td>Ingredients</td>
</tr>
<tr>
<td>30 Year</td>
<td>Medium-term</td>
<td>Ingredients</td>
</tr>
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<td>Expendible</td>
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<tr>
<td>31/2 Year</td>
<td>Long-term</td>
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</tr>
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### Risks for Provider

- Technical difficulties of building a system to last for 10 years. 90% of the service life should be delivered in the first 5 years.
- Time frame of commissioning with other project phases have been minimized by years of practice.
- Liability in case of failure and understanding the reasons. Demand a low initial investment. The awareness of the higher maintenance costs.
- More frequent returns of unsuitable components with advancing technology.

### Benefits for Provider

- Reduced “inventory” costs, over time due to the higher frequent innovation and replacement.
- Reduced costs and quick fabrication. Reusable for projects with long-term planning possibilities.
- Lower production energy. Theoretically potential for customization with high potential for reutilization.

### Benefits for Client

- More frequent maintenance of facade design and production.
- Systems required become a financial asset with long-term ownership.
- Comfortable and easy maintenance of facade and production.
- Systems can adjust to higher service levels. The frequency in which the facade is (dis)assembled reduces the potential for customization.

### Main differences against current model

<table>
<thead>
<tr>
<th>Benefits for Provider</th>
<th>Benefits for Client</th>
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<td>- Time frame of commissioning with other project phases have been minimized by years of practice.</td>
<td>- Financial and technical stability. High interest from high-quality maintenance standards. High customization possibilities.</td>
<td>- Fabrication</td>
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### Juan F Azcarate Aguerre | P5.Graduation Studio_Façade Leasing
### Façade Leasing | Renovation strategies - Planning and comparison

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<tr>
<td>10 Year</td>
<td>Low Term</td>
<td>Cheap equipment - Low contribution costs</td>
<td>Terminable, adaptable components: durable materials and techniques</td>
<td>Long-term investment with high customization options</td>
<td>Low material flow and waste disposal, enabling flexibility for future adjustments</td>
<td>Reduced risk of obsolescence, higher flexibility</td>
<td>Increased flexibility, reduced risk</td>
<td>Reduced return on investment, increased risk of obsolescence</td>
<td>Flexibility</td>
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<tr>
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<td>Cheap reprocessing - Low contribution costs</td>
<td>Fabricated components: interchangeable with new model</td>
<td>Fast installation, low material flow, enabling flexibility</td>
<td>Quick return and sustainable material use</td>
<td>Implementation of flexible recycling processes</td>
<td>Cost savings, increased sustainability</td>
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<tr>
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</tbody>
</table>

### Functional Strength

- Fast installation and low initial investment.
- Full material re-use allows more flexible contracts.
Façade Leasing | Renovation strategies - Planning and comparison

System Keystone
- Fabrication techniques and universal interconnectivity.
- Marketing appeal and component circulation.

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<tr>
<td></td>
<td></td>
<td>Terminals, adjustable components, transport materials and techniques, industrial processes.</td>
<td>Low investment with long expected service life.</td>
<td>Current material selection and production processes are in place.</td>
<td>Rapid fabrications and standardized materials are easy to build and maintain.</td>
<td>Fast installation and easy removal.</td>
<td>Physical, physical material, universal connections.</td>
<td>Costs and time of building components to be building. and easy to result in a quality higher than required.</td>
<td>Technical difficulties of building a component is set for 50 years. The service life should be deliverable in a fixed cost.</td>
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<td>Low operation costs</td>
<td>High construction costs</td>
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<td>Medium Term Components, transport materials and techniques, industrial processes.</td>
<td>High and long-term performance with reduced metal for sustainable structures.</td>
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Juan F Azcarate Aguerre | P5.Graduation Studio_Façade Leasing
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<td>Medium contribution costs</td>
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<td>Low maintenance with low maintenance and low intervention</td>
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<td>Universal</td>
<td>Reuse and replacement of materials in new buildings</td>
<td>Return on investment</td>
<td>Assembly</td>
<td>Unpredictable returns</td>
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<td>Cheaper materials</td>
<td>Low contribution costs</td>
<td>Fast component</td>
<td>Fast production</td>
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<td>Reduced cost and reuse of materials in new buildings</td>
<td>Return on investment</td>
<td>Fabrication</td>
<td>Temporary applications</td>
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<tr>
<td>High End</td>
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<td>Marketing flexibility</td>
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<td>Expensive planning and logistics</td>
<td>Cheaper production</td>
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<td>Return on investment with low maintenance and low intervention</td>
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<td>High quality for medium to long-term owners with strategic flexibility</td>
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<tr>
<td>30/30 Year</td>
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<td>Expensive planning and logistics</td>
<td>Combined production</td>
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**Risks for provider**
- Technical difficulty of building a system to last 10 years. 30% of service life should be delivered at 30% of the cost.

**Benefits for provider**
- Production can take advantage of technological innovation in shorter cycles. In theory optimizing material and industrial processes
**Façade Leasing | Renovation strategies - Planning and comparison**

<table>
<thead>
<tr>
<th>Project Life</th>
<th>Production Strategy</th>
<th>Financial Strategy</th>
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<th>Economic Strength</th>
<th>Functional Strength</th>
<th>Strategy Strength</th>
<th>System Strength</th>
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<th>Benefits for Client</th>
<th>Main Difference against Current Models</th>
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</tr>
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</table>

**Grading system**

- **€** - Economic
- **🌿** - Ecological
- **🍎** - Apple
- **💰** - Financial
- **瓘** - Planning
- **🗗** - Marketing
- **🛠️** - Fabricating
- **📦** - Producing

Juan F Azcarate Aguerre | P5_Graduation Studio_Façade Leasing
### Façade Leasing | Renovation strategies - Brand-inspired evaluation

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reusable</td>
<td>10 Years</td>
</tr>
<tr>
<td></td>
<td>30 Years</td>
</tr>
<tr>
<td></td>
<td>3 x (10) Years</td>
</tr>
<tr>
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De Meeuw Facades

IKEA Facades
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</tr>
<tr>
<td>Disposable</td>
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<tr>
<td>Rolls Royce Facade Group</td>
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<tr>
<td>IKEA</td>
<td>3 x (10) Years</td>
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<td>FACADE GROUP</td>
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<td>IKEA</td>
<td>XBOX FACADES</td>
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<td>Rolls Royce Group</td>
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<td>Pandora Facades</td>
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<table>
<thead>
<tr>
<th>Disposable Strategy</th>
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<tbody>
<tr>
<td>IKEA Facades</td>
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<tr>
<td>Xbox Facades</td>
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</tbody>
</table>
# Façade Leasing  | Renovation strategies - Brand-inspired evaluation

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Term 10 Years</th>
<th>Term 30 Years</th>
<th>Term 3 x (10) Years</th>
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<tbody>
<tr>
<td><strong>Reusable</strong></td>
<td>De Meeuw Facades</td>
<td>Rolls Royce Facade Group</td>
<td>Pandora Unforgettable Facades</td>
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<td>iFacade</td>
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</table>
4-Value Performance:

- Increased return in the long-run / Risk of dead inventory
- No reprocessing resource use
- Fast installation and removal
- Utilitarian look

Related branding: Temporary solutions to momentary problems
Façade Leasing | Value-Engineered design scenarios - 10 year Reusable

Related branding: Temporary solutions to momentary problems

4-Value Performance:

Design Keystone:
Assembly, durability and transportability.
Small initial cost foments regular replacement. Long-term cost might end up being higher. Hard to regulate service-life of all components equally. Constant functional renovations possible. Trend-based design possible.

Related branding: Trendy design, cheap to produce, easy to assemble.
Façade Leasing  |  Value-Engineered design scenarios - 10 year Disposable

Related branding: Trendy design, cheap to produce, easy to assemble

4-Value Performance:

Design Keystone:
Standardization, joining and renewable material use.
Higher investment is justified by higher predictability
Without space for updates obsolescence is always a risk
Materials are used for as long as possible
One-system-fits-all, limited flexibility over time
High customization potential and long term recognition

Related branding: Invest once, use forever

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Façade Leasing | Value-Engineered design scenarios - 30 year High-End (reusable)

Related branding: Invest once, use forever

4-Value Performance:

- €
- 🌿
- ☀️
- 🍋

Design Keystone:

Durability of material and currency of technologies.
Façade Leasing | Value-Engineered design scenarios - 30 year Economic (upgradable/ disposable)

Related branding: The more you spend the more fun you get

4-Value Performance:

- Smaller Initial investment
- Service-life of certain components not exploited
- Material use not optimized, energy savings gradual
- Changes done according to necessity and possibility
- Range of intervention increasingly limited
- Visual continuity might be a problem, activities affected
Façade Leasing | Value-Engineered design scenarios - 30 year Economic (upgradable/disposable)

Related branding: The more you spend the more fun you get

4-Value Performance:

€  ●  ●  ●  ●  ●  ●

Design Keystone:
Continuity between renovations
Façade Leasing | Value-Engineered design scenarios - 3x(10) year Standardized (reusable)

Related branding: Catalogue sales, continuous client engagement

Façade Leasing

4-Value Performance:
- € | Components available on demand, cost-effective production
- Risk of slow inventory
- Material life optimized, intermediate energy-use limited
- High degree of flexibility with low cost and free term
- Cosmetic personalization very limited

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Façade Leasing | Value-Engineered design scenarios - 3x(10) year Standardized (reusable)

Related branding: Catalogue sales, continuous client engagement

4-Value Performance:

Design Keystone:
Universal inter-connectivity and marketing appeal.
Façade Leasing | Value-Engineered design scenarios - 3x(10) year Stratified (disposable)

Related branding: Planning for obsolescence

4-Value Performance:

- Investment according to necessity
- Planned obsolescence results in higher final costs
- Technological integration optimized
- High reprocessing energy
- High flexibility, components always “new”
- Constant redesign of top layers guarantee currency
Façade Leasing | Value-Engineered design scenarios - 3x(10) year Stratified (disposable)

Related branding: Planning for obsolescence

4-Value Performance:

Design Keystone:
Material and production process to satisfy specific service-lives.
Façade Leasing | Strategies according to intended client

Temporary life-extension or market-integration projects
Short-term owners and “Fit-out” tenants
Stable organizations with long-term ownership and planning capacity
Limited resources or permission, unpredictable occupation
Long-term owners with changing needs (eg. Universities)
Long-term owners with demanding functional and branding needs
Façade Leasing | Evaluation - Interviews with stakeholders

- Client / End User: FMVG, TU Delft
- Architect
- Financing Company
- Cost Estimation: BBN Adviseurs
- General Contractor
- Producer: Kremers, Tilburg
- Service Provider
- Industry Organization: VMRG

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Façade Leasing | Evaluation - System advantages

- Broader portfolio flexibility
- Longer service-life, improved performance, optimize use of space
Façade Leasing  | Evaluation - System advantages

- More frequent upgrades to the top 20% performance
- Long-term investment opportunities, unlike short-term technological leasing
- Increased information continuity from project to project
- Standard iconicity is cheaper than formal uniqueness
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- Wider stability/predictability for DBFOM contracts
- Continuity of business-to-client relation over the service-life of the facade
- Economy of scale due to system standardization
- Entirely new business field
- Lower risks and liabilities, increase reliability
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Potential for product-based marketing

Anchor service for additional renovation projects

Service recognition and permanent partnership integration

Diversifies financing options to attract different clients

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Building’s efficiency remains the provider / contractor’s responsibility
Material ownership promotes reusing-recycling
Familiarity with system would lead to reduced waste and higher efficiency
Reliable, long-term investments prove financially sustainable.

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Façade Leasing | Evaluation - System challenges

- Lack of technical expertise
- Scale of required capital

Financing Company

- Limits design freedom
- Could be used as a tool to convince clients

Client / End User
FMVG, TU Delft

- Extra cost can be offset by improved productivity
- Short-term contract needs

Architect

- Best position in terms of portfolio diversity, financial power and technical knowhow

General Contractor

- Lack of financial expertise
- Building portfolio not broad enough to spread risks

Producer
Kremers, Tilburg

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Facade Leasing | Evaluation - Rate of innovation

Average service-life / consumption rate

Generations in 40 years

Facades

1 service-life

Architects

1.5 retired

IKEA

8 generations

SmartPhones

23rd

CocaCola

29,200 portions
Façade Leasing | Potential for industry change

**Product-based**
Warranties and liabilities

Poor communication and continuity

**Service delivery-based**
Performance

Constant communication.
Continuity of materials and knowledge.
Façade Leasing | Future Research - Technical definition of a “promising” scenario

Integrated frame
- Structure
- Insulation
- Electric installations
- Predefined connections

Double-glazing
- Fixed or operable

Blinds

Control panel

Horizontal louvers

Operable shading

Bldg. service module

Solar module

LED module

Blind module

Future Research - Technical definition of a “promising” scenario
Façade Leasing | Future Research - TU Delft_The first fully transformable campus