

# Service Management – Managing Demand

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1. Introduction
2. Service Strategy
3. New Service Development (NSD)
4. Service Quality
5. Supporting Facility
6. Forecasting Demand for Services
- 7. Managing Demand**
8. Managing Capacity
9. Managing Waiting Lines
10. Capacity Planning and Queuing Models
11. Services and Information Systems
12. ITIL Service Design
13. IT Service Infrastructures
14. Guest Lecture – Dr. Roehn, Deutsche Telekom
15. Summary and Outlook



- **Overview Strategies for Managing Demand and Capacity**
- Customer-induced variability
- Segmenting demand & Offering price incentives
  - General
  - First-degree price discrimination
  - Second-degree price discrimination
  - Third-degree price discrimination
- Reservation systems and overbooking



Capacity of services: Perishable (e.g., plane needs to be airborne and incurs costs even if half of the seats are empty: loss)

Capacity needs to be sold: Strategies are necessary

2 generic strategies for managing demand and capacity:

- **Level capacity (managing demand):** Marketing strategies to allocate the demand, better balance utilization of the capacity.
- **Chase demand (managing capacity):** Operations-oriented strategies to adapt the capacity to the demand, matching part of the capacity to short-time demand (short-time, e.g., per day or per week)

Most companies: **Combination of several strategies** (e.g., hotel: Marketing strategies to allocate customer demand to off-season dates & adoption of number of employees according to number of guests)



# Overview Strategies for Managing Demand and Capacity

Managing service operations

Strategy

Level capacity:  
**Managing demand**

1) Customer-induced variability

2) Segmenting demand & Offering price incentives

3) Reservation systems and overbooking

Chase demand:  
**Managing capacity**

5) Sharing capacity

6) Increasing customer participation

7) Cross-training employees

8) Scheduling work shifts

9) Using part-time employees

10) Creating adjustable capacity

11) Yield Management

(Fitzsimmons & Fitzsimmons, 2011)



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## Services: Direct involvement of customers in operations

- Disruption of processes by individual, unforeseeable behavior (e.g., want service provision at night or on Sundays, have special requests, change their minds)
- Variability is caused
- Costs are incurred (inefficiency)
- Customers require consistency, but cause variability

Types of variability	Characteristics	Example
<b>Arrival variability</b>	Customers request service at inconvenient times.	Many customers want to shop on Saturdays at the same time.
<b>Request variability</b>	Customers request many different things.	Customer requires a variety of drinks at a supermarket.
<b>Capability variability</b>	Not all customers are able to perform tasks needed to receive a service.	Patient cannot clearly describe his symptoms: Doctor has problems with diagnosis.
<b>Effort variability</b>	Customers make various efforts regarding tasks needed to receive service.	Customer does not return his shopping cart: Shop employee needs to collect it.
<b>Subjective preference variability</b>	Customers think differently about a well treatment.	Introduction of waiter by his first name: Welcomed by one guest, disliked by another.

(Fei, 2006)



2 strategies regarding variability: Reduction or accommodation of variability?

- Classic accommodation: Taking measures to adapt employees to variability
- Classic reduction: Taking measures to reduce influence of variability

Trade-offs need to be made for each of the strategies: There are also strategies in between (Low-cost accommodation, Uncompromised reduction)

Types of variability	Accommodation	Reduction
<b>Arrival variability</b>	Employment of enough employees	Reservations for service and off-peak pricing
<b>Request variability</b>	Training of employees to adapt to customer's skill level	Limit variety of services
<b>Capability variability</b>	Cross-training of staff	Demand customers to increase level of capability
<b>Effort variability</b>	Train employees to fill in for customer's lacking of effort	Employ rewards and penalties to increase customer's effort
<b>Subjective preference variability</b>	Train employees to identify customer's expectations and adapt	Convince customers to reduce their expectations

(Fei, 2006)



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**Market segmentation:** “Dividing a market into small groups with distinct needs, characteristics, or behavior that might require separate marketing strategies [..].” (Kotler & Armstrong, 2010)

The market can also be segmented according to the demand (e.g., segmentation of airline customers regarding price and time sensitivity): Different prices can be charged to the segments.

Demand can be better allocated: Adoption to capacity

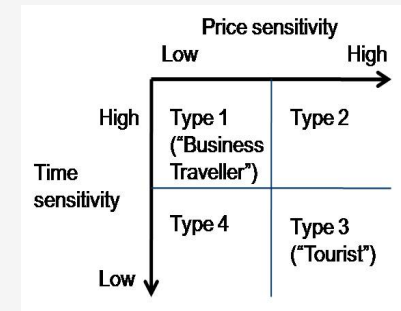
Especially in service industry, adoption to capacity is important: Provision of services cannot be stored. (Belobaba, 2009)

Objectives of company:

- Allocation of demand to lower frequented times (e.g., cinema: Seats must not only be sold on Fridays and Saturdays, but also at the other days of the week)
- Taking advantage of different budgets of customers
- Attracting further customers without losing current customers with high budget
- Gaining a higher profit (Mills, 2002)

Examples:

- Different hotel rates during the summer holidays and off-season
- Higher ticket prices for flights on Monday morning (business travellers) compared to Wednesday afternoon (tourists)
- Telephone companies: Lower prices for phone calls at the weekend than during the week (Mills, 2002)





**Willingness-to-pay: (WTP)** “[...] a measure of the value that a person assigns to a consumption or usage experience in monetary units” = Price a consumer wants to pay for a certain amount of a product (Homburg et al., 2005)

**Max. WTP:** Maximum price a consumer wants to pay for a product (Homburg et al., 2005)

**MC curve:** Marginal costs curve (measures change in costs for a certain change in output)

**Producer surplus:** Difference between actual price of the product and minimum price of producer (here monopoly: Difference between WTP of consumer and MC curve) =  
Producer's profit

**Consumer surplus:** Difference between WTP of consumer and actual price he has to pay =  
Consumer's profit



## Demand can be segmented by offering price incentives: Price discrimination

**Price discrimination:** Sale of output units at different prices.

Objective: Maximization of profit (different customers are willing to pay different prices)

3 types of price discrimination:

- **First-degree price discrimination:** Output units are sold at different prices which are different for each customer. Highly personalized products are sold at an individual price (market of one) = Perfect price discrimination.
  - E.g., Doctor in a small town who charges the customers according to their ability.
- **Second-degree price discrimination:** Output units are sold at different prices which vary regarding the output amount, but are the same for each customer purchasing this amount (non-linear pricing).
  - E.g., Volume discount: Subscription for the theatre.
- **Third-degree price discrimination:** Output units are sold at different prices to different consumer groups. Prices vary between the groups, but are the same for each person within one group = Classic type of price discrimination.
  - E.g., Student discount for a haircut.

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(Varian, 2001, Varian, 2011)



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Assumption: Company has a monopoly position (can charge customer's WTP as price for a certain amount of the product)

## **First-degree price discrimination:**

- Each unit is sold to the customer at his individual willingness-to-pay

**Demand curve (d):** Demand for individual regarding amount of the product and WTP is shown

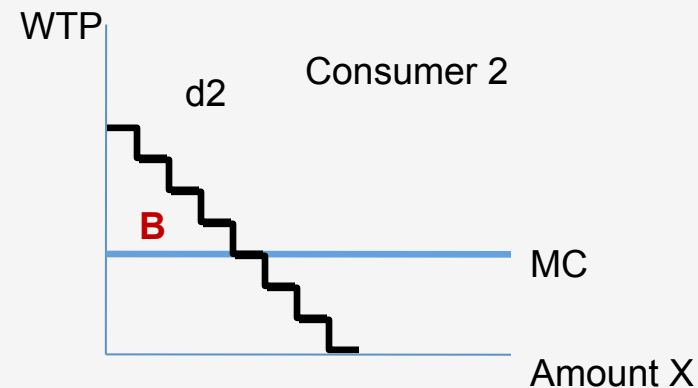
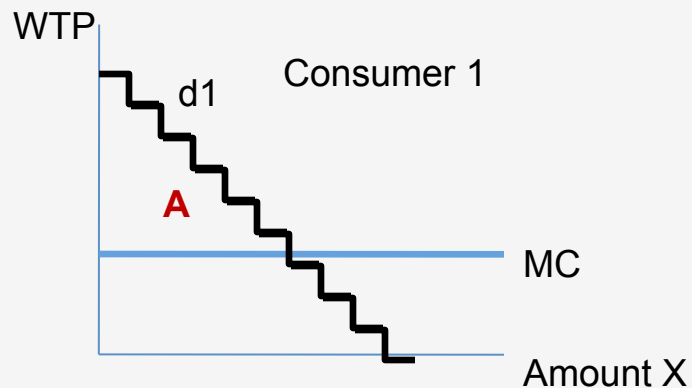
- One curve for each individual (1 & 2)
- Amount: only integer
- Each step of the curve shows change in WTP if purchasing another unit of the product
- Actual price of product is max. WTP of consumer: No consumer surplus (but producer surplus: characteristic of first-grade price discrimination)

Objective of producer: Maximization of producer surplus (already achieved here as max. WTP of consumer reached): Surfaces A and B



Consumers 1 & 2: Amount they would buy of the product for a certain price (WTP for each number of product units)

- Demand curves  $d$  (steps) for consumer 1 and 2
- MC curve for the producer (constant)
- Producer sells each product unit for the highest possible price to each consumer
- Price consumer 1: Surface A + costs, Price consumer 2: Surface B + costs
- Producer surplus (surface A & B): Larger for consumer 1 than for consumer 2

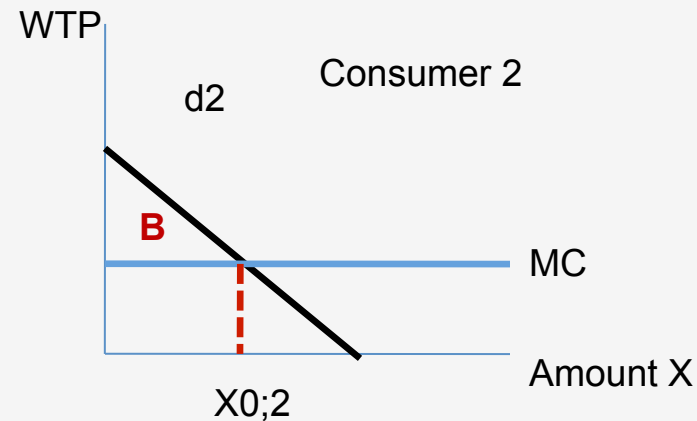
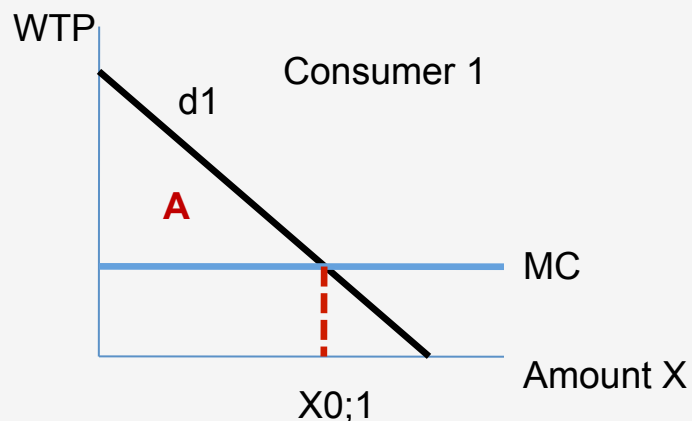


(Varian, 2011)



Objective: Maximization of producer surplus (= max. of profit): Finding the amount sold to the consumer at his WTP where the producer surplus is maximized

- Continuous demand: Demand curves are smoothed
- $X_{0;1}$ : Amount sold to consumer 1 to maximize producer surplus
- $X_{0;2}$ : Amount sold to consumer 2 to maximize producer surplus
- Maximum of producer surplus (surface A, surface B): When  $X_{0;1}$  and  $X_{0;2}$  are at the intersection point of demand curve  $d$  and marginal costs curve  $MC$  (no consumer surplus, as monopoly)



(Varian, 2011)



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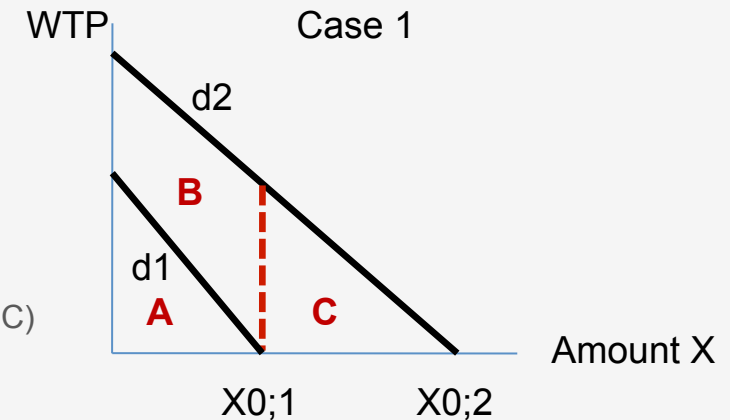


## Second-degree price discrimination:

- There are different prices for different product amounts (price per output unit varies)
- Offer of 2 different price-amount-combinations of the product
- Consumers chose which one suits best to them (self selection)

### 2 different amounts of the product at 2 prices are offered (case 1)

- Consumer 1: Low demand, lower WTP ( $d_1$ )
- Consumer 2: Higher demand, higher WTP ( $d_2$ )
- Here: Marginal costs MC are put to 0
- Consumer 1: Supposed to buy amount  $X_{0;1}$  at price A (surface A)
- Consumer 2: Supposed to buy amount  $X_{0;2}$  at price A+B+C (surface A+B+C)
- Producer surplus for consumer 1: surface A
- Producer surplus for consumer 2: surface A+B+C



Problem: consumer 2 could decide to buy amount  $X_{0;1}$  at price A (as it is lower)

- Consumer surplus consumer 2: B (as higher WTP than consumer 1)
- Producer loses money

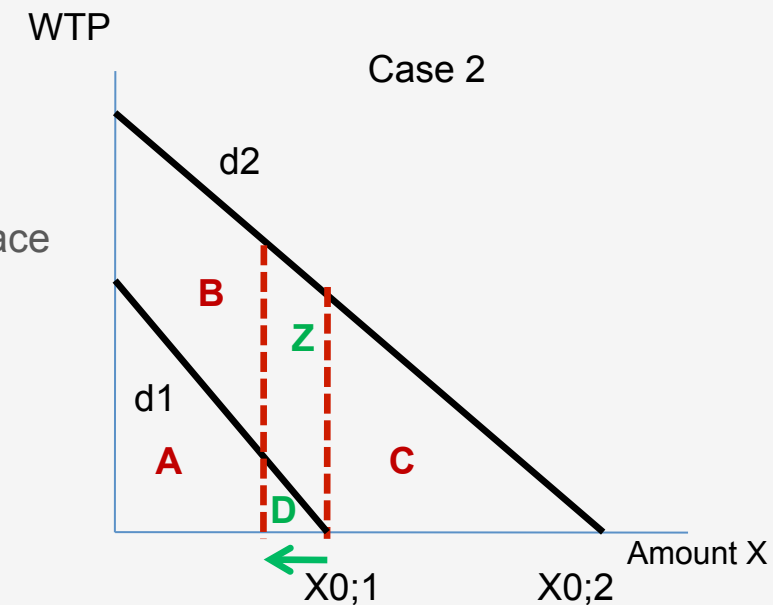
Solution: Amount  $X_{0;2}$  could be offered at price A+C

- Consumer surplus consumer 2: also B
- Producer surplus: A+C



## Extension for increasing profit of producer (case 2)

- Amount  $X_{0;1}$  is reduced and sold at a lower price
- Producer surplus regarding consumer 1 is reduced by surface Y
- Amount  $X_{0;1}$  becomes less attractive to consumer 2 because his consumer surplus is also reduced (by surface Z): He is more willing to buy amount  $X_{0;2}$
- Consumer surplus consumer 1: Zero
- Consumer surplus consumer 2: B-Z
- Producer surplus regarding consumer 1: A-Y
- Producer surplus regarding consumer 2 is increased: Surface C increases by surface Y and Z ( $A+Y+C+Z$ )



(Varian, 2011)

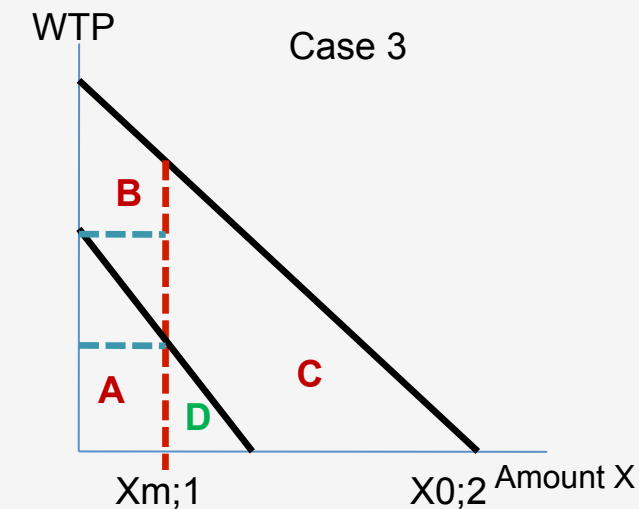


## Further possibilities for increasing profit of producer (case 3)

- Case 2 can be continued (reduction of amount  $X_{0;1}$  and the according price)
- Until: Lost profit (reduced producer surplus) regarding consumer 1 is equal to gained profit (gained producer surplus) regarding consumer 2
- Additional costs and additional benefit are balanced
- Consumer 1: Chooses amount  $X_{m;1}$  at price A (Consumer surplus: Zero)
- Consumer 2: Chooses amount  $X_{0;2}$  at price  $A+C+D$  (Consumer surplus: B)  
Consumer surplus for consumer 2 is the same as if he chooses amount  $X_{m;1}$
- Producer surplus consumer 1: A  
Producer surplus consumer 2:  $A+C+D$

This is often done by adopting the quality of the product instead of the amount of the product.

- High WTP: High quality
- Low WTP: Lower quality





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## Third-degree price discrimination:

- There are different prices for different groups of customers (e.g., students and “standard” customers)
- MR = Marginal revenue (additional revenue per additional output unit)  $MR = p(y) * \left[1 - \frac{1}{|E(y)|}\right]$
- MC = Marginal costs (additional costs per additional output unit)
- $p_i(y_i)$  = Inverse demand curve of consumer group  $i$
- $c(y_1+y_2)$  = Costs of production of consumer groups 1 and 2
- $E$  = Elasticity (Shows how “sensitive” demand reacts on price changes)

Profit maximization problem:

$$\text{maximize } (y_1, y_2): \quad p_1(y_1) * y_1 + p_2(y_2) * y_2 - c(y_1+y_2)$$

Condition for optimal solution:

$$MR_1(y_1) = MC(y_1+y_2)$$

$$MR_2(y_2) = MC(y_1+y_2)$$

Substitution of MR:

$$p_1(y_1) * \left[1 - \frac{1}{|E_1(y_1)|}\right] = MC(y_1 + y_2)$$
$$p_2(y_2) * \left[1 - \frac{1}{|E_2(y_2)|}\right] = MC(y_1 + y_2)$$

(Varian, 2011)



# Segmenting demand & Offering price incentives: Third-degree price discrimination

Assumption:  $p_1 > p_2$

$$1 - \frac{1}{|E_1(y_1)|} < 1 - \frac{1}{|E_2(y_2)|}$$

Transformation:

$$\frac{1}{|E_1(y_1)|} > \frac{1}{|E_2(y_2)|}$$

Transformation:

$$|E_2(y_2)| > |E_1(y_1)|$$

Market with lower price  $p_2$  has higher elasticity of demand: Lower price for this consumer group is appropriate (e.g., student discount for theatre tickets).

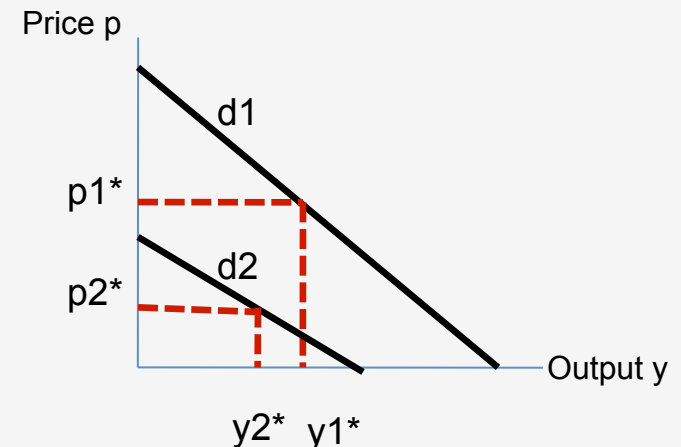
Linear demand function:

$$d_1 = a - bp_1$$

$$d_2 = c - dp_2$$

If only one price is possible:  $p_2$  is chosen

If price discrimination is possible:  $p_2$  &  $p_1$  for different markets





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When making reservations: Further demand may be denied or switched to other time slots (e.g., a fully-booked hotel over Christmas)

- Problem: Customers may not take the reserved service (“no-shows”)
- Service expires: Not storable
- No turnover, but high fixed costs for company
- E.g., hotel room stays empty without a guest, but employees are paid

If customers do not need to pay for unkept reservations: Often make several reservations and choose shortly before which one to take (e.g., several reservations for seats in airplane)

- Company needs to know some time in advance if reservation is cancelled: Empty seats otherwise

## Measures:

- Nonrefundable tickets (airlines)
- Cancellation deadlines, e.g., 6 pm (hotel)
- **Overbooking** of capacity





**Overbooking** of capacity (e.g., hotel rooms, airplane seats): Selling more seats than total capacity and expecting no-shows

Problems of overbooking:

- If overbooked capacity  $>$  number of no-shows:
    - Customers with reservation must be turned away
    - Angry customers: Might switch to competitor
    - Damaged image of company
    - Costs of overbooking: Reimbursement of denied customers
  - Overbooking strategy:
    - Minimization of opportunity costs of empty capacity
    - Minimization of costs of passengers with reservation being turned away
    - Training of employees dealing with passengers being turned away
- Minimization of expected costs on the long run

(Fitzsimmons & Fitzsimmons, 2011)



## Calculation of optimal number of overbookings

- $d$  = Number of no-shows
- $P(d)$  = Probability of a no-show
- $x$  = Number of reservations overbooked
- $P(d < x)$  = Cumulative probability of a no-show (Sum of probabilities of no-shows)

$$\text{Expected number of no-shows} = \sum d * P(d)$$

$$\text{Expected opportunity loss per night} = \sum P(d) * \text{contribution per room per night(lost)}$$

Additional costs of overbooking = Penalty, cost of accommodation in another hotel,  
lost of customer goodwill

Loss per overbooking = Expected opportunity loss p.n. + additional costs

$$\text{Total expected loss} = \sum \text{Loss per } d * P(d)$$



Optimal number of overbookings = Number that minimizes total expected loss  
Expected gain of overbooking = Loss p.n. without overbooking – total expected loss with overbooking p.n.

Critical fractile criterion (to identify best overbooking strategy):

- Critical probability
- Number of overbookings
- $d$  = number of no-shows
- $x$  = number of rooms overbooked
- $c_u$  = lost room contribution when customer does not keep his reservation (underestimation of number of no-shows)
- $c_o$  = opportunity loss when no room is available for an overbooked guest (overestimation of number of no-shows)

$$P(d < x) \leq \frac{c_u}{c_u + c_o}$$

(Fitzsimmons & Fitzsimmons, 2011)



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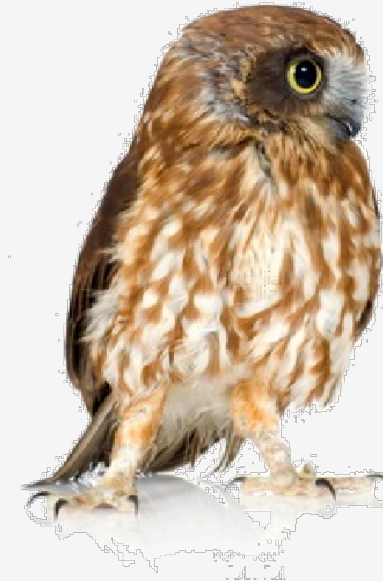


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