



Design Structure Matrix를 활용한 인체측정학적 제품설계 방법: Computer Workstation 설계 적용



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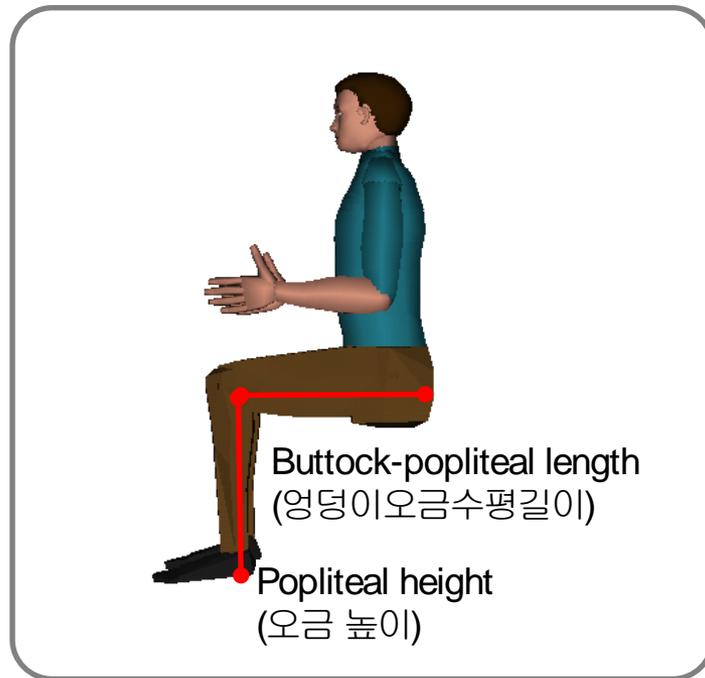
- 연구 배경 및 목적
- 체계적 인체측정학적 설계 방법
- Computer Workstation
-



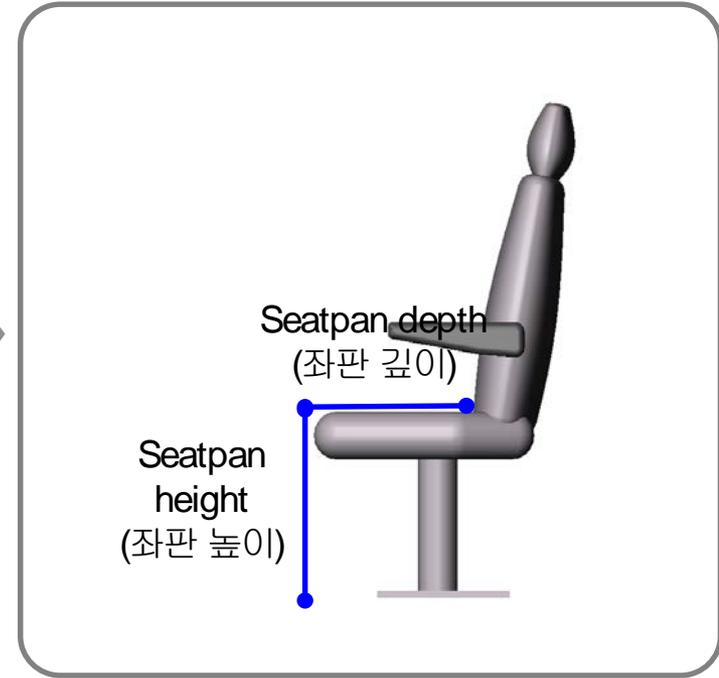


- 제품설계에 인체를 측정한 자료를 적용하여 보다 사용자의 인체 크기에 적합한 제품을 설계하는 것 (HFES 300, 2004)

인체측정자료



설계 대상 제품

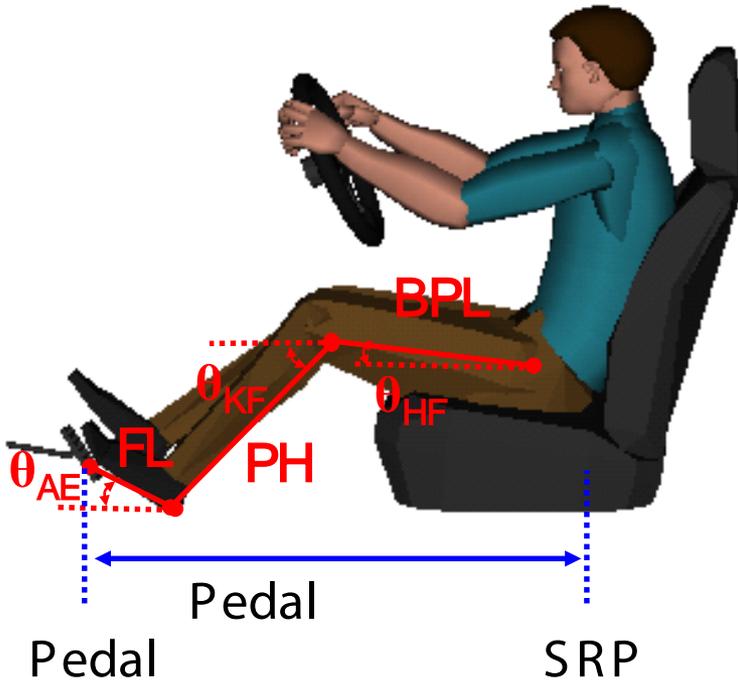




인체측정학적 설계공식

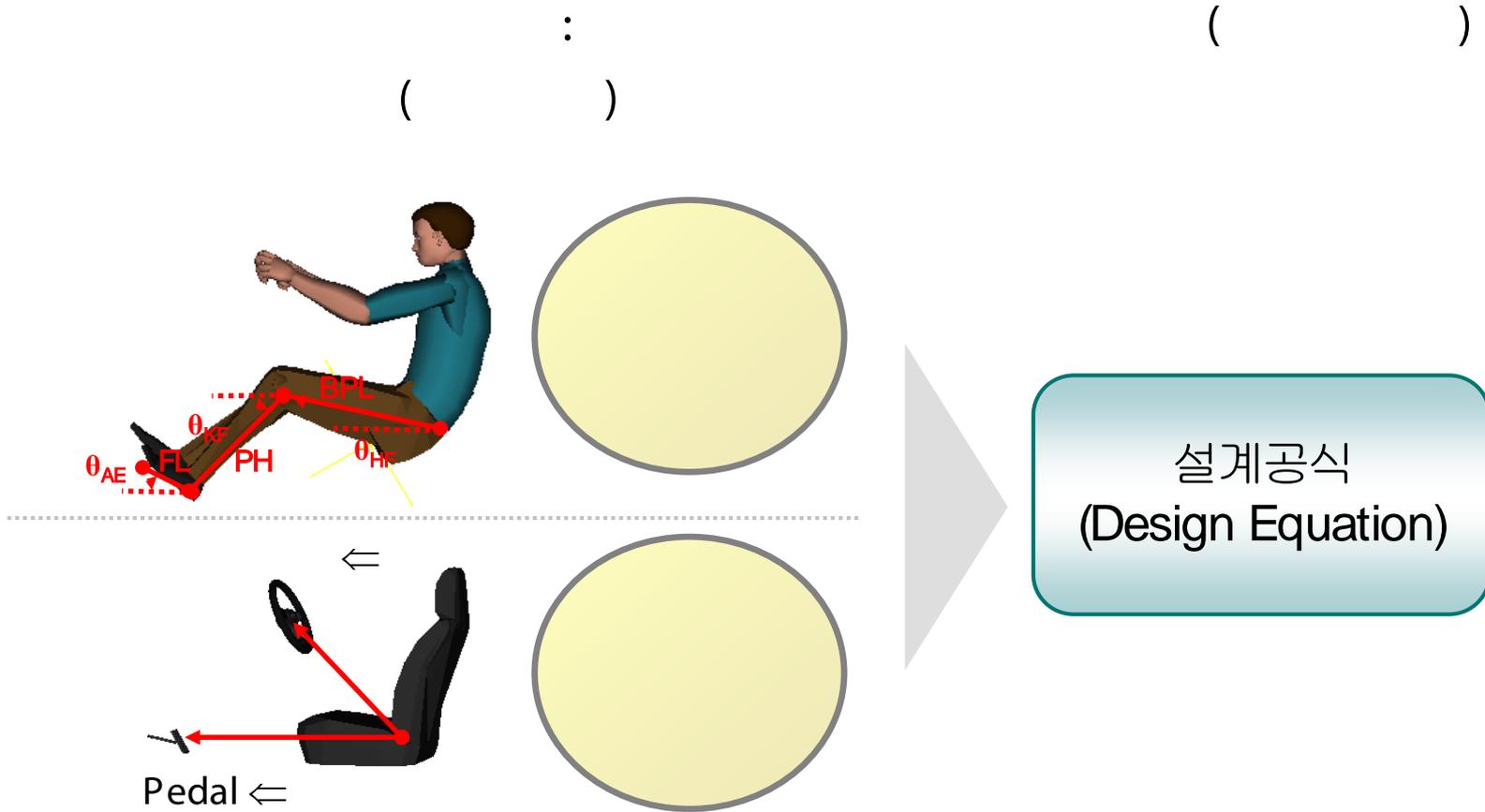
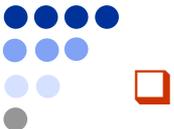
- 인체측정학적 제품설계에는 설계대상의 특성을 고려하여 개발된 설계공식이 활용(You et al., 1997; BSR/HFES 100, 2003)

$$\text{Pedal} = \text{SRP} + \text{BPL} \times \cos(\theta_{\text{HF}}) + \text{PH} \times \cos(\theta_{\text{KF}}) + \text{FL} \times \cos(\theta_{\text{AE}})$$



- SRP: Seat reference point
- BPL: Buttock-popliteal length
- PH: Popliteal height
- FL: Foot length
- θ_{HF} : Postural angle for hip flexion
- θ_{KF} : Postural angle for knee flexion
- θ_{AE} : Postural angle for ankle extension

설계공식 도출 시 고려사항



⇒ 설계공식의 효율적 개발을 위해 체계적인 연관성 분석 필요



체계적 인체측정학적 설계공식의 도출방법 개발

1. Design Structure Matrix (DSM)
2. Computer Workstation



Design Structure Matrix (DSM)



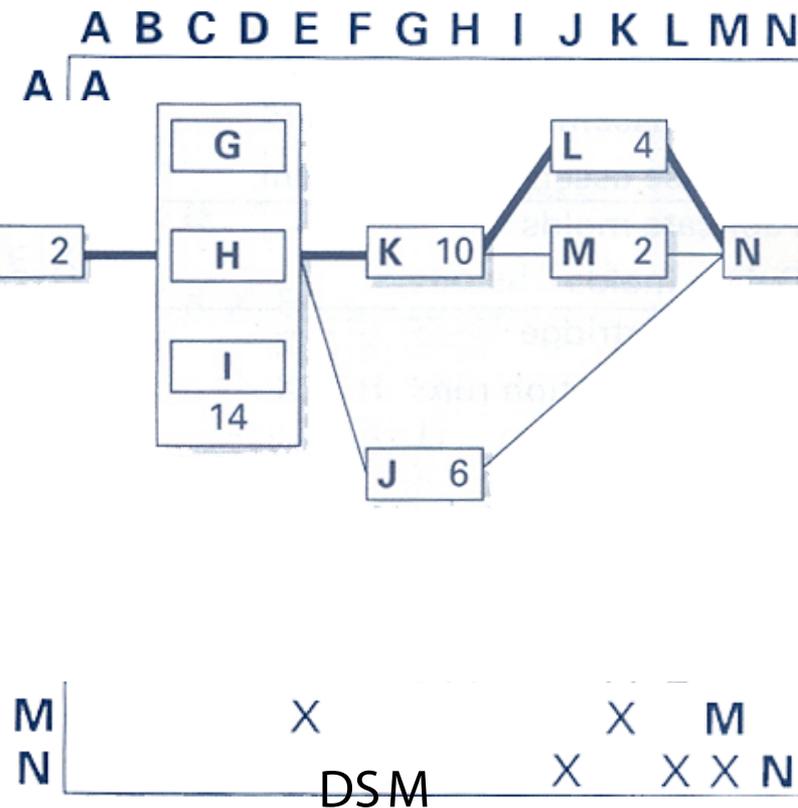
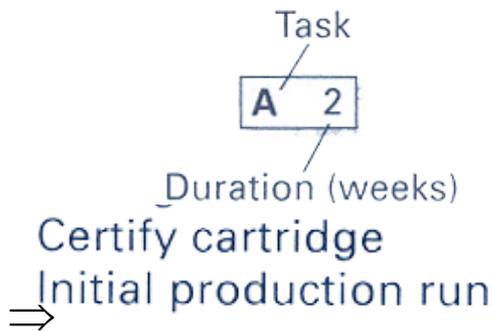
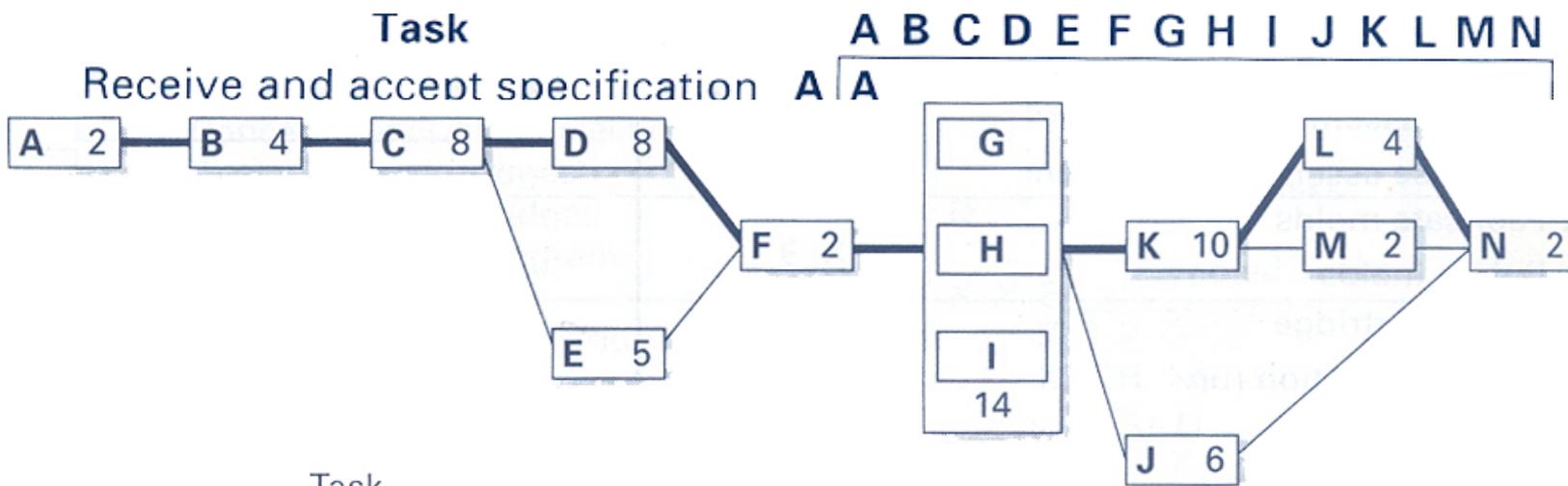
□ DSM은

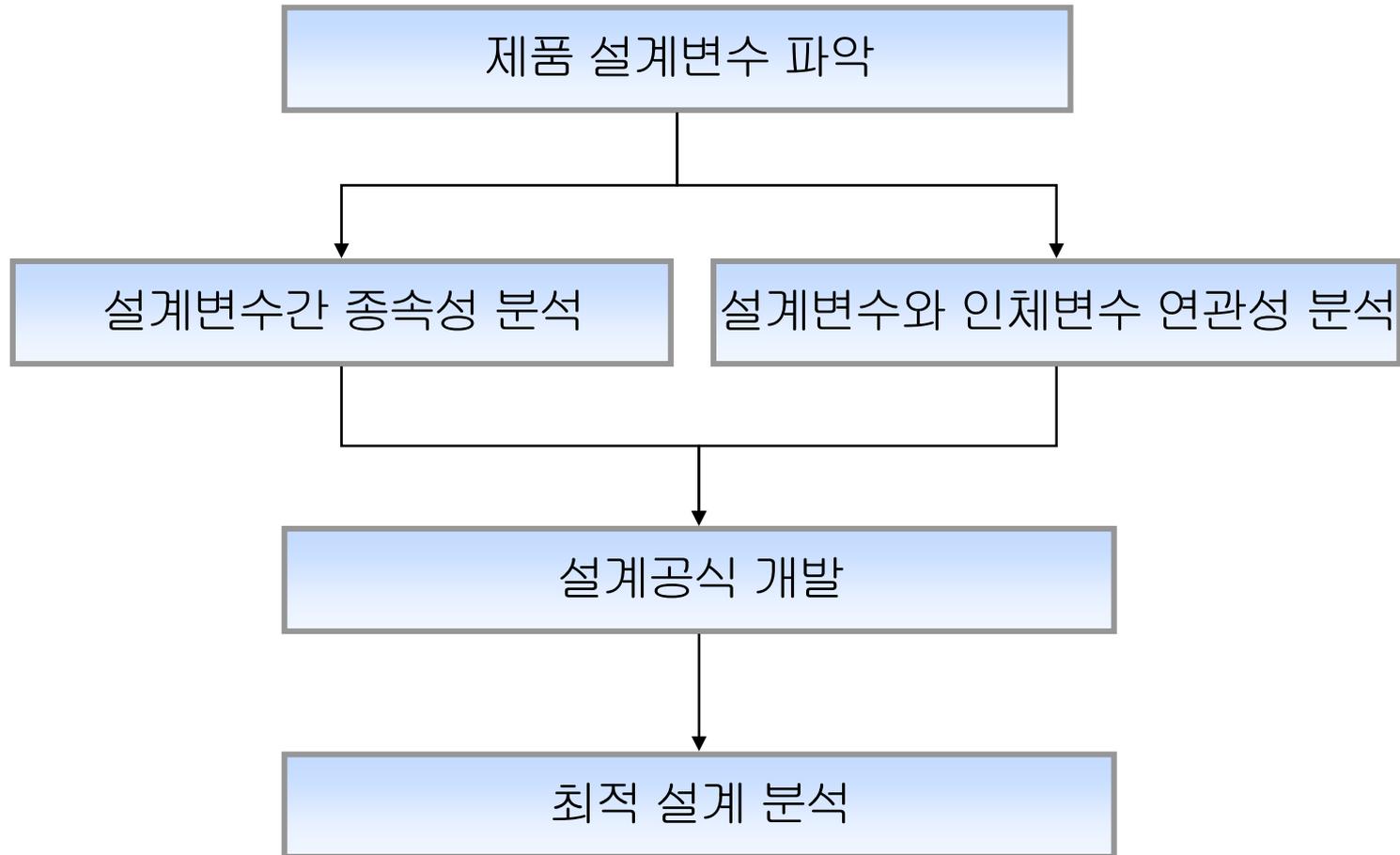
system

system

project

(DSMWEB, 2007)



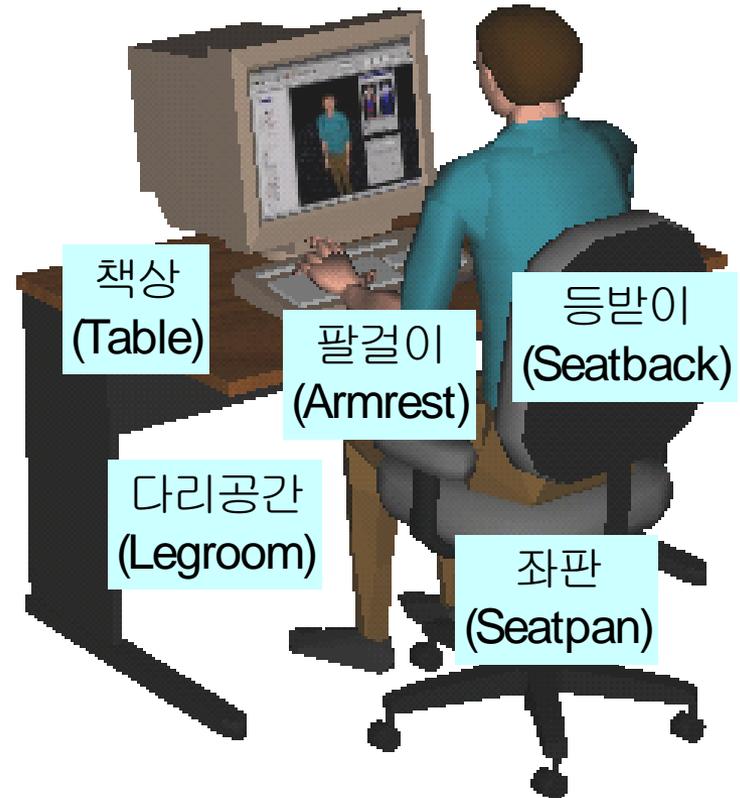


Computer Workstation 설계변수



Computer workstation은 5개 부문 14개 변수로 구성(BSR/HFES 100, 2003)

Design dimension (DD)			Code
Seat	Seatpan	Height	DD1
		Depth	DD2
		Width	DD3
	Seatback	Height	DD4
		Width	DD5
	Armrest	Height	DD6
		Clearance	DD7
Legroom	Height at upper leg		DD8
	Width		DD9
	Height at knee		DD10
	Depth at knee		DD11
	Depth at foot		DD12
Table	Height		DD13
	Width		DD14



DSM 적용 설계변수의 종속성 도식화 예



- Computer workstation 설계변수의 종속성을 matrix에 도식화

Design dimension (DD)			Code	DD1	DD2	DD3	DD4	DD5
Seat	Seatpan	Height	DD1					
		Depth	DD2					
		Width	DD3					
	Seatback	Height	DD4	X				
		Width	DD5			X		
	Armrest	Height	DD6	X				
		Clearance	DD7			X		
Legroom	Height at upper leg		DD8	X				
	Width		DD9			X		
	Height at knee		DD10	X				
	Depth at knee		DD11		X			
	Depth at foot		DD12		X			
Table	Height		DD13	X				
	Width		DD14			X		

설계변수의 종속성 분석 예



설계변수의 종속성에 따른 군집화(군집내: 독립, 군집간: 종속)

Cluster	Design dimension (DD)		Code	DD1	DD2	DD3	DD8	DD9	DD10	
1	Seatpan	Height	DD1							
		Depth	Seatback							
		Width								
2	Legroom	Height at upper leg								
		Height at knee	DD9			×				
		Seatpan knee	Armrest							
	Depth at foot	DD12			×					
	Seatback	Height	Legroom							
		Width								
	Armrest	Height	Table							
Clearance		DD7					×			
3	Table	Height	DD13	×			×		×	
		Width	DD14				×	×		

Matrix 활용 설계변수와 인체변수 연관관계 분석 예



Design dimension (DD)			Code	Body dimension (BD)			
				Abdominal extension depth	Biacromial breadth	Acromial height	Bideltoid breadth
				BD1	BD2	BD3	BD4
Seat	Seat pan	Height	DD1				
		Depth	DD2				
		Width	DD3				
	Seat back	Height	DD4			X	
		Width	DD5		X		
	Arm rest	Height	DD6				X
		Clearance	DD7				
Legroom	Height at upper leg		DD8	X	X		
	Width		DD9			X	
	Height at knee		DD10		X		
	Depth at knee		DD11				
	Depth at foot		DD12		X		

설계공식 개발사례: 좌판 높이



Design dimension	Seatpan height (DD1)		
Related design dimensions	-	Related body dimensions	Buttock-popliteal length (BD6) Popliteal height (BD11)
Related angular posture	Knee flexion (AD3) Hip flexion (AD6)	Allowance	Heel height: 2.5 cm
Design equation	$DD1 = BD11 \times \sin(AD3) - BD6 \times \sin(AD6) + 2.5$		
Drawing			

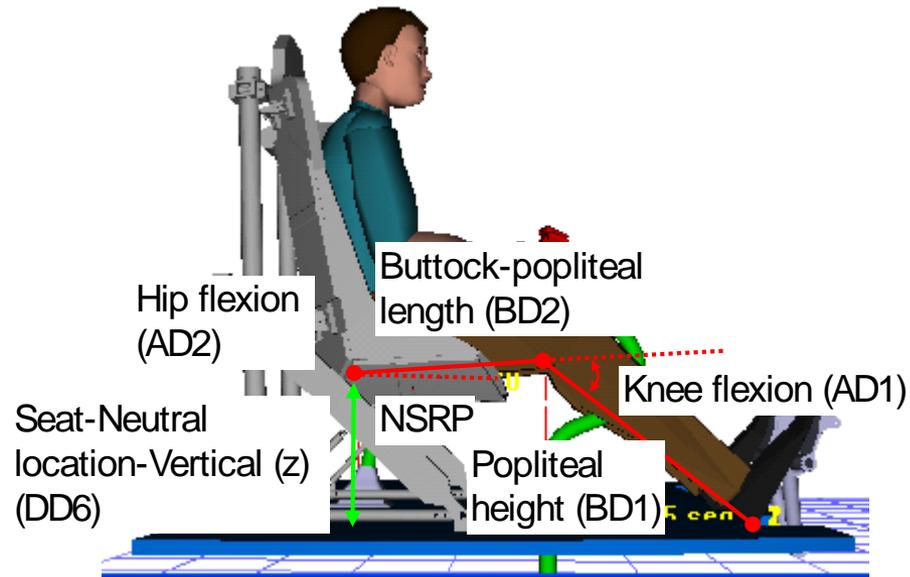


□ 체계적 분석을 통한 인체측정학적 설계공식 도출 방법 개발

- Design Structure Matrix (DSM)

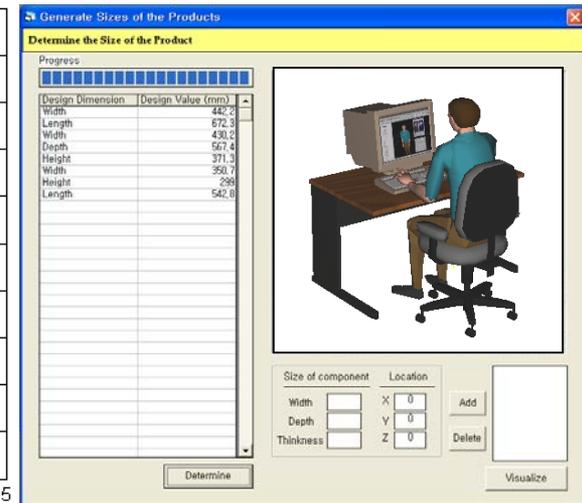
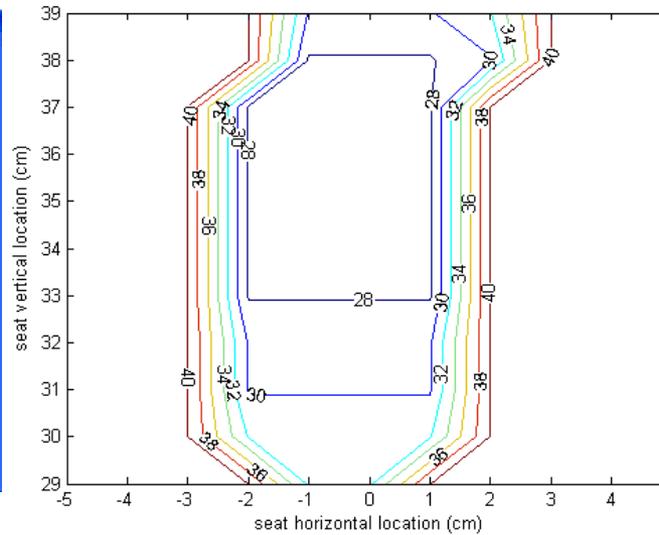
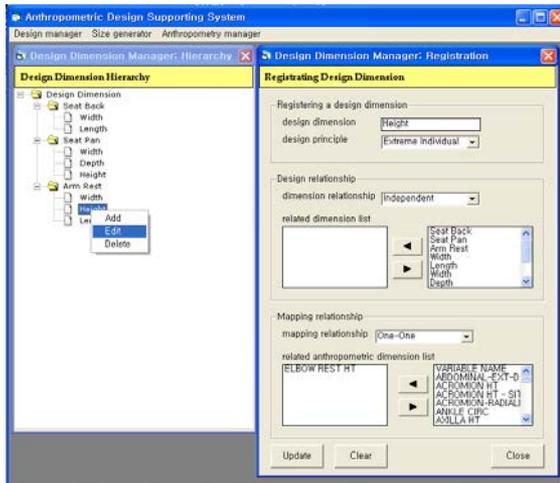
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□ (KHP project)





- 인체측정학적 제품설계 지원 시스템
 - 설계공식 생성 module: DSM
 - Simulation module:
 - Visualization module:





Thank you for your attention...

